IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) I Year- I Semester
B010101T: Mathematical Physics & Newtonian Mechanics

Objective: The aim of this course is to familiarize students about Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Part A: Basic Mathematical Physics

UNIT - I **(5 Sessions)**

Vector Algebra

Coordinate rotation, reflection and inversion as the basis for defining scalars, vectors, pseudo-scalars and pseudo vectors(include physical examples).Component form in 2D and 3D.Geometrical and physical interpretation of addition, subtraction, dot product, wedge product, cross product and triple product of vectors. Position, separation and displacement vectors.

UNIT - II **(6 Sessions)**

Vector Calculus

Geometrical and physical interpretation of vector differentiation, Gradient, Divergence and Curl and their significance. Vector integration, Line, Surface (flux) and Volume integrals of vector fields. Skills to define Gradient theorem, Gauss-divergence theorem, Stoke-curl theorem, Greens theorem and Helmholtz theorem (statement only).Introduction to Dirac delta function.

UNIT - III **(5 Sessions)**

Coordinate Systems

2D & 3D Cartesian, Spherical and Cylindrical coordinate systems, basis vectors, transformation equations. Expressions for displacement vector, arc length, area element, volume element, gradient, divergence and curl in different coordinate systems. Components of velocity and acceleration in different coordinate systems. Examples of non-inertial coordinate system and pseudo-acceleration.

UNIT - IV **(5 Sessions)**

Introduction to Tensors

Principle of invariance of physical laws w.r.t. different coordinate systems as the basis for defining tensors and related skill development. Coordinate transformations for general spaces of nD, contra variant, covariant & mixed tensors and their ranks, 4-vectors. Index notation and summation convention. Symmetric and skew-symmetric tensors. Invariant tensors, Kronecker delta and Epsilon (Levi Civita) tensors. Examples of tensors in physics.

Suggested Readings:

1. Murray Spiegel, Seymour Lipschutz, Dennis Spellman, "Schaum's Outline Series: Vector Analysis", Mc Graw Hill, 2017, 2e
2. Shanti Narayan, P.K. Mittal, "A Text Book of Vector Analysis", S. ChandPublishing,2010
3. Shanti Narayan, P.K. Mittal, "A Text BookofVectorCalculus",S.ChandPublishing,1987, 4e

Part B: Newtonian Mechanics &Wave Motion

UNIT - V **(5 Sessions)**

Dynamics of a System of Particles

Review of historical development of mechanics up to Newton. Background, statement and critical analysis of Newton's axioms of motion. Dynamics of a system of particles, centre of mass motion, and conservation laws & their deductions. Rotating frames of reference, general derivation of origin of pseudo forces (Euler, Coriolis& centrifugal) in rotating frame, and effects of Coriolis force.

UNIT - VI **(6 Sessions)**

Dynamics of a Rigid Body

Angular momentum, Torque, Rotational energy and the inertia tensor. Rotational inertia for simple bodies (ring, disk, rod, solid and hollow sphere, solid and hollow cylinder, rectangular lamina).The combined translational and rotational motion of a rigid body on horizontal and inclined planes. Elasticity, relations between elastic constants, bending of beam and torsion of cylinder.

UNIT - VII **(5 Sessions)**

Motion of Planets &Satellites

Two particle central force problem, reduced mass, relative and centre of mass motion. Newton's law of gravitation and related skill development, gravitational field and gravitational potential. Kepler's laws of planetary motion and their deductions. Motions of geo-synchronous & geo-stationary satellites and basic idea of Global Positioning System (GPS).

UNIT - VIII **(6 Sessions)**

Wave Motion

Differential equation of simple harmonic motion and its solution, use of complex notation, damped and forced oscillations, Quality factor. Composition of simple harmonic motion, Lissajous figures. Knowledge of differential equation of wave motion for employability. Plane progressive waves in fluid media, reflection of waves and phase change, pressure and energy distribution. Principle of superposition of waves, stationary waves, phase and group velocity.

Suggested Readings

1. Charles Kittel, Walter D. Knight, Malvin A. Ruderman, Carl A. Helmholz, Burton J. Moyer, "Mechanics (In SI Units): BerkeleyPhysicsCourseVol1", McGraw Hill, 2017, 2e
2. Richard P. Feynman, Robert B. Leighton, Matthew S ands, "The Feynman Lectures on Physics-Vol.1", Pearson Education Limited, 2012
3. Hugh D. Young and Roger A. Freedman,"Sears & Zemansky's University Physics with Modern Physics", Pearson Education Limited, 2017, 14e
4. D.S. Mathur, P. S. Hemne, "Mechanics", S. Chand Publishing,1981,3e

Course Outcomes:

Students completing this course will be able to:

CO1: Recognize the difference between scalars, vectors, pseudo-scalars and pseudo-vectors.
CO2: Understand the physical interpretation of gradient, divergence and curl for skill development.
CO3: Comprehend the difference and connection between Cartesian, spherical and cylindrical coordinate systems.
CO4: Know the meaning of 4-vectors, Kronecker delta and Epsilon (Levi Civita) tensors.
CO5: Study the origin of pseudo forces in rotating frame.
CO6: Study the response of the classical systems to external forces and their elastic deformation.

CO7: Understand the dynamics of planetary motion and the working of Global Positioning System (GPS) for skill development.

CO8: Comprehend the different features of Simple Harmonic Motion (SHM) and wave propagation for local/ global problems.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	1	2	2	1	1	1	1	1	1	1
CO 2	3	2	1	3	3	1	1	1	1	1	1	1
CO 3	1	3	1	2	1	1	1	1	1	1	1	1
CO 4	1	2	1	2	1	1	1	1	1	1	1	1
CO 5	1	3	1	1	1	1	1	1	1	1	1	1
CO 6	1	1	1	1	1	1	1	1	1	1	1	1
CO 7	3	1	2	2	2	1	1	1	1	1	1	1
CO 8	2	1	1	3	1	1	1	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	2	1	1
CO3	1	1	1
CO4	1	1	1

Website sources:

- https://openlearning.mit.edu
- https://www.youtube.com
- http://heecontent.upsdc.gov.in
- https://www.swayamprabha.gov.in

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) I Year- I Semester
B010102P: Mechanical Properties of Matter

Objective: The main goal of this course is to share the knowledge to the students about the Experiments. The students will get a better understanding of the concepts studied by them in the theory course and correlate with experimental observations.

Lab Experiment List **(20 Sessions)**

1. Moment of inertia of a flywheel.
2. Moment of inertia of an irregular body by inertia table.
3. Develop skills to understand modulus of rigidity by statistical method (Barton's apparatus).
4. Modulus of rigidity by dynamical method (sphere / disc / Maxwell'sneedle).
5. Young's modulus by bending of beam.
6. Young's modulus and Poisson's ratio by Searle's method.
7. Poisson's ratio of rubber-by-rubber tubing and related skill development.
8. Surface tension of water by capillary rise method.
9. Surface tension of water by Jaeger's method.
10. Develop skills to determine Coefficient of viscosity of water by Poiseuille's method.
11. Acceleration due to gravity by bar pendulum.
12. Frequency of AC mains by Sonometer.
13. Height of a building by Sextant.
14. Study the wave form of an electrically maintained tuning fork /alternating current source with the help of cathode ray oscilloscope.

Virtual Lab Experiment List

1. Torque and angular acceleration of a fly wheel
2. Torsional oscillations in different liquids
3. Moment of inertia of flywheel
4. Newton's second law of motion
5. Ballistic pendulum
6. Collision balls
7. Projectile motion
8. Elastic and inelastic collision

Course Outcomes:

Students completing this course will be able to:

CO1: Experimental physics has the most striking impact on the industry wherever the instruments are Used to study and determine the mechanical properties to enhance knowledge for employability.

CO2: Measurement precision and perfection is achieved through lab experiments for skill development.

CO3: Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for related local/ global modeling.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	1	1	1	1	1	2	1	1	1	1	1
CO 2	1	1	1	1	2	2	2	2	1	1	1	1
CO 3	1	1	1	1	3	1	3	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	1	1	1
CO3	2	1	1
CO4	2	1	1

Suggested Readings

1. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962, 9e
2. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015, 1e
3. R.K. Agrawal, G. Jain, R. Sharma, "Practical Physics", Krishna Prakashan Media (Pvt.) Ltd., Meerut, 2019
4. S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut, 2014, 2e

Website sources:

- https://vlab.amrita.edu
- https://dkpandey.weebly.com
- https://www.vedantu.com

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) I Year- I Semester
Course Code: B020101T
Course Title: Fundamentals of Chemistry

Objectives: Periodic trends, arising from the arrangement of the periodic table, provide students with an invaluable tool to quickly predict an element's properties. Reaction mechanism gives the fundamental knowledge of carrying out an organic reaction in a step-by-step manner. Students will enrich skill development to provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective.

UNIT – I: Molecular polarity and Weak Chemical Forces (10 Sessions)

Introduction to Indian ancient Chemistry and contribution of Indian Chemists, in context to the holistic development of modern science and technology. Resonance and resonance energy, formal charge, Van der Waals forces, ion-dipole forces, dipole dipole interactions, induced dipole interaction, dipole moment and molecular Structure (Diatomic and polyatomic molecules), Percentage ionic character from dipole moment, polarizing power and polarizability. Fajan's rules and consequences of polarization. Hydrogen bonding, van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction. Effects of weak chemical forces, melting and boiling points, solubility, energetics of dissolution process. Lattice energy and Borrn-Haber cycle, solvation energy, and solubility of ionic solids.

UNIT – II: Simple Bonding theories of Molecules (10 Sessions)

Atomic orbitals, Aufbau principle, multiple bonding (σ and π bond approach) and bond lengths, the valence bond theory (VBT), Concept of hybridization, hybrid orbitals and molecular geometry, Bent's rule, Valence shell electron pair repulsion theory (VSEPR), shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons: H_2O, NH_3, PCl_5, SF_6, SF_4, ClF_3, I_{3-}, ClF_2^- and SO_4^{2-} and H_3O^+. Molecular orbital theory (MOT). Molecular orbital diagrams bond orders of homonuclear and heteronuclear diatomic molecules and ions (N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions).

UNIT – III: Periodic properties of Atoms (with reference to s & p-block) (05 Sessions)

Brief discussion, factors affecting and variation trends of following properties in groups and periods. Effective nuclear charge, shielding or screening effect, Slater rules, Atomic and ionic radii, Electronegativity, Pauling's/ Allred Rochow's scales, Ionization enthalpy, Electron gain enthalpy.

UNIT – IV: Recapitulation of basics of Organic Chemistry (05 Sessions)

Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bonding, Van der Waals interactions, inclusion compounds, Clatherates, Charge transfer complexes, hyperconjugation, Dipole moment; Electronic Displacements: Inductive, electromeric, resonance mesomeric effects and their applications. Importance of general organic chemistry in development of employability in research and academic sector.

UNIT – V: Mechanism of Organic Reactions (10 Sessions)

Curved arrow notation, drawing electron movements with arrows, half-headed and double-headed arrows, homolytic and heterolytic bond fission, Types of reagents – electrophiles and nucleophiles, Types of organic reactions, Energy considerations. Reactive intermediates – Carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Assigning formal charges on intermediates and other ionic species.Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies), Importance of organic reactions and intermediates in development of employability.

UNIT – VI: Steriochemistry (10 Sessions)

Concept of isomerism, Types of isomerism; Optical isomerism – elements of symmetry, molecular

chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, disasteromers, threo and erythro diastereomers, meso compounds, resolution of enantionmer, inversion, retention and recemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. Geometric isomerism – determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism – conformational analysis of ethane and n-butane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives, Newman projection and Sawhorse formulae, Fischer and flying wedge formulae, Difference between configuration and conformation. Importance of stereochemistry in development of employability in research and development.

UNIT – VII: Basic Computer system (in brief) (05 Sessions)

Hardware and Software; Input devices, Storage devices, Output devices, Central Processing Unit (Control Unit and Arithmetic Logic Unit); Number system (Binary, Octal and Hexadecimal Operating System); Computer Codes (BCD and ASCII); development of skills for Numeric/String constants and variables. Operating Systems (DOS, WINDOWS, and Linux); Software languages: Low level and High Level languages (Machine language, Assembly language; QBASIC, FORTRAN and C++); Software Products (Office, chemsketch, scilab, matlab, hyperchem, etc.), internet application.

UNIT – VIII: Mathematical Concepts for Chemistry (05 Sessions)

Logarithmic relations, curve sketching, linear graphs and calculation of slopes, differentiation of functions like Kx, e^x, X^n, sin x, log x; maxima and minima, partial differentiation and reciprocity relations, Integration of some useful/relevant functions; permutations and combinations, Factorials, Probability.

Course outcomes:

Students completing this course will gain an understanding of

CO1: Molecular geometries, physical and chemical properties of the molecules.

CO2: Current bonding models for simple inorganic and organic molecules in order to predict structures and important bonding parameters.

CO3: The arrangement of elements in the periodic table and their periodic properties.

CO4: The most primary and utmost important knowledge and concepts of organic Chemistry.

CO5: A broader theoretical picture in multiple stages in an overall chemical reaction as well as reactive intermediates and transition states.

CO6: The clear picture of two-dimensional and three-dimensional structure of the molecules, and their role in reaction mechanism.

CO7: Skill development to understand the concepts of basic computer system, its components, operating systems and computer language for employability at local and national level.

CO8: Mathematical concepts such as logarithmic relations, differentiation and integration etc. which are useful to learn chemistry

Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	2	3	2	3	3	2	1
CO2	3	3	3	3	1	2	1	1	3	2	1	2
CO3	3	2	3	2	2	2	2	3	3	2	2	2
CO4	3	2	3	3	2	3	2	2	1	1	3	2
CO5	3	3	3	3	3	2	2	2	2	2	3	3
CO6	3	2	2	3	2	2	2	3	2	1	3	2
CO7	2	3	3	2	1	1	3	1	2	3	2	1
CO8	2	3	3	2	2	2	3	3	2	3	2	1

CO-Curriculum Enrichment Mapping
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	2	1
CO2	3	2	1
CO3	3	2	2
CO4	3	2	1
CO5	3	2	1
CO6	3	2	2
CO7	3	2	1
CO8	3	1	1

Suggested Readings:

1. Lee, J.D. Concise Inorganic Chemistry, Pearson Education 2010
1. 2. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.
2. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970
3. Shriver, D.D. & P. Atkins, Inorganic Chemistry 2nd Ed., Oxford University Press, 1994.
4. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.
5. Singh J., Yadav L. D. S., Advanced Organic Chemistry, Pragati Edition
6. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
7. Carey, F. A., Guiliano, R. M.Organic Chemistry, Eighth edition, McGraw Hill Education, 2012.
8. Loudon, G. M. Organic Chemistry, Fourth edition, Oxford University Press, 2008.
9. Clayden, J., Greeves, N. &Warren, S. Organic Chemistry, 2nd edition, Oxford University Press, 2012.
10. Graham Solomons, T.W., Fryhle, C. B. Organic Chemistry, John Wiley & Sons, Inc.
11. Sykes, P. A guidebook to Mechanism in Organic Chemistry, Pearson Education, 2003

Suggested online links:

- http://heecontent.upsdc.gov.in/Home.aspx 12
- https://nptel.ac.in/courses/104/106/104106096/
- http://heecontent.upsdc.gov.in/Home.aspx
- https://nptel.ac.in/courses/104/106/104106096/
- https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm
- https://nptel.ac.in/courses/104/103/104103071/#

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) I Year- I Semester
Course Code: B020102P
Course Title: Quantitative Analysis

Objectives: The objective of this course is to develop skills about the chemical experiments, properly carrying out of the experiments, and appropriately record and analyze the results. Students will be able to use standard laboratory equipment, modern instrumentation, and classical techniques to carry out experiments. Students will know and follow the proper procedures and regulations for safe handling and use of chemicals to development of employability skills.

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UNIT – I: Water Quality analysis **(16 Sessions)**

1. Estimation of hardness of water by EDTA.
2. Determination of chemical oxygen demand (COD).
3. Determination of Biological oxygen demand (BOD).

UNIT – II: Estimation of Metals ions **(14 Sessions)**

1. Estimation of ferrous and ferric by dichromate method.
2. Estimation of copper using thiosulphate.

UNIT – III: Estimation of acids and alkali contents **(14 Sessions)**

1. Determination of acetic acid in commercial vinegar using NaOH.
2. Determination of alkali content – antacid tablet using HCl.
3. Estimation of oxalic acid by titrating it with KMnO4.

UNIT – IV: Estimation of inorganic salts and hydrated water **(16 Sessions)**

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of calcium content in chalk as calcium oxalate by permanganometry.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$ Importance of titrimetric methods in development of employability in research and development.

Course outcomes:

Students completing this course will be able togain knowledge and skills to understand the laboratory methods for:

CO1: Portability tests of water samples
CO2: Estimation of metals ions.
CO3: Development of skills for estimation of acids and alkali contents in commercial products for employability at local level
CO4: Estimation of inorganic salts and hydrated water in samples

Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	3	3	2	2	2	2	1	3
CO2	3	3	2	3	3	3	2	1	2	2	2	3
CO3	3	3	2	3	2	1	2	2	2	2	3	2
CO4	3	3	2	3	2	2	2	2	1	2	3	3

CO-Curriculum Enrichment Mapping
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	3	3
CO2	3	3	2
CO3	3	3	2
CO4	3	3	1

Suggested Readings:

1. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
2. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007) Chapters3-5.
3. Harris, D. C. *Exploring Chemical Analysis*, 9th Ed. New York, W.H. Freeman, 2016.
4. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.
5. Skoog, D.A. Holler F.J. and Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Edition

Suggestive online links

- https://www.labster.com/chemistry-virtual-labs/
- https://www.vlab.co.in/broad-area-chemical-sciences
- http://chemcollective.org/vlabs

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) I Year- I Semester
B030101T: Differential Calculus & Integral Calculus

Objective: -The main aim of this course is to provide entrepreneurial skills to the student with necessary analytic and technical skills to handle problems of mathematical nature as well as practical problems. More precisely, main target of this course is to explore the different tools for higher order derivatives, to plot the various curves and to solve the problems associated with differentiation and integration of vector functions. This course is primarily concerned with developing experimental skills in the students and understanding of the concepts of calculus and providing experience with its methods and applications to create mathematical models in order to arrive into an optimal solution.

Part- A
Differential Calculus

UNIT-I **(09 Sessions)**

Definition of a sequence, theorems on limits of sequences, bounded and monotonic sequences, Cauchy's convergence criterion, Cauchy sequence, limit superior and limit inferior of a sequence, subsequence, Series of non-negative terms, convergence and divergence, Comparison tests, Cauchy's integral test, Ratio tests, Root test, Raabe's logarithmic test, de Morgan and Bertrand's tests, alternating series, Leibnitz's theorem, absolute and conditional convergence to develop skill.

UNIT-II **(07 Sessions)**

Limit, continuity and differentiability of function of single variable, Cauchy's definition, Heine's definition, equivalence of definition of Cauchy and Heine, Uniform continuity, Chain rule, indeterminate forms for skill development.

UNIT-III **(07 Sessions)**

Rolle's theorem, Lagrange and Cauchy Mean value theorems, mean value theorems of higher order, Taylor's theorem with various forms of remainders, Successive differentiation, Leibnitz theorem, Maclaurin's and Taylor's series, Partial differentiation, Euler's theorem on homogeneous function to develop skill.

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UNIT-IV **(07 Sessions)**

Tangent and normals, Asymptotes, Curvature, Envelops and evolutes, Tests for concavity and convexity, Points of inflexion, Multiple points, Parametric representation of curves and tracing of parametric curves, Tracing of curves in Cartesian and Polar forms for skill development.

Suggested Readings (Part-A Differential Calculus):

1. R. G. Bartle & D. R. Sherbert, Introduction to Real Analysis, John Wiley & Sons
2. T. M. Apostal, Calculus Vol. I, John Wiley & Sons Inc.
3. S. Bala Chandra Rao& C. K. Shantha, Differential Calculus, New Age Publication.
4. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons,Inc.,2002.
5. G. B. Thomas and R. L. Finney, Calculus, Pearson Education,2007.
6. Suggestive digital platforms weblinks : NPTEL/SWAYAM/MOOCS
7. Course Books (text/reference) published in Hindi may be prescribed by the Universities.

Part-B
Integral Calculus

UNIT-V **(09 Sessions)**

Definite integrals as limit of the sum, Riemann integral, Integrability of continuous and monotonic functions, Fundamental theorem of Integral calculus, Mean value theorems of integral calculus, Differentiation under the sign of Integration to develop skill.

UNIT-VI **(07 Sessions)**

Improper integrals, their classification and convergence, Comparison test, μ-test, Abel's test, Dirichlet's test, quotient test, Beta and Gamma functions for skill development.

UNIT-VII **(07 Sessions)**

Rectification, Volumes and Surfaces of Solid of revolution, Pappus theorem, Multiple integrals, change of order of double integration, Dirichlet's theorem, Liouville's theorem for multiple integrals to develop skills.

UNIT-VIII **(07 Sessions)**

Vector Differentiation, Gradient, Divergence and Curl, Normal on a surface, Directional Derivative, Vector Integration, Theorems of Gauss, Green, Stokes and related problems for development of skills.

Suggested Readings (Part-B Integral Calculus):

1. T.M. Apostal, Calculus Vol.II, John Wiley Publication
2. Shanti Narayan & Dr. P.K. Mittal, Integral Calculus, S. Chand
3. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
4. Suggestive digital platforms weblinks: NPTEL/SWAYAM/MOOCS
5. Course Books (text/reference) published in Hindi may be prescribed by the respective universities at local level.

Course outcomes:

CO1: To enhance knowledge of real valued functions such as sequence and series. They will also be able to know about continuous and differentiable functions for development of skills.

CO2: They should have knowledge about curvature, envelope and evolutes and trace curve in polar, Cartesian as well as parametric curves and many other related concepts for development of skills.

CO3: The course is to equip the student with necessary analytic and technical skills. By applying the principles of integral they learn to solve a variety of practical problems in science and engineering to develop skills.

CO4: To get the knowledge of beta gamma function and different theorems regarding vector integration to develop skills.

CO5: To increase the knowledge of students regarding many engineering problems to develop skills.

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	3	2	3	3	2	3	2
CO2	1	3	1	3	3	1	2	1	2	1
CO3	3	2	3	2	2	2	1	1	3	1
CO4	2	3	3	1	3	3	3	3	1	3
CO5	3	3	3	2	3	3	3	2	3	2

CO- Curriculum Enrichment Mapping

Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	1	1
CO4	3	2	1
CO5	3	2	1

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) I Year- I Semester
B030102P: Practical

Practical / Lab work to be performed in Computer Lab.

List of the practical's to be done using R/ Python/ Mathematica/ MATLAB/ Maple/ Sci lab/ Maxima etc.

1. Plotting the graphs of the following functions:

(i) ax

(ii) [x] (greatest integer function)

(iii) x^{2n}; $n \in N$

(iv) x^{2n-1}; $n \in N$

(v) $\frac{1}{x^{2n-1}}$; $n \in N$

(vi) $\frac{1}{x^{2n}}$; $n \in N$

(vii) $\sqrt{}ax+b$, $|ax+b|$, $c \pm |ax+b|$

(viii) $\frac{|x|}{x}$, $\sin \sin\left(\frac{1}{x}\right)$, $x \sin \sin\left(\frac{1}{x}\right)$, e^{x}, e^{-x} for $x \neq 0$.

(ix) e^{ax+b}, $\log(ax+b)$, $\frac{1}{(ax+b)}$, $\sin(ax+b)$, $\cos(ax+b)$, $|\sin(ax+b)|$, $|\cos(ax+b)|$.

Observe and discuss the effect of changes in the real constants a and b on the graphs.

(2) By plotting the graph find the solution of the equation
$x=e^{x}$, $x^2+1=e^{x}$, $1-x^2=e^{x}$, $x=\log_{10}(x)$, $\cos(x)=x$, $\sin(x)=x$, $\cos(y)=\cos(x)$, $\sin(y)=\sin(x)$ etc

(3) Plotting the graphs of polynomial of degree 2, 3, 4 and 5, and their first and second derivatives.

(4) Sketching parametric curves, e.g., Trochoid, Cycloid, Epicycloid and Hypocycloid etc.

(5) Tracing of conic in Cartesian coordinates.

(6) Graph of circular and hyperbolic functions.

(7) Obtaining surface of revolution of curves.

(8) Complex numbers and their representations, Operations like addition, Multiplication, Division, Modulus. Graphical representation of polar form.
Matrix Operations: Addition, Multiplication, Inverse, Transpose, Determinant, Rank, Eigenvectors, Eigen values, Characteristic equation and verification of the Cayley-Hamilton theorem, Solving the systems of linear equations to develop skill.

(9) Study the convergence of sequences through plotting.

(10) Verify Bolzano Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot.

(11) Cauchy's root test by plotting n^{th} roots for better understanding.

(12) Ratio test by plotting the ratio of n^{th} and $(n+1)^{th}$ term.

Course outcomes:

CO1: The main objective of the course is to give knowledge for better employability to the student. To plot the different graph and solve the different type of equations by plotting the graph using different computer software such as Mathematica /MATLAB /Maple /Sci lab / Maxima etc.

CO2: After completion of this course student would be able to know the convergence of sequences through plotting, verify Bolzano-Weierstrass theorem through plotting the sequence, Cauchy's root test by plotting n^{th} roots and Ratio test by plotting the ratio of n^{th} and $(n+1)^{th}$ term to develop skill.

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CO3: Student would be able to plot Complex numbers and their representations, Operations like addition, subtraction, Multiplication, Division, Modulus and Graphical representation of polar form to develop skill.

CO4: Student would be able to perform following task of matrix as Addition, Multiplication, Inverse, Transpose, Determinant, Rank, and Eigen vectors, Eigen values, Characteristic equation and verification of the Cayley-Hamilton theorem, solving the systems offline are equations for better employability.

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	3	1	3	2	3	1
CO2	1	3	1	3	3	2	2	1	2	1
CO3	3	2	3	2	2	3	1	3	3	2
CO4	2	3	3	1	3	3	3	1	1	3

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	1
CO3	3	1	1
CO4	3	2	1

Note: Latest editions of all the suggested readings must be used.

Co-curricular course
Bachelor of Science Programme
B. Sc. (PCM) I Year- I Semester
Course Title: Food, Nutrition and Hygiene

Programme/Class: Certificate	**Year: First**	**Semester: First**
Co-Curricular Course		
CourseCode:Z010101T	Course Title: Food, Nutrition and Hygiene	

Course outcomes:

- To learn the basic concept of the Food and Nutrition
- Tostudythenutritiverequirementduringspecialconditionslikepregnancyandlactation
- To learn meal planning
- Tolearn100daysNutritionConcept
- To study common health issues in the society
- To learn the special requirement of food during common illness

Credits: 2	Compulsory
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical(in hours per week):L-T-P:2-0-0

Unit	**Topics**	**No. of Lectures Total=30**
I	Concept of Food and Nutrition (a) Definition of Food, Nutrients, Nutrition, Health, balanced Diet (b) Types of Nutrition-Optimum Nutrition, under Nutrition, Over Nutrition (c) Meal planning-Concept and factors affecting Meal Planning (d) Food groups and functions of food	8
II	Nutrients: Macro and Micro RDA, Sources, Functions, Deficiency and excess of (a) Carbohydrate (b) Fats (c) Protein (d) Minerals Major: Calcium, Phosphorus, Sodium, Potassium Trace: Iron, Iodine, Fluorine, Zinc (e) Vitamins Water soluble vitamins: Vitamin B, C Fat soluble vitamins: Vitamin A, D, E, K (f) Water (g) Dietary Fibre	7
III	1000daysNutrition (a) Concept, Requirement, Factors affecting growth of child (b) Prenatal Nutrition (0 - 280 days): Additional Nutrients' Requirement and risk factors during pregnancy (c) Breast / Formula Feeding (Birth – 6 months of age) Complementary and Early Diet (6 months – 2years of age)	8

IV	Community Health Concept (a) Causes of common diseases prevalent in the society and Nutrition requirement in the following: Diabetes Hypertension (High Blood Pressure)Obesity Constipation Diarrhea Typhoid (b) National and International Program and Policies for improving Dietary Nutrition (c) Immunity Boosting Food	7

Suggested Readings:

1. Singh,Anita,"FoodandNutrition",StarPublication,Agra,India,2018.
2. 1000Days-Nutrition_Brief_Brain-Think_Babies_FINAL.pdf
3. https://pediatrics.aappublications.org/content/141/2/e20173716
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5750909/
5. SheelSharma,NutritionandDietTherapy,PeepeePublishersDelhi,2014,FirstEdition.

Suggested Continuous Evaluation Methods:
MCQs, Practical Diet/ Meal Planning, assignments Presentations, group Discussion, Case study, Survey

Suggested equivalent online courses:
https://www.udemy.com/course/internationally-accredited-diploma-certificate-in-nutritionDiplomain Human Nutrition-Revised Offered by Alison

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) I Year- II Semester
B010201T: Thermal Physics & Semiconductor Devices

Objective: The objective of this course is to develop a working knowledge of the laws and methods of thermodynamics and use this knowledge to explore various applications and also helps to acquire the fundamental knowledge and related skill development and expose to the field of semiconductor theory and devices and their applications.

Part A: Thermodynamics & Kinetic Theory of Gases

UNIT-I **(5 Sessions)**

0^{th} & 1^{st} Law of Thermodynamics:

State functions and terminology of thermodynamics. Zeroth law and temperature. Develop skills to understand First law, internal energy, heat and work done. Work done in various thermodynamical processes. Enthalpy, relation between C_P and C_V. Carnot's engine, efficiency and Carnot's theorem. Efficiency of internal combustion engines (Otto and diesel).

UNIT-II **(6 Sessions)**

2^{nd} & 3^{rd} Law of Thermodynamics:

Different statements of second law and related skill development, Clausius inequality, entropy and its physical significance. Entropy changes in various thermodynamical processes. Third law of thermodynamics and unattainability of absolute zero. Thermodynamical potentials, Maxwell's relations, conditions for feasibility of a process and equilibrium of a system. Clausius- Clapeyron equation, Joule-Thompson effect.

UNIT-III **(5 Sessions)**

Kinetic Theory of Gases:

Kinetic model and deduction of gas laws. Derivation of Maxwell's law of distribution of velocities and its experimental verification for employability. Degrees of freedom, law of equipartition of energy (no derivation) and its application to specific heat of gases (mono, di and polyatomic).

UNIT-IV **(6 Sessions)**

Theory of Radiation:

Blackbody radiation, spectral distribution, concept of energy density andpressure of radiation. Derivation of Planck's law, deduction of Wien's distribution law, Rayleigh-Jeans law, Stefan-Boltzmann law and Wien'sdisplacement law from Planck's law.

Suggested Readings:

1. M.W. Zemansky, R. Dittman, "Heat and Thermodynamics", McGraw Hill, 1997, 7e
2. F.W. Sears, G.L. Salinger, "Thermodynamics, Kinetic theory & Statistical thermodynamics", NarosaPublishing House, 1998
3. Enrico Fermi, "Thermodynamics", Dover Publications, 1956
4. S. Garg, R. Bansal, C. Ghosh, "Thermal Physics", McGraw Hill, 2012, 2e
5. Meghnad Saha, B.N. Srivastava, "A Treatise on Heat", Indian Press, 1973, 5e

Part B: Circuit Fundamentals & Semiconductor Devices

UNIT-V **(6 Sessions)**

DC & AC Circuits:

Growth and decay of currents in RL circuit. Charging and discharging ofcapacitor in RC, LC and RCL circuits.

Network Analysis - Superposition, Reciprocity, Thevenin's and Norton's theorems and related skill development. AC Bridges - measurement of inductance (Maxwell's, Owen's and Anderson's bridges) and measurement of capacitance (Schering's, Wein's and de Sauty's bridges).

UNIT-VI **(6 Sessions)**

Semiconductors & Diodes:

P and N type semiconductors, qualitative idea of Fermi level. Formation ofdepletion layer in PN junction diode, field & potential at the depletion layer.Qualitative idea of current flow mechanism in forward & reverse biased diode.Diode fabrication. PN junction diode and its characteristics, static and dynamic resistance. Principle, structure, characteristics and applications ofZener, Light Emitting, and Photo diodes. Half and Full wave rectifiers, calculation of ripple factor, rectification efficiency and voltage regulation. Basic idea about filter circuits and voltage regulated power supply.

UNIT-VII **(6 Sessions)**

Transistors:

Bipolar Junction PNP and NPN transistors. Study of CB, CE & CC configurations w.r.t. active, cutoff & saturation regions; characteristics; current, voltage & power gains; transistor currents & relations between them. Idea of base width modulation, base spreading resistance & transition time. DC Load Line analysis and Q-point stabilization.

UNIT-VIII **(5 Sessions)**

Electronic Instrumentation:

Multimeter: Principles of measurement of dc voltage, dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance. Knowledge of Cathode Ray Oscilloscope for employability, Block diagram of basic CRO. Construction of CRT, electron gun, electrostatic focusing and acceleration (no mathematical treatment). Front panel controls, special features of dual trace CRO, specifications of a CRO and their significance. Applications of CRO to study the waveform and measurement of voltage, current, frequency & phase difference.

Suggested Readings:

1. R.L. Boylestad, L. Nashelsky, "Electronic Devices and Circuit Theory", Prentice-Hall of India Pvt. Ltd., 2015, 11e
2. J. Millman, C.C. Halkias, Satyabrata Jit, "Electronic Devices and Circuits", McGraw Hill, 2015, 4e
3. B.G. Streetman, S.K. Banerjee, "Solid State Electronic Devices", Pearson Education India, 2015, 7e
4. J.D. Ryder, "Electronic Fundamentals and Applications", Prentice-Hall of India Private Limited, 1975, 5e
5. A. Sudhakar, S.S. Palli, "Circuits and Networks: Analysis and Synthesis", McGraw Hill, 2015, 5e
6. S.L. Gupta, V. Kumar, "Hand Book of Electronics", Pragati Prakashan, Meerut, 2016, 43e

Course Outcomes:

Students completing this course will be able to:

CO1: Recognize the difference between reversible and irreversible processes.

CO2: Understand the physical significance of thermodynamical potentials for skill development.

CO3: Comprehend the kinetic model of gases w.r.t. various gas laws.
CO4: Study the implementations and limitations of fundamental radiation laws.
CO5: Utility of AC bridges in local/ global scenario.
CO6: Recognize the basic components of electronic devices.
CO7: Design simple electronic circuits for skill development and employability.
CO8: Understand the applications of various electronic instruments for skill development and employability.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	1	2	1	1	2	1	1	1	1	1	1
CO 2	1	1	2	1	1	2	1	1	1	1	1	1
CO 3	3	1	1	1	2	3	1	1	1	1	1	1
CO 4	2	1	2	1	1	1	1	1	1	1	1	1
CO 5	2	1	1	1	3	1	1	1	1	1	1	1
CO 6	1	1	3	1	1	2	1	1	1	1	1	1
CO 7	1	1	2	1	1	1	1	1	1	1	1	1
CO 8	1	1	1	1	1	2	1	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	1	1	1
CO3	2	1	1
CO4	1	1	1

Website sources:

- https://openlearning.mit.edu
- https://www.youtube.com
- http://heecontent.upsdc.gov.in
- https://www.swayamprabha.gov.in

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) I Year- II Semester
B010202P: Thermal Properties of Matter & Electronic Circuits

Objective: The main goal of this course is to share the knowledge to the students about the Experiments. The students will get a better understanding of the concepts studied by them in the theory course and correlate with experimental observations

Lab Experiment List **(20 Sessions)**

1. Mechanical Equivalent of Heat by Callender and Barne's method
2. Coefficient of thermal conductivity of copper by Searle's apparatus
3. Coefficient of thermal conductivity of rubber and related skill development
4. Develop skills to determine value of Stefan's constant
5. Verification of Stefan's law
6. Variation of thermo-emf across two junctions of a thermocouple with temperature
7. Temperature coefficient of resistance by Platinum resistance thermometer
8. A.C. Bridges: Various experiments based on measurement of L and C
9. Resonance in series and parallel RCL circuit and related skill development.
10. Characteristics of PN Junction, Zener, Tunnel, Light Emitting and Photo diode
11. Characteristics of a transistor (PNP and NPN) in CE, CB and CCconfigurations
12. Half wave & full wave rectifiers and Filter circuits
13. Knowledge of Unregulated and Regulated power supply for employability
14. Various measurements with Cathode Ray Oscilloscope (CRO)

Online Virtual Lab Experiment List

1. Heat transfer by radiation
2. Heat transfer by conduction
3. Heat transfer by natural convection
4. The study of phase change
5. Black body radiation: Determination of Stefan's constant
6. Newton's law of cooling and related skill development
7. Lee's disc apparatus
8. Thermo-couple: Seebeck effects

Semiconductor Devices:

1. Familiarisation with resistor
2. Familiarisation with capacitor
3. Familiarisation with inductor
4. Develop skills to understand Ohm's Law
5. RC Differentiator and integrator
6. VI characteristics of a diode and related skill development
7. Develop skills to design Half & Full wave rectification
8. Capacitative rectification
9. Zener Diode voltage regulator
10. BJT common emitter characteristics
11. BJT common base characteristics
12. Studies on BJT CE amplifier

Course Outcomes:

Students completing this course will be able to:

CO1: Experimental physics has the most striking impact on the industry wherever the instruments are used to study anddetermine the thermal and electronic properties.

CO2: Develop skills to measure precision and perfection through Lab Experiments.

CO3: Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for related local/ global modeling.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	1	1	1	1	1	2	1	1	1	1	1
CO 2	1	1	1	1	3	2	3	2	1	1	1	1
CO 3	1	1	1	1	2	1	2	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	1	1	1
CO3	2	1	1
CO4	2	1	1

Suggested Readings:

1. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962, 9e
2. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015, 1e
3. R.L. Boylestad, L. Nashelsky, "Electronic Devices and Circuit Theory", Prentice-Hall of India Pvt. Ltd.,2015, 11e
4. A. Sudhakar, S.S. Palli, "Circuits and Networks: Analysis and Synthesis", McGraw Hill, 2015, 5e

Website sources:

- https://vlab.amrita.edu/
- http://vlabs.iitkgp.ac.in/be/#
- https://thermtest.com
- https://sjce.ac.in/

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) I Year- II Semester
Course Code: B020201T
Course Title: Bioorganic and Medicinal Chemistry

Objectives: This course will equip students to develop skills to understand biomolecules. Students can understand the physiological function that regulates the proper growth and development of a human body. This course aims to introduce the students with basic experimental understanding of carbohydrates, amino acids, proteins, nucleic acids and medicinal chemistry. Importance of medicinal plants for employability and entrepreneurship.

UNIT – I: Chemistry of Carbohydrates (10 Sessions)

Classification of carbohydrates, reducing and non-reducing sugars, General Properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers. Mechanism of mutarotation Determination of configuration of Glucose (Fischer's proof).Cyclic structure of glucose. Haworth projections.Cyclic structure of fructose .Interconversions of sugars (ascending and descending of sugar series, conversion of aldoses to ketoses). Lobry de Bruyn-van Ekenstein rearrangement; stepping–up (Kiliani-Fischer method) and stepping–down (Ruff's & Wohl's methods) of aldoses; end-group-interchange of aldoses Linkage between monosachharides, structure of disacharrides (sucrose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation. Importance of carbohydrates in development of employability in research and development.

UNIT – II: Chemistry of Proteins (10 Sessions)

Classification of amino acids, zwitter ion structure and Isoelectric point. Overview of primary, secondary, tertiary and quaternary structure of proteins. Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and C–terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme).Synthesis of simple peptides (upto dipeptides) by N-protection & C-activating groups and Merrifield solid phase synthesis. Protein denaturation/ renaturation Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action (Including stereospecifity), Enzyme inhibitors and their importance for employability opportunities in different chemical sectors.

UNIT – III: Chemistry of Nucleic Acids (05 Sessions)

Constituents of Nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), Nucleosides and nucleotides (nomenclature), Synthesis of nucleic acids, Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation.

UNIT – IV: Introductory Medicinal Chemistry (10 Sessions)

Drug discovery, design and development; Basic Retrosynthetic approach. Drug action-receptor theory. Structure –activity relationships of drug molecules, binding role of –OH group,-NH2 group, double bond and aromatic ring. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti- inflammatory agents (Aspirin, paracetamol); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide); antiviral agents (Acyclovir).

UNIT – V: Solid State (05 Sessions)

Definition of space lattice, unit cell. Laws of crystallography – (i) Law of constancy of interfacial angles, (ii) Law of rationality of indices and iii) Symmetry elements in crystals and law of symmetry. X-ray

diffraction by crystals. Derivation of Bragg equation. Determination of crystal structure of NaCl, KCl and CsCl (Laue's method and powder method).

UNIT – VI: Introduction to Polymer (10 Sessions)

Monomers, Oligomers, Polymers and their characteristics, Classification of polymers: Natural synthetic, linear, cross linked and network; plastics, elastomers, fibres, Homopolymers and Co-polymers, Bonding in polymers: Primary and secondary bond forces in polymers ; cohesive energy, and decomposition of polymers. Determination of Molecular mass of polymers: Number Average molecular mass (Mn) and Weight average molecular mass (Mw) of polymers and determination by (i) Viscosity (ii) Light scattering method (iii) Gel permeation chromatography (iv) Osmometry and Ultracentrifuging.

UNIT – VII: Kinetics and Mechanism of Polymerization (05 Sessions)

Polymerization techniques, Mechanism and kinetics of copolymerization, Addition or chain- growth polymerization, Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler- Natta polymerization and vinyl polymers, Condensation or step growth-polymerization,Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxyresins and polyurethanes, Natural and synthetic rubbers, Elementary idea of organic conducting polymers.

UNIT – VIII: Synthetic Dyes (05 Sessions)

Colour and constitution (electronic Concept), Classification of dyes, Chemistry and synthesis of Methyl orange, Congo red, Malachite green, crystal violet, phenolphthalein. Application of dyes in development of employability in research and development and at industrial level.

Suggested Readings:

1. Davis, B. G., Fairbanks, A. J., *Carbohydrate Chemistry*, Oxford Chemistry Primer, Oxford University Press.
2. Finar, I. L. *Organic Chemistry* (*Volume 2)*, Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
3. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Bioch*emistry *7th Ed.,* W. H. Freeman.
4. Berg, J. M., Tymoczko, J. L. &Stryer, L. *Biochemistry 7th Ed.,* W. H. Freeman.
5. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Patrick, G. L. Introduction to Medicinal Chemistry, Oxford University Press, UK, 2013.
7. Singh, H. &Kapoor, V.K. Medicinal and Pharmaceutical Chemistry, VallabhPrakashan, Pitampura, New Delhi, 2012.
8. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press 13 (2006).
9. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
10. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
11. R.B. Seymour & C.E. Carraher: *Polymer Chemistry: An Introduction,* Marcel Dekker, Inc. New York, 1981.
12. G. Odian: *Principles of Polymerization*, 4th Ed. Wiley, 2004.
13. F.W. Billmeyer: *Textbook of Polymer Science*, 2nd Ed. Wiley Interscience, 1971.
14. P. Ghosh: Polymer Science & Technology, Tata McGraw-Hill Education, 1991.

Course outcomes:

Upon completion of this course students will able to:

CO1: Understand classification, nomenclature, preparation and properties of carbohydrates.

CO2: Develop skills to learn the synthesis, properties and mechanism of action of proteins.

CO3: Learn about cconstitution, structure, synthesis and biological role of nucleic acids.

CO4: Understand the concept of drug discovery, design and development for employability at local and national level.

CO5: Understand thelaws of crystallography and determine structure of crystals.
CO6: Understand the importance of macromolecules/polymers in day to day life and apply their knowledge in sustainable development.
CO7: Learn about the techniques involved in polymerization as well as mechanism and kinetics of polymerization
CO8: Learn about the preparation and properties of various kinds of dyes.

Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	2	2	2	3	2	2	3	2
CO2	2	2	2	3	2	2	2	3	2	2	3	2
CO3	2	2	2	3	2	2	2	3	2	2	3	2
CO4	2	2	2	3	2	2	2	3	2	2	3	2
CO5	3	2	3	1	2	2	2	1	2	3	1	2
CO6	2	2	2	3	2	2	2	1	2	1	3	2
CO7	3	2	3	1	2	2	2	1	2	3	1	2
CO8	1	1	2	3	2	2	2	3	2	1	3	2

CO-Curriculum Enrichment Mapping
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	2	1
CO2	3	2	2
CO3	3	2	1
CO4	3	3	2
CO5	3	2	2
CO6	3	3	1
CO7	3	3	1
CO8	3	3	1

Suggested online links:

- http://heecontent.upsdc.gov.in/Home.aspx
- https://nptel.ac.in/courses/104/105/104105124/
- https://nptel.ac.in/courses/103/106/105106204/
- https://nptel.ac.in/courses/104/105/104105034/
- https://nptel.ac.in/courses/104/103/104103121/
- https://nptel.ac.in/courses/104/102/104102016/
- https://nptel.ac.in/courses/104/106/104106106/
- https://nptel.ac.in/courses/104/105/104105120/

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) I Year- II Semester
Course Code: B020202P
Course Title: Biochemical Analysis

Objectives: This course will develop skills to provide basic qualitative and quantitative experimental knowledge of biomolecules such as carbohydrates, proteins, amino acids, nucleic acids drug molecules.

UNIT – I: Qualitative and quantitative analysis of Carbohydrates (15 Sessions)

1. Separation of a mixture of two sugars by ascending paper chromatography
2. Differentiate between a reducing/ non reducing sugar
3. Synthesis of Osazones.

UNIT – II: Qualitative and quantitative analysis of Proteins, amino acids and Fats (20 Sessions)

1. Isolation of protein.
2. Determination of protein by the Biuret reaction.
3. TLC separation of a mixture containing 2/3 amino acids
4. Paper chromatographic separation of a mixture containing 2/3 amino acids
5. To determine the concentration of glycine solution by formylation method.
6. To determine the saponification value of an oil/fat.
7. To determine the iodine value of an oil/fat

UNIT – III: Determination and identification of Nucleic Acids (12 Sessions)

1. Determination of nucleic acids
2. Extraction of DNA from onion/cauliflower

UNIT – IV: Synthesis of Simple drug molecules (13 Sessions)

1. To synthesize aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC and development of TLC methods for the purpose of employability in research and development and at industrial level.
2. Synthesis of propranolol

Suggested Readings:

1. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012).
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education.
3. *Vogel's Qualitative Inorganic Analysis*, Revised by G. Svehla.
4. Vogel, A.I. *A Textbook of Quantitative Analysi*s, ELBS. 1986
5. Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. *Vogel's Textbook of Practical Organic Chemistry,* ELBS.
6. Ahluwalia, V.K. &Aggarwal, R. *Comprehensive Practical Organic Chemistry*,Universities Press
7. Cooper, T.G. Tool of Biochemistry. Wiley-Blackwell (1977).
8. Wilson, K. & Walker, J. Practical Biochemistry. Cambridge University Press (2009).
9. Varley, H., Gowenlock, A.H & Bell, M.: Practical Clinical Biochemistry, Heinemann,

Course outcomes:

Students completing this course will able to:

CO1: Development of skills to understand the qualitative and quantitative analysis.

CO2: Determine qualitative and quantitative information for proteins, amino acids and fats for employability at local and national industrial sector.

CO3: Determine and extract nucleic acids.
CO4: Synthesize drug molecules such as propranolol, aspirin and barbituric acid.

Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	3	2	2	3	2	2	3	1
CO2	3	2	2	2	3	2	2	3	2	2	3	2
CO3	3	2	2	2	1	2	2	3	2	2	3	2
CO4	3	2	2	2	3	2	2	3	2	2	3	3

CO-Curriculum Enrichment Mapping
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	3	1
CO2	3	3	2
CO3	3	2	1
CO4	3	2	2

Suggestive online links

- https://www.labster.com/chemistry-virtual-labs/
- https://www.vlab.co.in/broad-area-chemical-sciences
- http://chemcollective.org/vlabs

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) I Year- II Semester
B030201T: Matrices and Differential Equations & Geometry

Objective: -The main aims of this course is to introduce the basic tools of matrices to solve the systems of linear equations, eigenvalues and corresponding eigenvectors for a square matrix and to recognize differential equations that can be solved by each of the three methods – direct integration, separation of variables and integrating factor method – and use the appropriate method to solve them. The concept and applications co-ordinate geometry of three dimensions. These methods provide a natural aid to the understanding of geometry and some physical concepts. They are also a fundamental tool in many theories of Applied Mathematics to enhance skill development and employability.

PART-A
Matrices and Differential Equations

UNIT-I **(12 Sessions)**

Types of Matrices, Elementary operations on Matrices, Rank of a Matrix, Echelon form of a Matrix, Normal form of a Matrix, Inverse of a Matrix by elementary operations, System of linear homogeneous and non-homogeneous equations, Theorems on consistency of a system of linear equations for skill development.

UNIT-II **(11 Sessions)**

Eigen values, Eigen vectors and characteristic equation of a matrix, Caley-Hamilton theorem and its use in finding inverse of a matrix, Complex functions and separation into real and imaginary parts, Exponential and Logarithmic functions Inverse trigonometric and hyperbolic functions for skill development.

UNIT-III **(11 Sessions)**

Formation of differential equations, Geometrical meaning of a differential equation for better understanding of concept, Equation of first order and first degree, Equation in which the variables are separable ,Homogeneous equations, Exact differential equations and equations reducible to the exact form, Linear equations.

UNIT-IV **(11 Sessions)**

First order higher degree equations solvable for x, y, p, Clairaut's equation and singular solutions, orthogonal trajectories, Linear differential equation of order greater than one with constant coefficients, Cauchy-Euler form for skill development.

Suggested Readings (PART-A Matrices and Differential Equations):

1. Stephen H. Friedberg, A. J Insel& L. E. Spence, Linear Algebra, Person
2. B. Rai, D.P. Choudhary& H. J. Freedman, A Course in Differential Equations, Narosa
3. D. A. Murray, Introductory Course in Differential Equations, Orient Longman
4. Suggested digital plate form : NPTEL /SWAYAM /MOOCs
5. Course Books published in Hindi may be prescribed by the Universities.

PART-B
Geometry

UNIT-V **(12 Sessions)**

General equation of second degree, System of conics, Tracing of conics, Confocal conics, Polar equation of conics and its properties to develop skills**.**

UNIT-VI **(11 Sessions)**

Three-Dimensional Coordinates, Projection and Direction Cosine, Plane (Cartesian and vector form), Straight line in three dimension (Cartesian and vector form) to develop skills.

UNIT-VII **(11 Sessions)**

Sphere, Cone and Cylinder to develop skills.

UNIT-VIII **(11 Sessions)**

Central conicoids, Paraboloids, Plane section of conicoids, Generating lines, confocal conicoids, Reduction of second degree equations to develop skills.

Course Outcomes:

CO1 : Perform the matrix operations of addition, multiplication and transposition and express a system of simultaneous linear equations in matrix form. Solve a system of linear equations by row-reducing its augmented form, inverse of a matrix to develop skills.

CO2 : Solve the problems of Complex number, Function of complex variable, Trigonometric, Exponential, Logarithmic functions to develop skills.

CO3 : Determine the different types of differential equations their solutions using different methods to develop skills.

CO4 : Use three dimensional geometry to understand different mathematical problems to develop skills..

CO5 : Study the basic concepts regarding three dimensional geometry for better employability

Suggested Readings (Part-B Geometry):

1. Robert J.TBell, Elementary Treatiseon Coordinate Geometry of three dimensions, Macmillan India Ltd.
2. P. R.Vittal, Analytical Geometry 2d & 3D, Pearson.
3. S. L. Loney, The Elements of Coordinate Geometry, Mc Millanand Company, London.
4. Suggested digital plate form : NPTEL /SWAYAM /MOOCs
5. Course Books (text/reference) published in Hindi may be prescribed by the Universities at local levels.

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	3	3	3	2	3	1
CO2	2	3	1	1	3	2	2	3	2	1
CO3	1	1	3	3	2	2	1	1	3	2
CO4	3	2	3	2	3	3	3	2	1	3
CO5	3	3	2	3	1	1	3	2	3	1

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	1
CO3	3	1	1
CO4	3	2	1
CO5	3	1	1

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

Note: Latest editions of all the suggested readings must be used.

Co-curricular course

Bachelor of Science Programme
B. Sc. (PCM) I Year- II Semester
Course Title: First Aid and Health

Programme/Class: Certificate	Year: First	Semester: Second
Co-Curricular Course		
Course Code: Z020201	Course Title: First Aid and First Aid and Health	

Course outcomes:

- *Learn the skill needed to assess the ill or injured person.*
- *Learn the skills to provide CPR to infants, children and adults.*
- *Learn the skills to handle emergency child birth*
- *Learn the Basic sex education help young people navigate thorny questions responsibly and with confidence.*
- *Learn the Basic sex education help youth to understand Sex is normal. It's a deep, powerful instinctat the core of our survival as a species. Sexual desire is a healthy drive.*
- *Help to understand natural changes of adolescence*
- *Learn the skill to identify Mental Health status and Psychological First Aid*

Credits:2(1Theory+1Practical)	Compulsory
Max.Marks:25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials-Practical(in hours per week):
L-T-P:2-0-0

Unit	Topics	No. of Lectures Total = 15Theory + 30Practical
I	***A. Basic First Aid*** • Aims of first aid & First aid and the law. • Dealing with an emergency, Resuscitation (basic CPR). • Recovery position, Initial to ptotoe assessment. • Hand washing and Hygiene • Types and Content of a First aid Kit ***B. First AID Technique*** • Dressings and Bandages. • Fast evacuation techniques (single rescuer). • Transport techniques. ***C. First aid related with respiratory system*** • Basics of Respiration.	2 (Theory) 10 (Practical)
	• No breathing or difficult breathing, Drowning, Choking, Strangulation and hanging, • Swelling with in the throat, Suffocation by smoke or gases and Asthma. ***D. First aid related with Heart, Blood and Circulation*** • Basics of The heart and the blood circulation. • Chest discomfort, bleeding. ***D. First aid related with Wounds and Injuries*** • Type of wounds, Small cuts and abrasions • Head, Chest, Abdominal injuries • Amputation, Crush injuries, Shock ***E. First aid related with Bones, Joints Muscle related injuries*** • Basics of The skeleton, Joints and Muscles. • Fractures (injuries to bones).	

II	***F. First aid related with Nervous system and Unconsciousness*** • Basics of the nervous system. • Unconsciousness, Stroke, Fits–convulsions–seizures, Epilepsy. ***G. First aid related with Gastrointestinal Tract*** • Basics of The gastrointestinal system. • Diarrhea, Food poisoning. ***H. First aid related with Skin, Burns*** • Basics of The skin. • Burn wounds, Dry burns and scalds (burns from fire, heat and steam). • Electrical and Chemical burns, Sunburns, heat exhaustion and heat stroke. • Frostbites (cold burns), Prevention of burns, Fever and Hypothermia. ***I. First aid related with Poisoning*** • Poisoning by swallowing, Gases, Injection, Skin ***J. First aid related with Bites and Stings*** • Animal bites, Snake bites, Insects tings and bites ***K. First aid related with Sense organs*** • Basic of Sense organ. • Foreign objects in the eye, ear, nose or skin. • Swallowed foreign objects. ***L. Specific emergency satiation and disaster management*** • Emergencies at educational institutes and work • Road and traffic accidents. • Emergencies in rural areas. • Disasters and multiple casualty accidents. • Triage. ***M. Emergency Childbirth***	2 (Theory) 10 (Practical)
III	***Basic Sex Education*** • Overview, ground rules, and a pre-test • Basics of Urinary system and Reproductive system. • Male puberty—physical and emotional changes • Female puberty—physical and emotional changes • Male-female similarities and differences • Sexual intercourse, pregnancy, and childbirth • Facts, attitudes, and myths about LGBTQ + issues and identities • Birth control and abortion • Sex without love —harassment, sexual abuse, and rape • Prevention of sexually transmitted diseases.	9 (Theory)
IV	Mental Health and Psychological First Aid • What is Mental Health First Aid? • Mental Health Problems in the India • The Mental Health First Aid Action Plan • Understanding Depression and Anxiety Disorders • Crisis First Aid for Suicidal Behavior & Depressive symptoms • What is Non-Suicidal Self-Injury? • Non-crisis First Aid for Depression and Anxiety • Crisis First Aid for Panic Attacks, Traumatic events • Understanding Disorders in Which Psychosis may Occur • Crisis First Aid for Acute Psychosis • Understanding Substance Use Disorder • Crisis First Aid for Overdose, Withdrawal • Using Mental Health First Aid	2 (Theory) 10 (Practical)

Suggested Readings:

- Indian First Aid Mannual-https://www.indianredcross.org/publications/FA-manual.pdf
- Red Cross First Aid/CPR/AED Instructor Manual
- https://mhfa.com.au/courses/public/types/youthedition4
- Finkelhor,D.(2009).Thepreventionofchildhoodsexualabuse.Durham,NH:CrimesAgainstChildrenResearchCenter.www.unh.edu/ccrc/pdf/CV192.pdf
- Kantor L.& Levitz N.(2017). Parents' views on sex education in schools: How much do Democrats and Republic ansagree? PLoSONE, 12(7):e0180250.
- Orenstein, P.(2016).Girls and sex: Navigating the complicated new landscape. New York, NY: Harper.
- Schwiegershausen,E.(2015,May28).TheCut.www.thecut.com/2015/05/most-women-are-catcalled-before-they-turn-17.html
- Wiggins,G.&McTighe,J.(2008).Understandingbydesign.Alexandra,VA:ASCD.
- https://marshallmemo.com/marshall-publications.php#8

Suggested Continuous Evaluation Methods:
Assignments, Presentation, Group Discussion, and MCQ

Suggested equivalent online courses:

- https://www.redcross.org/take-a-class/first-aid/first-aid-training/first-aid-online
- https://www.firstaidforfree.com/
- https://www.coursera.org/learn/psychological-first-aid
- https://www.coursera.org/learn/mental-health

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) II Year- III Semester
B010301T: Electromagnetic Theory & Modern Optics

Objective: In this course student will be concerned with the disciplines of electromagnetic theory is basic to all other branches of physics. This course provides students with a working knowledge of optical physics, including diffraction and polarisation, laser physics.

Part A: Electromagnetic Theory

UNIT-I **(5 Sessions)**

Electrostatics:

Electric charge & charge densities, electric force between two charges. General expression for Electric field in terms of volume charge density (divergence & curl of Electric field), general expression for Electric potential in terms of volume charge density and Gauss law (applicationsincluded). Study of electric dipole. Electric fields in matter, polarization, auxiliary field **D** (Electric displacement), electric susceptibility and permittivity.

UNIT-II **(6 Sessions)**

Magnetostatics:

Electric current & current densities, magnetic force between two currentelements. General expression for Magnetic field in terms of volume current density (divergence and curl of Magnetic field), General expression for Magnetic potential in terms of volume current density and Ampere's circuital law (applications included). Study of magnetic dipole(Gilbert & Ampere model). Magnetic fields in matter, magnetization, auxiliary field **H**, magnetic susceptibility and permeability.

UNIT-III **(5 Sessions)**

Time Varying Electromagnetic Fields:

Faraday's laws of electromagnetic induction and Lenz's law and related skill development. Displacement current, equation of continuity and Maxwell-Ampere's circuital law. Self and mutual induction (applications included). Derivation and physical significance of Maxwell's equations. Theory and working of moving coil ballistic galvanometer (applications included).

UNIT-IV **(6 Sessions)**

Electromagnetic Waves:

Electromagnetic energy density and Poynting vector. Plane electromagnetic waves in linear infinite dielectrics, homogeneous & inhomogeneous plane waves and dispersive & non-dispersive media. Develop skills to understand reflection and refraction of homogeneous plane electromagnetic waves, law of reflection, Snell's law, Fresnel's formulae (only for normal incidence & optical frequencies) and Stoke's law.

Suggested Readings:

1. H. K. Malik and A.K. Singh "Engineering Physics", McGraw Hill Education (India) Private Limited, 2018, 2e.
2. Richard P. Feynman, Robert B. Leighton, Matthew Sands, "The Feynman Lectures on Physics - Vol. 2", Pearson Education Limited, 2012
3. D. J. Griffiths, "Introduction to Electrodynamics", Prentice-Hall of India Private Limited, 2002, 3e
4. E. M. Purcell, "Electricity and Magnetism (In SI Units): Berkeley Physics Course Vol 2", McGraw Hill,2017, 2e
5. D.C. Tayal, "Electricity and Magnetism", Himalaya Publishing House Pvt. Ltd., 2019, 4e

Part B: Physical Optics & Lasers

UNIT- V **(5 Sessions)**

Interference:

Conditions for interference and spatial & temporal coherence. Division of Wavefront - Fresnel's Biprism and Lloyd's Mirror. Division of Amplitude - Parallel thin film, wedge shaped film and Newton's Ring experiment. Interferometer - Michelson and Fabry-Perot.

UNIT-VI **(5 Sessions)**

Diffraction:

Distinction between interference and diffraction. Fresnel's and Fraunhofer's class of diffraction. Fresnel's Half Period Zones and Zone plate. Fraunhofer diffraction at a single slit, n slits and Diffracting Grating. Resolving Power of Optical Instruments - Rayleigh's criterion and resolving power of telescope, microscope & grating.

UNIT-VII **(6 Sessions)**

Polarization:

Polarization by dichroic crystals and related skill development, birefringence, Nicol prism, retardation plates and Babinet's compensator. Analysis of polarized light. Optical Rotation - Fresnel's explanation of optical rotation and Half Shade & Biquartz polarimeters.

UNIT- VIII **(5 Sessions)**

Lasers:

Characteristics and uses of Lasers. Quantitative analysis of Spatial and Temporal coherence. Conditions for Laser action and Einstein's coefficients. Three and four level laser systems (qualitative discussion). Types of lasers and laser.

Suggested Readings:

1. H. K. Malik, "Engineering Physics", McGraw Hill Education (India) Private Limited, 2018, 2e.
2. Francis A. Jenkins, Harvey E. White, "Fundamentals of Optics", McGraw Hill, 2017, 4e
3. Samuel Tolansky, "An Introduction to Interferometry", John Wiley & Sons Inc., 1973, 2e
4. A. Ghatak, "Optics", McGraw Hill, 2017, 6e

Course Outcomes:

Students completing this course will be able to:

CO1: Better understanding of electrical and magnetic phenomenon in daily life.
CO2: To troubleshoot simple problems related to electrical devices for skill development.
CO3: Comprehend the powerful applications of ballistic galvanometer.
CO4: Study the fundamental physics behind reflection and refraction of light (electromagnetic waves) for skill development.
CO5: Study the working and applications of Michelson and Fabry-Perot interferometers.
CO6: Recognize the difference between Fresnel's and Fraunhofer's class of diffraction.
CO7: Comprehend the use of polarimeters in local/ global scenario.
CO8: Study the characteristics and uses of lasers in local/ global perspectives.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	1	1	2	1	1	1	1	1	1	1
CO 2	1	3	1	1	1	2	1	1	1	1	1	1
CO 3	1	1	2	1	1	2	1	1	1	1	1	1
CO 4	1	1	3	2	1	1	1	1	1	1	1	1
CO 5	1	1	2	1	2	3	1	1	1	1	1	1
CO 6	1	1	3	1	1	1	1	1	1	1	1	1

CO 7	1	1	1	1	1	1	1	1	1	1	1	1
CO 8	1	1	1	1	1	2	1	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	**Employability**	**Entrepreneurship Development**
CO1	2	1	1
CO2	1	1	1
CO3	2	1	1
CO4	1	1	1

Website sources:

- https://openlearning.mit.edu
- https://www.youtube.com
- http://heecontent.upsdc.gov.in
- https://www.swayamprabha.gov.in

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) II Year- III Semester
B010302P: Demonstrative Aspects of Electricity & Magnetism

Objective: The main goal of this subject is to share the knowledge to the students about the Experiments. The students will get a better understanding of the concepts studied by them in the theory course and correlate with experimental observations.

Lab Experiment List **(20 Sessions)**

1. Variation of magnetic field along the axis of single coil.
2. Develop skills to understand variation of magnetic field along the axis of Helmholtz coil.
3. Ballistic Galvanometer: Ballistic constant, current sensitivity and voltage sensitivity
4. Ballistic Galvanometer: High resistance by Leakage method
5. Ballistic Galvanometer: Low resistance by Kelvin's doublebridge method
6. Ballistic Galvanometer: Self-inductance of a coil by Rayleigh'smethod
7. Ballistic Galvanometer: Comparison of capacitances
8. Carey Foster Bridge: Resistance per unit length and low resistance for skill development
9. Deflection and Vibration Magnetometer: Magnetic moment of amagnet and horizontal component of earth's magnetic field
10. Earth Inductor: Horizontal component of earth's magnetic field

Online Virtual Lab Experiment List

1. Tangent galvanometer
2. Magnetic field along the axis of a circular coil carrying current
3. Deflection magnetometer
4. Van de Graaff generator
5. Barkhausen effect
6. Temperature coefficient of resistance
7. Anderson's bridge
8. Quincke's method

Suggested Readings:

1. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962, 9e
2. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015, 1e
3. R.K. Agrawal, G. Jain, R. Sharma, "Practical Physics", Krishna Prakashan Media (Pvt.) Ltd., Meerut, 2019
4. S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut, 2014, 2e

Course Outcomes:

Students completing this course will be able to:

CO1: Experimental physics has the most striking impact on the industry wherever the instruments are used to study and determine the electric and magnetic properties.

CO2: Measurement precision and perfection is achieved through Lab Experiments for skill development.

CO3: Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for related local/ global modeling.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	1	1	1	1	1	2	1	1	1	1	1
CO 2	1	1	1	1	2	2	3	1	1	1	1	1
CO 3	1	1	1	1	3	1	2	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	1	1	1
CO2	2	1	1
CO3	3	1	1
CO4	2	1	1

Website sources:

- https://vlab.amrita.edu
- http://sites.iiserpune.ac.in
- https://www.ucd.ie
- https://pgslogan.weebly.com

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) II Year- III Semester
Course Code: B020301T
Course Title: Chemical Dynamics & Coordination Chemistry

Objectives: The main objectives of this course is to develop the skills to learn the characteristic of the three states of matter and describe the different physical properties of each state of matter. Kinetic theory of gases, laws of crystallography, liquid state and liquid crystals, conductometric, potentiometric, optical methods, polarimetry and spectrophotometer technique to study Chemical kinetics and chemical equilibrium and development of employability and entrepreneurship.

UNIT – I: Chemical Kinetics **(10 Sessions)**

Rate of a reaction, molecularity and order of reaction, concentration dependence of rates, mathematical characteristic of simple chemical reactions – zero order, first order, second order, pseudo order, half-life and mean life. Determination of the order of reaction – differential method, method of integration, half-life method and isolation method. Brief outline of experimental methods of studying chemical kinetics: Conductometric, potentiometric, optical methods, polarimetry and spectrophotometer

Theories of chemical kinetics: Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and thermodynamic aspects (no derivation).

UNIT – II: Chem**ical Equilibrium** **(05 Sessions)**

Equilibrium constant and free energy, thermodynamic derivation of law of mass action. Le-Chatelier's principle. reaction isotherm and reaction isochore – Clapeyron-Clausius equation and its applications.

UNIT – III: PhaseEquilibrium **(05 Sessions)**

Phase Equilibrium : Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system– water, CO2 and systems. Phase equilibria of two component systems – Solid - liquid equilibria, simple eutectic – Bi-Cd, Pb-Ag systems.

UNIT – IV: Kinetic theories of gases **(10 Sessions)**

Gaseous State: Postulates of kinetic theory of gases, deviation from ideal behavior, van der Waals equation of state.

Critical phenomena: PV isotherms of real gases, continuity of states, the isotherms of Van der Waals equation, relationship between critical constants and Van der Waals constants, the law of corresponding states, reduced equation of state.

Molecular Velocities: Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect).

UNIT – V: Liquid State **(05 Sessions)**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals: Difference between liquid crystal, solid and liquid. Classification, structure of nematic and cholesterol phases.Thermography and seven segment cell.

Liquids in solids (gels): Classification, preparation and properties, inhibition, general application.

UNIT – VI: Coordination Chemistry **(05 Sessions)**

Coordinate bonding: double and complex salts. Werner’s theory of coordination complexes, classification of ligands, ambidentate ligands, chelates, coordination numbers, IUPAC nomenclature of coordination

complexes (up to two metal centers), Isomerism in coordination compounds, constitutional and stereo isomerism, geometrical and optical isomerism in square planar and
octahedral complexes. Application of coordination chemistry in development of employability in research and development and at industrial level.

UNIT – VII: Theories of Coordination Chemistry (10 Sessions)

I. Metal- ligand bonding in transition metal complexes, limitations of valance bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planner complexes, factors affecting the crystal-field parameters.

II. Thermodynamic and kinetic aspects of metal complexes: A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, stability constants of complexes and their determination, substitution reactions of square planar complexes

UNIT – VIII: Inorganic Spectroscopy and Magnetism (10 Sessions)

I) Electronic spectra of Transition Metal Complexes

Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series, Orgel-energy level diagram for d1 and d9 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complex ion.

II)Magnetic properties of transition metal complexes, types of magnetic behaviour, skill development for determining magnetic susceptibility, spin-only formula, L-S coupling, correlation of μ s and μ eff values, orbital contribution to magnetic moments, application of magnetic moment data for 3d-metal complexes.

Physical properties and molecular structure : Optical activity, polarization – (Clausius - Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment-temperature method and refractivity method, dipole moment and structure of molecules, magnetic properties paramagnetism, diamagnetism and ferromagnetism, magnetic susceptibility, its measurements and its importance.

Suggested Readings:

1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press 13 (2006).
2. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
3. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
4. Cotton, F.A, Wilkinson, G and Gaus, P. L ,Basic Inorganic Chemistry, 3rd Edition ,Wiley 1995
5. Lee, J. D, Concise Inorganic Chemistry 4th Edition ELBS,1977
6. Douglas, B, McDaniel, D and Alexander, J, Concepts of Models of Inorganic Chemistry, John Wiley & Sons; 3rd edition , 1994
7. Shriver, D. EAtkins, P.W and Langford, C. H., Inorganic Chemistry ,Oxford University Press, 1994.
8. Porterfield, W.W, Inorganic Chemistry, Addison Wesley 1984.
9. Sharpe, A .G, Inorganic Chemistry, ELBS,3rd edition ,1993
10. Miessler, G.L, Tarr, D.A, Inorganic Chemistry, 2nd edition, Prentice Hall,2001

Course outcomes:

Upon successful completion of this course students should be able to

CO1: Evaluate rate constant of a reaction as well as understand theories of reaction rates.

CO2: Understand the concept of equilibrium constant and free energy.

CO3: Development of skills to Learn the concept of phases, component and degree of freedom and its applications to various phase diagrams

CO4: Understand the concept of kinetic theory of gases and behavior of real gases.

CO5: Understand the basic concepts of liquid state and liquid crystals for employability at local and national level

CO6: Skill development in learning about coordination compounds of transition metal complexes and their applications.

CO7: Describe metal-ligand bonding, thermodynamic and kinetic aspects of metal complexes.
CO8: Explain the electronic spectra and magnetic behavior of transition metal complexes

Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	2	2	3	1	3	3	1
CO2	3	2	2	3	2	2	2	2	2	3	1	2
CO3	3	1	2	3	2	2	2	2	2	3	2	2
CO4	3	2	3	3	2	2	2	2	2	3	2	2
CO5	3	2	3	3	2	2	2	2	2	3	2	1
CO6	3	3	2	3	1	3	2	2	2	1	3	1
CO7	3	3	2	3	3	1	2	2	2	2	3	3
CO8	3	3	2	3	1	3	2	2	2	2	1	1

CO-Curriculum Enrichment Mapping
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	2	1
CO2	3	2	2
CO3	3	2	2
CO4	3	3	2
CO5	3	2	1
CO6	3	2	2
CO7	3	2	2
CO8	3	3	1

Suggested online links:

- https://swayam.gov.in/
- https://www.coursera.org/learn/physical-chemistry
- https://www.mooc-list.com/tags/physical-chemistry
- https://www.openlearning.com/courses/introduction-to-physical-chemistry/
- https://www.my-mooc.com/en/categorie/chemistry
- https://onlinecourses.swayam2.ac.in/nce19_sc15/preview
- https://swayam.gov.in/
- https://www.coursera.org/browse/physical-science-and-engineering/chemistry

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) II Year- III Semester
Course Code: B020302P
Course Title: Physical Analysis

Objectives: The primary objective of this course is to develop skill to make students aware of apparatus calibration, solution preparation, estimation by through volumetric analysis and analysis of phase equilibrium.

UNIT – I: Strengths of Solution (20 Sessions)

Calibration of fractional weights, pipettes and burettes. Preparation of standards solutions. Dilution – 0.1 M to 0.001 M solutions.

Mole Concept and Concentration Units: Mole Concept, molecular weight, formula weight, and equivalent weight. Concentration units: Molarity, Formality, Normality, Molality, Mole fraction, Percent by weight, Percent by volume, Parts per thousand, Parts per million, Parts per billion, pH, pOH, milli equivalents, Milli moles.

UNIT – II: Surface Tension and Viscosity (06 Sessions)

1. Determination of surface tension of pure liquid or solution
2. Determination of viscosity of liquid pure liquid or solution

UNIT – III: Boiling point and Transition Temperature (14 Sessions)

1. Boiling point of common organic liquid compounds (**ANYFIVE)** *n*-butylalcohol, cyclohexanol, ethyl methyl ketone, cyclohexanone, acetylacetone, isobutyl methyl ketone, isobutyl alcohol, acetonitrile, benzaldehyde and acetophenone.[Boiling points of the chosen organic compounds should preferably be within180^0C].
2. Transition Temperature, Determination of the transition temperature of the given substance by thermometric /dialometric method (e.g. $MnCl_2.4H_2O/SrBr_2.2H_2O$).

UNIT – IV: Phase Equilibrium (20 Sessions)

1. To study the effect of a solute (e.g. NaCl, succinic acid) on the critical solution temperature of two partially miscible liquids (e.g. phenol water system) and to determine the concentration of that solute in the given phenol-water system
2. To construct the phase diagram of two component (e.g. diphenylamine – benzophenone) systemby cooling curve method. Role of phase equilibrium in development of employability in research and development and at industrial level.

Course outcomes:

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

CO1: Calibrate apparatus and prepare solutions of various concentrations.
CO2: Determine surface tension and viscosity of any solution.
CO3: Development of skills to perform dilatometric experiments for a given substance for employability at local and national level.
CO4: analyze component and phase in an equilibrium

Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	2	2	2	3	2	3	1	2
CO2	3	3	1	3	2	2	2	3	2	3	2	2
CO3	3	2	2	3	2	2	2	1	2	3	3	2
CO4	3	1	2	3	1	1	1	1	2	3	1	2

CO-Curriculum Enrichment Mapping
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	3	1
CO2	3	3	1
CO3	3	3	1
CO4	3	3	1

Suggested Readings:

1. Skoog .D.A., West.D.M and Holler .F.J., "Analytical Chemistry: An Introduction", 7th edition, Saunders college publishing, Philadelphia, (2010).
2. Larry Hargis. G "Analytical Chemistry: Principles and Techniques" Pearson©(1988)

Suggestive online links

- https://www.labster.com/chemistry-virtual-labs/
- https://www.vlab.co.in/broad-area-chemical-sciences
- http://chemcollective.org/vlabs

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) II Year- III Semester
B030301T: Algebra & Mathematical Methods

Objective: - The main aims of this course abstract algebra are to provide a first approach to the subject of algebra, which is one of the basic pillars of modern and applied mathematics. The focus of the subject will be the study of certain structures called groups, rings, fields, field extensions, ideals and some related structures. To describe Laplace Transforms, the ideas of Fourier and indicate their applications in the fields such as application of PDE, theory of wave equations, differential equations and many others for better employability in industry.

Part- A
Algebra

UNIT-I **(12 Sessions)**

Equivalence relations and partitions, Congruence modulo, Definition of a group with examples and simple properties, Subgroups, Generators of a group, Cyclic groups for skill development.

UNIT-II **(11 Sessions)**

Permutation groups, Even and odd permutations, The alternating group, Cayley's theorem, Direct products, Coset decomposition, Lagrange's theorem and its consequences, Fermat and Euler theorems for skill development.

UNIT-III **(11 Sessions)**

Normal subgroups, Quotient groups, Homomorphism and isomorphism, Fundamental theorem of homomorphism, Theorems on isomorphism for skill development.

UNIT-IV **(11 Sessions)**

Rings, Sub rings, Integral domains and fields, Characteristic of a ring, Ideal and quotient rings, Ring homomorphism, Field of quotient of an integral domain for skill development.

Suggested Readings (Part-A Algebra):

1. J.B. Fraleigh, A first course in Abstract Algebra, Addison-weley
2. I. N. Herstein, Topicsin Algebra, John Wiley & Sons
3. Suggested digital platform : NPTEL /SWAYAM /MOOCS
4. Course Books (text/reference) published in Hindi may be prescribed by the Universities at local levels.

Part-B
Mathematical Methods

UNIT-V **(12 Sessions)**

Limit and Continuity of functions of two variables, Differentiation of function of two variables, Necessary and sufficient condition for differentiability of functions two variables, Schwarz's and Young theorem, Taylor's theorem for functions of two variables with examples, Maxima and minima for functions of two variables, Lagrange multiplier method, Jacobians to provide skills.

UNIT-VI **(11 Sessions)**

Existence theorems for Laplace transforms, Linearity of Laplace transform and their properties, Laplace transform of the derivatives and integrals of a function, Convolution theorem, inverse Laplace transforms, Solution of the differential equations using Laplace transforms for skill development.

UNIT-VII **(11 Sessions)**

Fourier series, Fourier expansion of piece wise monotonic functions, Half and full range expansions, Fourier transforms (finite and Infinite), Fourier Sine and Cosine transforms and their properties to provide skills.

UNIT-VIII **(11 Sessions)**

Calculus of variations- Variational problems with fixed boundaries-Euler's equation for functional containing first order derivative and one independent variable to provide skills, Extremals, Functionals dependent on higher order derivatives, Functionals dependent on more than one independent variable, Variational problems in parametric form.

Suggested Readings (Part-B Mathematical Methods):

1. T.M. Apostal, Mathematical Analysis, Person
2. G. F. Simmons, Differential Equations with Application and Historical Notes, Tata McGrawHill.
3. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
4. Suggested digital platform : NPTEL/SWAYAM/MOOCs
5. Course Books (text /reference) published in Hindi may be prescribed by the Universities at local levels.

Course Outcomes:

CO1: Group theory is one of the building blocks of modern algebra. Objective of this course is to introduce students to basic concepts of Group, Ring theory and their properties to enhance students' knowledge.

CO2: A student learning this course gets a concept of Group, Ring, Integral Domain and their properties. These courses willed the student to basic course in advanced mathematics and Algebra for skill development.

CO3: The course gives emphasis to enhance students' knowledge of functions of two variables, Laplace Transforms, Fourier Series.

CO4: On successful completion of the course students should have knowledge about higher different mathematical method sand will help him in going for higher studies and research and students will also get knowledge for better employability in industry.

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	3	3	3	2	3	1
CO2	2	3	1	1	3	2	2	3	2	1
CO3	1	1	3	3	2	2	1	1	3	2
CO4	3	2	3	2	3	3	3	2	1	3

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	2	1
CO4	3	2	1

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

Note: Latest editions of all the suggested readings must be used.

Co-curricular course

Bachelor of Science Programme

B. Sc. (PCM) II Year- III Semester

Course Title: Human Values and Environment studies

Programme/Class: Certificate	Year: Second	Semester: Third
Co-Curricular Course		
Course Code: Z030301	Course Title: Human Values and Environment studies	

Course outcomes:

The mission of the course on Human Values and Environmental Studies is to create morally articulate solutions to be truthful and just and to become responsible towards humanity. The course seeks to establish a continuous interest in the learners to improve their thought process with intent to develop a new generation of responsible citizens capable of addressing complex challenges faced by the society due to disruptions in human interactions effecting human values. This course works towards

- Building fundamental knowledge of the interplay of markets, ethics, and law,
- Look at various challenges faced by individual to counter un ethical issues
- Look at core concepts for business ethics
- Look at core concepts of anti-corruption
- Look at core concepts for a morally articulate solution evolver to management issues in general,
- Issues of sustainable development for a better environment.
- To know how environmental degradation has taken place.
- Be aware of negotiations and international efforts to save environment.
- How to develop sustainably?
- Efforts taken up by UN in Sustainable Development.
- Efforts taken by India in Sustainable Development.

- The course intends to create a sense of how to be more responsible towards the environment.

Upon finishing of the course students will be able to come up with using ethical reasoning for decision making and frame ethical issues as well as operational is an ethical choice. The course integrates various Facets of human values and environment.

Credits:2	
Max. Marks: 100	Min.PassingMarks:40

Total No. of Lectures- Tutorials- Practical (in hours per week): L-T-P:2-0-0

As the course requires, we are as of Human Values and Environment Studies institutions can even opt for a parallel delivery.

Unit	Topics	No. of Lectures Total=30
I	**Human Values**- Introduction- Values, Characteristics, Types, Developing Value System in Indian Organization, Values in Business Management, value based Organization, Trans–cultural Human values in Management. Swami Vivekananda's Philosophy of Character Building, Gandhi's concept of Seven Sins, APJ Abdul Kalam View on role of parents and Teachers. **Human Values and Present Practices–**Issues: Corruption and Bribe, Privacy Policy in Web and Social Media, Cyber threats, Online Shopping etc. Remedies **UK Bribery Act, Introduction to sustainable policies and practices in Indian Economy.** **Principles of Ethics**	02 02 03

	Secular and Spiritual Values in Management- Introduction-Secular and Spiritual values, features, Levels of value Implementation. Features of spiritual Values, **Corporate Social Responsibility-**Nature, Levels, Phases and Models of CSR, Corporate Governance. CSR and Modern Business Tycoons Ratan Tata, Azim Premji And Bill Gates.	
II	**Holistic Approach in Decision making-** Decision making**,** the decision making process, The Bhagavad Gita: Techniques in Management, Dharma and Holistic Management. **Discussion through Dilemmas** – Dilemmas in Marketing and Pharma Organisations, moving from Public to Private– Monopoly context, Dilemma of privatisation, Dilemma on liberalization, Dilemma on Social media and cyber security, Dilemma on Organic food, Dilemma on standardization, Dilemma on Quality standards. **Case Studies**	03 03 02
III	Ecosystem: Concept, structure & functions of ecosystem: producer, consumer, decomposer, food web, food chain, energy flow, Ecological pyramids Conservation of Biodiversity- In-situ & Ex- situ conservation of biodiversity Role of individual in Pollution control Human Population & Environment Sustainable Development India and UN Sustainable Development Goals Concept of circular economy and entrepreneurship	7
IV	Environmental Laws? International Advancements in Environmental Conservation Role of National Green Tribunal Air Quality Index Importance of Indian Traditional knowledge on environment	8
	Bio assessment of Environmental Quality Environmental Management System Environmental Impact Assessment and Environmental Audit	

Suggested Readings:

1. A foundation course in Human Values and Professional Ethics by RR. Gaur, R. Sangalet.al
2. JUSTICE: What's the Right Thing to Do? Michael J. Sandel.
3. Human Values by A. N. Tripathi New Age International
4. Environmental Management by N. K. Uberoi
5. https://www.un.org/sustainabledevelopment/sustainable-development-goals/
6. https://www.india.gov.in/my-government/schemes
7. https://www.legislation.gov.uk/ukpga/2010/23/contents
8. DanielKahneman,Thinking,FastandSlow;AllenLaneNov2011 ISBN:9780141918921

Suggested Continuous Evaluation Methods:

In addition to the theoretical inputs the course will be delivered through case studies and dilemma as . Assignments, Presentation, Group Discussions. This will in still in student a sense of decision making and practical learning. The course participants can be evaluated on the following structure.

- ➢ Assignments(10)
- ➢ Presentation(10)
- ➢ Attendance (5)
- ➢ Final exam (75)

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) II Year- IV Semester
B010401T: Perspectives of Modern Physics & Basic Electronics

Objective: It aims to introduce students to frontiers of modern physics and illustrate the benefits that scientific investigation brings to society and basic electronics helps to study the basic principles of electronics and devices as semiconductor materials, prototype semiconductor based electronic devices and various electronic devices and their applications in daily life.

Part A: Perspectives of Modern Physics

UNIT-I **(5 Sessions)**

Relativity-Experimental Background:

Structure of space & time in Newtonian mechanics and inertial & non- inertial frames. Galilean transformations. Newtonian relativity. Develop skills to understand Galilean transformation and Electromagnetism. Attempts to locate the Absolute Frame: Michelson-Morley experiment and significance of the null result. Einstein's postulates of special theory of relativity.

UNIT- II **(6 Sessions)**

Relativity-Relativistic Kinematics:

Structure of space & time in Relativistic mechanics and derivation of Lorentz transformation equations (4-vector formulation included). Consequences of Lorentz Transformation Equations (derivations & examples included): Transformation of Simultaneity (Relativity of simultaneity); Transformation of Length (Length contraction); Transformation of Time (Time dilation); Transformation of Velocity (Relativistic velocity addition); Transformation of Acceleration; Transformation of Mass (Variation of mass with velocity). Relation between Energy & Mass (Einstein's mass & energy relation) and Energy & Momentum.

UNIT-III **(6 Sessions)**

Inadequacies of Classical Mechanics:

Particle Properties of Waves: Spectrum of Black Body radiation, Photoelectric effect, Compton effect and their explanations based on Max Planck's Quantum hypothesis.

Knowledge of Wave Properties of Particles for employability, Louis de Broglie's hypothesis of matter waves and their experimental verification by Davisson-Germer's experiment and Thomson's experiment.

UNIT-IV **(5 Sessions)**

Introduction to Quantum Mechanics:

Matter Waves: Mathematical representation, Wavelength, Concept of Wave group, Group (particle) velocity, Phase (wave) velocity and relation between Group & Phase velocities.

Wave Function: Functional form, Normalization of wave function, Orthogonal & Orthonormal wave functions and Probabilistic interpretation of wave function based on Born Rule.

Suggested Readings:

1. A. Beiser, Shobhit Mahajan, "Concepts of Modern Physics: Special Indian Edition", McGraw Hill, 2009,6e
2. H. K. Malik and A.K. Singh "Engineering Physics", McGraw Hill Education (India) Private Limited, 2018,2e.

3. John R. Taylor, Chris D. Zafiratos, Michael A.Dubson, "Modern Physics for Scientists and Engineers", Prentice-Hall of India Private Limited, 2003, 2e
4. R.A. Serway, C.J. Moses, and C.A. Moyer, "Modern Physics", Cengage Learning India Pvt. Ltd, 2004, 3e
5. R. Resnick, "Introduction to Special Relativity", Wiley India Private Limited, 2007
6. R. Murugeshan, Kiruthiga Sivaprasath, "Modern Physics", S. Chand Publishing, 2019, 18e

Part B: Basic Electronics & Introduction to Fiber Optics

UNIT-V **(5 Sessions)**

Transistor Biasing:

Faithful amplification & need for biasing. Stability Factors and its calculation for transistor biasing circuits for CE configuration: Fixed Bias (Base Resistor Method), Emitter Bias (Fixed Bias with Emitter Resistor), Collector to Base Bias (Base Bias with Collector Feedback) & Voltage Divider Bias. Discussion of Emitter-Follower configuration.

UNIT-VI **(6 Sessions)**

Amplifiers:

Classification of amplifiers based on Mode of operation (Class A, B, AB,C & D), Stages (single & multi stage, cascade & cascode connections), Coupling methods (RC, Transformer, Direct & LC couplings), Nature ofamplification (Voltage & Power amplification) and Frequency capabilities (AF, IF, RF & VF). Theory & working of RC coupled voltage amplifier (Uses of various resistors & capacitors, and Frequency response) and Transformer coupled power amplifier (calculation of Power, Effect of temperature, Use of heat sink & Power dissipation).

Calculation of Amplifier Efficiency (power efficiency) for Class A Series-Fed, Class A Transformer Coupled, Class B Series-Fed and ClassB Transformer Coupled amplifiers.

UNIT-VII **(5 Sessions)**

Feedback & Oscillator Circuits:

Knowledge of Feedback Circuits for employability, Effects of positive and negative feedback. Voltage Series, Voltage Shunt, Current Series and Current Shunt feedback connection types and their uses for specific amplifiers. Estimation of Input Impedance, Output Impedance, Gain, Stability, Distortion, Noise and Band Width for Voltage Series negative feedback.

Oscillator Circuits: Use of positive feedback for oscillator operation. Barkhausen criterion for self-sustained oscillations. Feedback factor andfrequency of oscillation for RC Phase Shift oscillator and Wein Bridge oscillator. Qualitative discussion of Reactive Network feedback oscillators (Tuned oscillator circuits): Hartley & Colpitts oscillators.

UNIT-VIII **(6 Sessions)**

Introduction to Fiber Optics:

Basics of Fiber Optics and related skill development, step index fiber, graded index fiber, light propagation through an optical fiber, acceptance angle & numerical aperture, qualitative discussion of fiber losses and applications of optical fibers.

Course Outcomes:

Students completing this course will be able to:

CO1: Recognize the difference between the structure of space & time in Newtonian & Relativistic mechanics.

CO2: Understand the physical significance of consequences of Lorentz transformation equations.

CO3: Comprehend the wave-particle duality in local/ global perspectives.

CO4: Develop an understanding of the foundational aspects of Quantum Mechanics for skill development.
CO5: Study the comparison between various biasing techniques.
CO6: Study the classification of amplifiers for skill development and employability.
CO7: Comprehend the use of feedback and oscillators in local/ global perspectives.
CO8: Comprehend the theory and working of optical fibers along with its applications.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	1	2	1	1	1	1	1	1	1	1
CO 2	1	1	1	1	1	2	1	1	1	1	1	1
CO 3	1	1	2	1	1	1	1	1	1	1	1	1
CO 4	1	1	1	2	2	1	1	1	1	1	1	1
CO 5	1	1	2	1	1	2	1	1	1	1	1	1
CO 6	1	1	3	1	1	1	1	1	1	1	1	1
CO 7	1	1	2	1	1	1	1	1	1	1	1	1
CO 8	1	1	2	1	1	1	1	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	2	1	1
CO3	1	1	1
CO4	1	1	1

Suggested Readings:

1. H. K. Malik and A.K. Singh "Engineering Physics", McGraw Hill Education (India) Private Limited,2018, 2e.
2. R.L. Boylestad, L. Nashelsky, "Electronic Devices and Circuit Theory", Prentice-Hall of India Pvt. Ltd., 2015, 11e
3. J. Millman, C.C. Halkias, Satyabrata Jit, "Electronic Devices and Circuits", McGraw Hill, 2015, 4e
4. B.G. Streetman, S.K. Banerjee, "Solid State Electronic Devices", Pearson Education India, 2015, 7e
5. J.D. Ryder, "Electronic Fundamentals and Applications", Prentice-Hall of India Private Limited, 1975, 5e
6. John M. Senior, "Optical Fiber Communications: Principles and Practice", Pearson Education Limited,2010, 3e
7. John Wilson, John Hawkes, "Optoelectronics: Principles and Practice", Pearson Education Limited, 2018,3e
8. S.L. Gupta, V. Kumar, "Hand Book of Electronics", Pragati Prakashan, Meerut, 2016, 43e

Website sources:

- https://openlearning.mit.edu
- https://www.youtube.com
- http://heecontent.upsdc.gov.in
- https://www.swayamprabha.gov.in

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) II Year- IV Semester
B010402P: Basic Electronics Instrumentation

Objective: To expose students to electronic devices and their evaluation techniques. The students will get a better understanding of the concepts studied by them in the theory course and correlate with experimental observations.

Lab Experiment List **(20 Sessions)**

1. Transistor Bias Stability
2. Comparative Study of CE, CB and CC amplifier
3. Develop skills to design Clippers and Clampers
4. Study of Emitter Follower and related skill development
5. Frequency response of single stage RC coupled amplifier
6. Frequency response of single stage Transformer coupled amplifier
7. Effect of negative feedback on frequency response of RC coupled amplifier
8. Study of Schmitt Trigger
9. Develop skills to study of Hartley oscillator
10. Study of Wein Bridge oscillator

Online Virtual Lab Experiment List

1. Diode as Clippers
2. Diode as Clampers
3. BJT as switch and Load Lines
4. RC frequency response
5. Hartley oscillator
6. Colpitt oscillator
7. Fiber Optic Analog and Digital Link
8. Fiber Optic Bi-directional Communication
9. Wavelength Division Multiplexing
10. Measurement of Bending Losses in Optical Fiber
11. Measurement of Numerical Aperture
12. Study of LED and Detector Characteristics

Course Outcomes:

Students completing this course will be able to:

CO1: Basic Electronics instrumentation has the most striking impact on the industry wherever the components / instruments are used to study and determine the electronic properties.

CO2: Measurement precision and perfection is achieved through Lab Experiments for skill development.

CO3: Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for related local/ global modeling.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	1	1	1	1	1	2	1	1	1	1	1
CO 2	1	1	1	1	2	3	1	2	1	1	1	1
CO 3	1	1	1	1	3	1	2	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	1	1	1
CO2	1	1	1
CO3	2	1	1
CO4	2	1	1

Suggested Readings

1. R.L. Boylestad, L. Nashelsky, "Electronic Devices and Circuit Theory", Prentice-Hall of India Pvt. Ltd., 2015, 11e
2. J. Millman, C.C. Halkias, Satyabrata Jit, "Electronic Devices and Circuits", McGraw Hill, 2015, 4e
3. B.G. Streetman, S.K. Banerjee, "Solid State Electronic Devices", Pearson Education India, 2015, 7e
4. J.D. Ryder, "Electronic Fundamentals and Applications", Prentice-Hall of India Private Limited, 1975, 5e
5. John M. Senior, "Optical Fiber Communications: Principles and Practice", Pearson Education Limited, 2010, 3e
6. John Wilson, John Hawkes, "Optoelectronics: Principles and Practice", Pearson Education Limited, 2018, 3e
7. S.L. Gupta, V. Kumar, "Hand Book of Electronics", Pragati Prakashan, Meerut, 2016, 43e

Website sources:

- http://vlabs.iitkgp.ac.in
- https://vlab.amrita.edu

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) II Year- IV Semester
Course Code: B020401T
Course Title: Quantum Mechanics and Analytical Techniques

Objectives: A main objective of this course is to develop basics skills to understand the atomic structure, elementary quantum mechanics, wave function and its significance ;Schrodinger wave equation and its applications; Molecular orbital theory, basic ideas – Criteria for forming molecular orbital from atomic orbitals, Molecular Spectroscopy, Rotational Spectrum ,vibrational Electronic Spectrum: photo chemistry and kinetics of photo chemical reaction. It is also of great importance to develop basic skills required for purification, solvent extraction, TLC and column chromatography.

UNIT – I: Atomic Structure **(05 Sessions)**

Idea of de-Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrödinger wave equation, significance of Ψ and Ψ^2, quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, d, orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule.

UNIT – II: Elementary Quantum Mechanics **(10 Sessions)**

Elementary Quantum Mechanics : Black-body radiation, Planck's radiation law, photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect. de-Broglie hypothesis. Heisenberg uncertainty principle. Hamiltonian Operator. Schrödinger wave equation (time dependent and time independent) and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box. Schrödinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial wave functions, angular wave functions. Molecular orbital theory, basic ideas – Criteria for forming MO from AO, construction of MO by LCAO – H_2 + ion, calculation of energy levels from wave functions, physical picture of bonding and anti-bonding wave functions, concept of σ, σ^*, π, π^* orbitals and their characteristics.

UNIT – III: Molecular Spectroscopy **(10 Sessions)**

Introduction: Electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom

Rotational Spectrum: Diatomic molecules. Energy levels of a rigid rotor (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell- Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotor, isotope effect.

Vibrational Spectrum: Infrared spectrum: Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, development of skills for force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups.

Raman spectrum: Concept of polarizability, pure rotational and pure vibrational, Raman spectra of diatomic molecules, selection rules. Electronic Spectrum: Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules
and Franck-Condon principle. Application of molecular spectroscopy in interpretation and employability in research and industries.

UNIT – IV: UV-Visible Spectroscopy **(05 Sessions)**

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules. Types of electronic transitions, λmax, chromophores and auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; application of Woodward Rules for calculation of λmax for

the conjugated dienes: alicyclic, homoannular and heteroannular; extended conjugated systems distinction between cis and trans isomers.

UNIT – V: Infrared Spectroscopy (05 Sessions)

Fundamental and non-fundamental molecular vibrations; Hooke's lawselection rule, IR absorption positions of various functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis and and interpretation of I.R. spectra of simple organic compounds.

UNIT – VI: ^{1}H-NMR Spectroscopy (PMR) (10 Sessions)

NMR Spectroscopy: introduction; nuclear spin; NMR active molecules; basic principles of Proton Magnetic Resonance; choice of solvent and internal standard; equivalent and non-equivalent protons; chemical shift and factors influencing it; ring current effect; significance of the terms: up-/downfield, shielded and deshielded protons; spin coupling and coupling constant (1st order spectra); relative intensities of first-order multiplets: Pascal's triangle; chemical and magnetic equivalence in NMR ; anisotropic effects in alkene, alkyne, aldehydes and aromatics; NMR peak area, integration; relative peak positions with coupling patterns of common organic compounds; interpretation of NMR spectra of simple compounds. Applications of IR, UV and NMR spectroscopy for identification of simple organic molecules. Application of NMR Spectroscopy in interpretation of compounds and employability in research and development.

UNIT – VII: Introduction to Mass Spectrometry (03 Sessions)

Principle of mass spectrometry, the mass spectrum, mass spectrometry diagram, molecular ion, metastable ion, fragmentation process, McLafferty rearrangement.

UNIT – VIII: Separation Techniques: Solvent Extraction (07 Sessions)

Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non-aqueous media.

Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods.

Suggested Readings:

1. Alberty, R A, Physical Chemistry, 4th edition Wiley Eastern Ltd, 2001.
2. Atkins, PW, The elements of physical chemistry, Oxford,1991
3. Barrow, G .M, International student Edition. McGraw Hill, McGraw-Hill, 1973.
4. Cotton, F.A, Wilkinson, G and Gaus,P. L , Basic Inorganic Chemistry, 3rd Edition ,Wiley1995
5. Lee, J.D, Concise Inorganic Chemistry 4th Edition ELBS,1977
6. Clayden, J., Greeves, N., Warren, S., *Organic Chemistry*, Second edition, Oxford University Press2012.
7. Silverstein, R. M., Bassler, G. C., Morrill, T. C. *Spectrometric Identification of Organic Compounds*, John Wiley and Sons, INC, Fifth edition.
8. Pavia, D. L. *et al. Introduction to Spectroscopy,* 5th Ed. Cengage Learning IndiaEd.
9. Willard, H.H. *et al.*: *Instrumental Methods of Analysis*, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
10. Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
11. Harris, D.C.: *Exploring Chemical Analysis*, 9th Ed. New York, W.H. Freeman, 2016.
12. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.

Course outcomes:

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

CO1: Describe atomic structure, wave function and its significance; Schrodinger wave equation and its applications.

CO2: Learn elementary quantum mechanics, molecular orbital theory, basic ideas – Criteria for forming molecular orbital from atomic orbitals.

CO3: Development of basic skills to Analyze molecular Spectra such as rotational, vibrational and Raman Spectra

CO4: Learn concepts of electronic spectrum, Woodward-Fieser rules and fundamental laws of spectroscopy.

CO5: Determine various functional groups of organic molecules using IR spectra.

CO6: Determine the structure of organic molecules using NMR spectroscopic techniques for employability at local and national level.

CO7: Skill development to understand the importance of mass spectra in determination of structure of organic compounds.

CO8: Develop basic skills required for purification, solvent extraction, TLC and column chromatography

Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	2	2	2	3	3	1	1
CO2	3	1	1	2	1	2	2	2	3	3	2	2
CO3	3	3	3	2	3	2	2	2	1	1	2	2
CO4	3	3	3	2	1	2	2	2	1	1	2	2
CO5	2	3	3	2	2	2	3	3	1	1	3	3
CO6	2	3	3	2	2	2	1	1	2	2	3	3
CO7	2	3	3	1	3	1	1	3	2	2	3	3
CO8	2	3	3	1	2	2	3	1	2	2	3	3

CO-Curriculum Enrichment Mapping
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	2	1
CO2	3	2	2
CO3	3	2	1
CO4	3	2	1
CO5	3	3	2
CO6	3	3	1
CO7	3	3	1
CO8	3	3	2

Suggested online links:

- https://www.coursera.org/courses?query=chemistry&languages=en
- https://www.mooc-list.com/tags/physical-chemistry
- https://www.coursera.org/learn/physical-chemistry
- https://ocw.mit.edu/courses/chemistry/5-61-physical-chemistry-fall-2017/
- http://heecontent.upsdc.gov.in/Home.aspx
- https://nptel.ac.in/courses/104/108/104108078/

- https://nptel.ac.in/courses/104/108/104108124/
- https://nptel.ac.in/courses/104/106/104106122/

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) II Year- IV Semester
Course Code: B020402P
Course Title: Instrumental Analysis

Objectives: To develop skills for critical thinking and scientific inquiry in the performance, design, interpretation and documentation of laboratory experiments, at a level suitable to succeed at an entry-level position in chemical industry or a chemistry graduate program for development of employability and entrepreneurship.

UNIT – I: Molecular Weight Determination (10 Sessions)

1. Determination of molecular weight of a non-volatile solute by Rast method/ Beckmann freezing point method.
2. Determination of the apparent degree of dissociation of an electrolyte (e.g., NaCl) in aqueous solution at different concentrations by ebullioscopy

UNIT – II: Spectrophotometry (20 Sessions)

1. To verify Beer – Lambert Law for $KMnO_4/K_2Cr_2O_7$ and determining the concentration of the given solution of the substance from absorption measurement
2. Determination of pKa values of indicator using spectrophotometry.
3. Determination of chemical oxygen demand (COD).
4. Determination of Biological oxygen demand (BOD).

UNIT – III: Spectroscopy (10 Sessions)

1. Assignment of labelled peaks in the IR spectrum of the same compound explaining the relative frequencies of the absorptions (C-H, O-H, N-H, C-O, C-N, C-X, C=C, C=O, N=O, C≡C, C≡N stretching frequencies; characteristic bending vibrations are included. Spectra to be provided).
2. Assignment of labelled peaks in the ^1H NMR spectra of the known organic compounds explaining the relative δ-values and splitting pattern.
3. Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy (Spectra to be provided). Application of Spectroscopy in interpretation of synthesized compounds and employability in research and development.

UNIT – IV: Chromatographic Separations (20 Sessions)

1. Paper chromatographic separation of following metal ions: i. Ni (II) and Co (II) ii. Cu(II) and Cd(II)
2. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer Chromatography (TLC)
3. Separation and identification of the amino acids present in the given mixture by paper chromatography. Reporting the Rf values
4. TLC separation of a mixture of dyes (fluorescein and methylene blue) Application of TLC methods of compounds and employability in research and development.

Suggested Readings:

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.*, Pearson, 2009.

2. Willard, H.H. *et al.*: *Instrumental Methods of Analysis*, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
4. Harris, D.C. *Exploring Chemical Analysis*, 9th Ed. New York, W.H. Freeman, 2016.
5. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.
6. Skoog, D.A. Holler F.J. and Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Edition.
7. Mikes, O. &Chalmes, R.A. *Laboratory Handbook of Chromatographic & Allied Methods*, Elles Harwood Ltd. London.
8. Ditts, R.V. *Analytical Chemistry: Methods of separation.* Van Nostrand, New York, 1974.

Course outcomes:

Upon completion of this course will be able to:

CO1: To develop methods for determine molecular weight of a non-volatile solute.

CO2: Apply Beer – Lambert Law for determination of concentration as well as evaluate BOD, COD of any sample.

CO3: Determine the structure of organic molecules using IR and NMR spectroscopic techniques for employability at local and national level.

CO4: Develop basic skills required for purification, solvent extraction, TLC and column chromatography.

Mapping of Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs)
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	1	1	2	1	1	3	3	2
CO2	1	2	3	2	3	3	2	2	2	2	3	1
CO3	1	2	3	2	3	3	2	2	2	2	3	3
CO4	1	2	3	2	1	3	1	2	1	2	3	3

CO-Curriculum Enrichment Mapping
(Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped)

	Skill Development	Employability	Entrepreneurship
CO1	3	3	1
CO2	3	3	3
CO3	3	3	2
CO4	3	3	1

Suggestive online links

- https://www.labster.com/chemistry-virtual-labs/
- https://www.vlab.co.in/broad-area-chemical-sciences
- http://chemcollective.org/vlabs

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) II Year- IV Semester
B030401T: Differential Equations & Mechanics

Objective: - The main aims of this course to provide the solution of second-order linear equations, power series solutions and higher-order linear equations, systems of equations, non-linear equations, Sturm Liouville theory, and applications. An introduction to numerical solutions and applications of differential equations in physics, engineering, biology, and economics are presented. This course covers more material at greater depth than the standard undergraduate-level ODE course also this course are helps the students to develop skills, employability and knowledge of standard concepts in mechanics to become aware of their applications. Both the components of mechanics, namely, statics and dynamics are dealt with in this course. Study of various forces and components.

Part- A
Differential Equations

UNIT-I **(12 Sessions)**

Second order linear differential equations with variable coefficients: Part of C.F. is known, solution to find another, normal form, method of undetermined coefficient, variation of parameters, Series solutions of differential equations, Power series method to provide skills.

UNIT-II **(11 Sessions)**

Bessel, Legendre and Hyper geometric functions and their properties, recurrence and generating relations to provide skills.

UNIT-III **(11 Sessions)**

Origin of first order partial differential equations, Partial differential equations of the first order and degree one, Lagrange's solution, Partial differential equation of first order and degree greater than one, Charpit's method, Surfaces Orthogonal to the given system of surfaces to improve the skills.

UNIT-IV **(11 Sessions)**

Origin of second order PDE, Solution of partial differential equations of the second and higher order with constant coefficients, Classification of linear partial differential equations of second order, Solution of second order partial differential equations with variable coefficients, Monge's method of solution to provide basic knowledge.

Suggested Readings (Part-A Differential Equations):

1. G.F. Simmons, Differential Equations with Application and Historical Notes, Tata–McGraw Hill
2. B. Rai, D. P. Choudhary& H. J. Freedman, A Course of Ordinary Differential Equations, Narosa
3. Ian N. Snedden, Elements of Partial Differential Equations, Dover Publication
4. L. E. Elsgolts, Differential Equation and Calculus of variations, University Press of the Pacific.
5. Suggested digital platform: NPTEL/SWAYAM/MOOCs
6. Course Books (text/reference) published in Hindi may be prescribed by the Universities at local levels.

Part- B
Mechanics

UNIT-V **(12 Sessions)**

Frame of reference, work energy principle, Forces in three dimensions, Poinsot's central axis, Wrenches, Null lines and planes to provide skills**.**

UNIT-VI **(11 Sessions)**

Virtual work, Stable and Unstable equilibrium, Catenary, Catenaries of uniform strength to provide skills.

UNIT-VII **(11 Sessions)**

Velocities and accelerations along radial and transverse directions, and along tangential and normal directions, Simple Harmonic motion, Motion under other law of forces. Elastic strings, Motion in resisting medium, constrained motion, to get skills regarding concepts used in industry for better employment.

UNIT-VIII **(11 Sessions)**

Motion on smooth and rough plane curves, Rocket motion, Central orbits and Kepler's law, Motion of a particle in three dimensions.

Suggested Readings (Part-B Mechanics):

1. R.C. Hibbeler, Engineering Mechanics-Statics, Prentics Hall Publishers
2. R.C. Hibbeler, Engineering Mechanics-Dynamics, Prentics Hall Publishers
3. A. Nelson, Engineering Mechanics Statics and Dynamics, Tata McGraw Hill
4. J. L. Synge & B.A. Griffith, Principles of Mechanics, Tata McGraw Hill
5. Suggested digital platform : NPTEL/SWAYAM/MOOCs
6. Course Books (text/reference) published in Hindi may be prescribed by the Universities at local levels.

Course outcomes:

CO1: The objective of this course is to familiarize the students with various methods of solving differential equations, partial differential equations of first order and second order and to have qualitative applications for skill development.

CO2: A student doing this course is able to solve differential equations and is able to model problems in nature using ordinary differential equations. After completing this course, a student will be able to take more courses on wave equation, heat equation, diffusion equation, gas dynamics, nonlinear evolution equation etc for skill development.

CO3: The object of the course is to give students knowledge of basic mechanics such as simple harmonic motion, motion under other laws and forces for better employment.

CO4: The student, after completing the course can go for higher problems in mechanic such as Hydrodynamics this will be helpful in getting employment in industry.

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	3	3	3	2	3	1
CO2	3	3	3	1	3	2	2	3	2	3
CO3	3	1	3	3	2	2	1	3	3	2
CO4	3	2	3	2	3	3	3	2	1	3

CO- Curriculum Enrichment Mapping

Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	1	1
CO3	3	2	1
CO4	3	2	1

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

Note: Latest editions of all the suggested readings must be used.

Co-curricular course
Bachelor of Science Programme
B. Sc. (PCM) II Year- IV Semester
Course Title: Physical Education and Yoga

Programme: Certificate	Year: First	Semester: Fourth
Co-Curricular Course		
Course Code: Z040401	Course Title: Physical Education and Yoga	

Course outcomes:
Students will earn the introduction of Physical Education, Concept of fitness and wellness, Weight management and life style of an individual. The student will also learn about the relation of Yoga with mental health and value Education. In this course student will also learn about the aspects of the Traditional games of India.

Credits: 2	Compulsory
Max. Marks: 25+75	Min. Passing Marks:

Total No. of Lectures-Tutorials- Practical (in hours per week): L-T-P:2-0-0

Unit	Topics	No. of Lectures Total=30
I	**Physical Education:** • Meaning, Definition, Aim and Objective. • Misconception About Physical Education. • Need, Importance and Scope of Physical Education in the Modern Society. • Physical Education Relationship with General Education. • Physical Education in India before Independence. Education in India after Independence.	6 Theory
II	**Concept of Fitness and Wellness:** • Meaning, Definition and Importance of Fitness and Wellness. • Components of Fitness. • Factor Affecting Fitness and Wellness. **Weight Management:** • Meaning and Definition of Obesity. • Causes of Obesity. • Management of Obesity. • Health problems due to Obesity. **Lifestyle:** • Meaning, Definition, Importance of Lifestyle. • Factor affecting Lifestyle. • Role of Physical activity in the maintains of Healthy Lifestyle.	5 Theory 3Practical

III	**Yoga and Meditation**: • Historical aspect of yoga. • Definition, types scopes &importance of yoga. • Yoga relation with mental health and value education. • Yoga relation with Physical Education and sports. • Definition of Asana, differences between asana and physical exercise. • Definition and classification of pranayama. • Difference between pranayama and deep breathing. • **Practical**: Asana, Suraya-Namaskar, Bhujang Asana, Naukasana, Halasana, Vajrasan, Padmasana, Shavasana, Makrasana, Dhanurasana, Tad Asana. Pranayam: Anulom,Vilom.	2 Theory 6Practical
IV	**Traditional Games of India:** • Meaning; Types of Traditional Games- Gilli-Danda, Kanche, Stapu, Gutte, etc. • Importance/Benefits of Traditional Games. • How to Design Traditional Games. **Recreation in Physical Education:** • Meaning, Definition of Recreation. • Scope and Importance of Recreation. • General Principles of Recreation. • Types of Recreational Activities. • Aerobics and Zumba (Fir India Movement)	2 Theory 6 Practical

Suggested Readings:

- Singh, Ajmer, Physical Education and Olympic Abhiyan, "Kalayani Publishers", New Delhi, Revised Addition, 2006
- Patel, Shrikrishna, Physical Education, "Agrawal Publishers", Agra, 2014-15 Panday, Preeti, Sharirik Shiksha Sankalan, "KhelSanskritiPrakashan,Kanpur

- ❖ Kamlesh M. L.,"Physical Education, Facts and foundations", Faridabad P.B. Publications.
- ❖ B.K.S.Yengar, & quot; Light and Yog. Yoga Deepika & quot, George Allen of Unwin Ltd., London,1981. Braj Bilari Nigam, Yoga Power & quot; TheKpath of Personal achievement & quot; Domen and Publishers,New Delhi, 2001.
- ❖ Indira Devi, " Yoga for You & quot;, Gibbs, Smith Publishers, Salt Lake City,2002 Domen and Publishers, New Delhi-2001.
- ❖ Jack Peter, "Yoga Master the Yogic Powers& quot;, Abhishek Publications, Chandigarh, 2004.JaniceJerusalim, " A Guide To Yoga"ParragonBath,Baiihe-2004.

Suggested Continuous Evaluation Methods:

- Assignments(10)
- Presentation(10)
- Attendance(5)
- Final exam (75)

Suggested equivalent online courses:

- IGNOU.
- Rajarshi Tandan Open University.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year V Semester
BPHY-501: Quantum Mechanics & Atomic Spectra

Objective: The objective of this course is to explain the basic principles and formulations of quantum mechanics**.**

UNIT-I **(10 Sessions)**

Failure of classical physics to explain black body spectra, Planck's radiation law to provide employability & skills, Compton Effect, Wave particle duality, de Broglie's hypothesis, Concept of wave and group velocity, Experimental demonstration of matter waves, Davisson and Germer experiment, Heisenberg's uncertainty principle. Inadequacies of classical mechanics, Photoelectric phenomena, Compton effect, Wave-particle duality, de Broglie matter waves and their experimental verification, Heisenberg's Uncertainty principle, Complementary principle, Principle of superposition, Motion of wave packets .

UNIT -II **(10 Sessions)**

Schrodinger's equation (Time dependent and time independent equations), Physical significance of wave function Ψ, Expectation values of a dynamical quantities, Ehrenfest's theorem, Eigen value and Eigen functions, Particle in a box, Harmonic Oscillator understanding for entrepreneurial skill, One dimensional motion in step potential, Rectangular barrier.

UNIT-III **(10 Sessions)**

Operators, Hermitian operator understanding for entrepreneurial skill, Parity operator, orbital angular momentum operator, Effect of operators, Commutation relations, Eigen values and Eigen functions, Orthonormality, normalization, Dirac Delta function.

UNIT-IV **(12 Sessions)**

Bohr's atomic model, Somerfield elliptic orbits , Effect of finite nuclear mass in relation to Rydberg constant, Vector atom model, Spinning of electron, Space quantization, Selection rules, Pauli's exclusion principal, Larmor precession to provide employability & skills

Course Outcomes:

Students completing this course will be able to:

CO1: Understand the failure of classical physics and explain Compton effect, wave particle duality, de Broglie's hypothesis to develop related skills.

CO2: Derive Schrodinger's equation and understand physical significance of wave function Ψ for local/ global skill development.

CO3: Develop skills to explain Operators, orthonormality, normalization.

CO4: Study Bohr's atomic model, Sommerfeld elliptic orbits. Develop skills to understand Pauli's exclusion principle.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2	1	2	1	1	2	1	1	2	1
CO 2	2	3	1	3	2	3	1	1	2	1	1	1
CO 3	3	2	2	1	1	1	1	1	1	2	1	1
CO 4	2	2	1	1	1	2	1	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	3	1	1
CO3	1	1	1
CO4	2	1	1

Suggested Readings:

1. Quantum Mechanics by L.I. Schiff.
2. Concept of modern Physics by A. Beiser.
3. Quantum mechanics` By Ghatak and Loknathan,
4. Fundamentals of Modern Physics by R.M. Eisberg.
5. Introduction to Atomic Spectra by H.E. White.
6. Quantum Mechanics by Eugen Merzbacher
7. Quantum Mechanics by S P Singh
8. Quantum Mechanics by V K Thankappam
9. Quantum Mechanics by L.D. Landau

Website Source

- https://en.wikipedia.org
- https://ocw.mit.edu
- http://physics.mq.edu.au
- https://faculty.washington.edu
- http://www.nat.vu.nl

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year V Semester
BPHY-502A: Elements of Nuclear Physics

Objective: The aim of the course is to impart knowledge in the content areas of nuclear physics and various decay process for employability skill development.

UNIT -1 **(12 Sessions)**

Basic Properties of the nucleus, Mass/ size (radius), Nuclear spin, Magnetic dipole moment understanding for entrepreneurial skill, Electric Quadrapole moment, Parity, packing friction, Binding energy, Saturation of nuclear forces, Main Characteristics of Nuclear forces, Meson theory of nuclear Forces. Introduction to the nucleus, Fermi gas model, Binding energy, Bethe-Weizsaecker mass formula and its application to explain most stable isobars and nuclear fission, Inferences of nuclear size from elastic electronnucleus experiments (no derivation)

UNIT -II **(10 Sessions)**

Alpha decay, Range of α particle, Geiger Nuttal law, Magnetic spectrometer for energy of α particle, Tunneling, Gamow's theory of α decay for better skilling of entrepreneurship, β- decay, Measurement of energy of β particle and end point energy, Neutrino theory of β- decay, γ- decay, Energy of γ photon.

UNIT -III **(10 Sessions)**

Gas filled counter, Ionization chamber, Proportional counter, Linear accelerators, Cyclotron, Synchrotrons, Geiger Muller detector understanding for entrepreneurial skill, Semiconductor Detector, Scintillation detector.

UNIT - IV **(10 Sessions)**

Classification of elementary particles (Quarks, Strange, Mesons), Quantum Numbers, Yukawa's Theory for better skilling of entrepreneurship, Gell Mann-okubo mass formula.

Course Outcomes:

Students completing this course will be able to:

CO1: Acquire basic knowledge about nuclear properties, binding energy, characteristics of Nuclear forces understanding for entrepreneurial skill.
CO2: Explain various decays and their explanation for better skilling of entrepreneurship.
CO3: Describe principle, working and applications of various counters and accelerators understanding for local/ global entrepreneurial skill.
CO4: Study of elementary particles and their classification for better skilling of entrepreneurship.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	2	1	2	1	1	1	1	2	1	1
CO 2	3	2	1	2	2	1	1	1	1	1	1	1
CO 3	2	3	3	3	1	2	1	2	2	1	1	1
CO 4	2	2	2	1	1	1	1	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1
CO4	2	1	1

Suggested Readings:

1. Nuclear Physics, by- S. N. Ghoshal.
2. Fundamentals of nuclear Physics by- B. B. Srivastava
3. Nuclear Physics by- I. Kaplan
4. Concept of Nuclear Physics by B.L. Cohen
5. Nuclear Physics by –S.B. Patel
6. Nuclear Physics theory and experiment by – R.R. Roy and B.P Nigam
7. Nuclear Physics by D. C. Tayal

Website Sources

- https://www.hep.phy.cam.ac.uk
- http://oms.bdu.ac.in
- http://oregonstate.edu
- https://en.wikipedia.org
- http://www.pas.rochester.edu
- https://science.mcmaster.carad

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year V Semester
BPHY-502B: Biophysics and its Applications

Objective: The course aims at impart knowledge in depth about Biophysics, and its applications for the medical science.

UNIT I Atomic & Molecular structure (10 sessions)

Develop skills to understand basics of Structure of atom-Models & theories, Periodic table, Concept of bonding; valence of carbon; hybridizations of carbon; hybridizations of nitrogen & oxygen; molecular orbital theories, polar & non polar molecules; inductive effect; Secondary bonding: weak interactions, hydrogen bonding; dipole-dipole & dipoleinduced dipole interactions; London dispersion forces. Bonds within molecules-Ionic, covalent, Hydrogen, Electrostatic, Disulphide & peptide bonds, Van-der Waals forces Bond lengths & Bond energies, Bond angles, Structural isomerism; optical isomerism & optical activity.

UNIT II Physico-chemical Foundations (10 sessions)

Biophysics of Water: Physicochemical properties of water, Molecular structure, Nature of hydrophobic interactions, Water Structure. Small-Molecule Solutes: Hydrophiles, Hydrophobes, Large Hydrophobic Solutes and Surfaces, Develop skills to understand basics of Aqueous Environment of the Cell, State of water in bio- structures & its significance, Protein Hydration-Nonspecific Effects, The Hydration Shell. Acid & Bases: Acid-Base theories, Mole concept, Molarity, Molality & Normality, Ampholyte, concept of pH,measurements of pH , Henderson–Hasselbatch equation, Titration curve & pK values, Buffers & Stability of their pH , numerical problems. Redox potential: Oxidation –Reduction, examples of redox potential in biological system.

UNIT III Physical Foundations of Biophysics (10 sessions)

Develop skills to understand basics of Thermodynamics of Biological system: First and second laws of thermodynamics, activation energy. Biological systems as open, non-equilibrium systems, Concept of free energy, unavailable energy and entropy, heat content of food, bomb calorimetry, Enthalpy, Negative entropy as applicable to biological systems. Thermodynamics of passive and active transport, glycolytic oscillations, biological clocks. Bioenergetics: Concept of energy coupling in biological processors, Energy requirements in cell metabolism, structure and role of mitochondria, high energy phosphate bond, energy currency of cell, Biological oxidation, Electron-transport chain, Oxidative Phosphorylation including chemiosmotic hypothesis. Thermodynamic analysis of TCA cycle and oxidative phosphorylation.

UNIT IV Biomolecules as molecular alphabets of life (10 sessions)

Nucleic acids: Purine and Pyrimidine bases, nucleosides, nucleotides, basic differences in structure and function of RNA and DNA Amino acids & Proteins: Amino acid general structure & types, peptide bond, Develop skills to understand basics of Structure of Proteins - primary, secondary, tertiany and quarternary , Carbohydrates : Structure and function of mono, di ,oligo and polysaccharides, Structure of D-glucose & D-fructose; formation of glucosides & the cyclic structure of Dglucose; Structure and conformation of diasacharides and polysaccharides- cellulose, amylopectin & glycogen,Chitin. Lipids: Defination: Types of lipids; Triglycerides , fatty acids,

Fats & oils, Phospholopids, Glycolipids; lipoproteins, Structure, Function and Localization Vitamins & hormones: Structure, classification & function.

UNIT V Applications (6 sessions)

Medical Applications, Develop skills to understand basics of Environmental Applications, Protein engineering, Membrane biophysics, Radiation biophysics.

Suggested Readings

1. Biophysics - An Introduction by Rodney Cotterill (Wiley)
2. Biophysics by W.Hoppe W. Lohmann, H. Markl, H. Ziegler (Springer)
3. The Biophysical Chemistry of Nucleic Acids & Proteins by Thomas E. Creighton (Helvetica Press)
4. The Physical and Chemical Basis of Molecular Biology by Thomas E. Creighton (Helvetica Press)

Course Outcomes:

CO1: Understand Developed skill for Molecular structure
CO2: Explain Physico-chemical Foundations
CO3: Develop skills to Understand Physical Foundations of Biophysics
CO4: Understand Biomolecules as molecular alphabets of life
CO5: Explain various applications of biophysics

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	2	2	2	1	2	1	1	1	2	1	1
CO 2	1	3	3	3	2	1	2	1	2	2	1	1
CO 3	1	2	1	2	2	1	1	1	1	1	2	1
CO 4	2	2	1	2	1	1	1	1	1	2	2	1
CO 5	1	2	1	2	2	1	1	1	2	2	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	2	1	1
CO3	1	1	1
CO4	1	1	1
CO5	1	1	1

Website

- https://science.jrank.org/pages/898/Biophysics.html
- https://iopscience.iop.org/article/10.1088/0953-8984/13/21/322/meta
- http://www.scienceclarified.com/Bi-Ca/Biophysics.html
- https://www.physicsforums.com/threads/applications-of-biophysics.265839/
- https://encyclopedia.pub/257
- https://www.academia.edu/8401415/How_essential_is_biophysics_to_progress_in_biology

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year V Semester
BPHY-502C: Condensed Matter Physics

Objective: This course introduces the basic concepts and principles required to understand the various properties exhibited by condensed matter, especially solids. The gained knowledge helps to solve problems in solid state physics using relevant mathematical tools.

UNIT – I Band Theory of Solids (8 Sessions)

Band Theory of Solids: Density of states, K-space, Bloch wave, Bloch theorem, The Kronig-Penny model, origin of energy gap, Brillouin zones, Number of wave functions per energy band, Motion of electrons in one dimensional- according to band theory, Develop skills to understand the Distinction between metals, insulators and intrinsic semiconductors.

UNIT- II Theory of Dielectrics (10 Sessions)

Theory of Dielectrics, Piezoelectricity and Ferroelectrics: Explanation of Polarization, Dielectric constant, Local electric field, Dielectric polarizability, Clausius-Mossoti Relation, Types of polarizability, Frequency dependence of dipolar polarizability, Calculation of Ionic & Electronic polarizability, Total polarizability, Measurement of dielectric constants. Piezoelectricity, Ferro electricity, Theories of ferroelectricity, Dielectric behavior above Tc, Spontaneous polarization below Tc, Ferroelectric Hysteresis, Develop skills to understand the Applications of ferroelectrics.

UNIT- III Magnetism (10 Sessions)

Magnetism: Introduction, Classification of magnetic materials. Diamagnetism: Lagevin's classical theory of diamagnetism. Paramagnetism- Origin of permanent magnetic moments in paramagnetism, Lagevin's classical theory of paramagnetism. Weiss theory of paramagnetism, comparison of theory with experimental results. Paramagnetism at low temperature. Develop skills to understand the basics of Ferromagnetism, Antiferromagnetism and ferrimagnetism: Weiss theory of ferromagnetism, ferromagnetic domains, Bloch wall, Neel's model of ferrimagnetism.

UNIT- IV Superconductivity (6 Sessions)

Develop skills to understand the basics of Superconductivity and its employability: Basic Concept, Occurrence, Meissner effect, Critical field, type-I, type-II superconductors, Critical currents, Thermodynamics of super conducting transitions, London equations, Coherence length, London penetration Depth, BCS theory of superconductivity, High Tc super conducting materials.

UNIT-V Nanomaterials (8 Sessions)

Introduction to Nanostructure Materials: Develop skills to understand the basics of Nano science & nanotechnology, Size dependence of properties, Moor's law, Surface energy and Melting point (quasi melting) of nanoparticles, Conducting polymers, Graphene.

Change band structure of nanomaterials: Change in energy gap, Density of Structure distribution, Effective masses and Fermi surfaces, Localized particles, Donors, Acceptors and Deep traps, Mobility, Excitons, Density of states, and Variation of density of states with energy and Size of crystal

Suggested Readings:

1. Introduction to Solid State Physics by C. Kittle.
2. Solid State Physics by A. J. Dekkar.

3. Solid State Physics by S.L. Gupta & V. Kumar.
4. Solid State Physics by R. L. Katiyar.
5. Solid State Physics by S.O. Pillai
6. Solid State Physics by R. K. Puri and V. K. Babbar

Course Outcomes:

Students completing this course will be able to:

CO1: Develop skill to understand the Bloch theorem, The Kronig-Penny model and understar thee concept of reciprocal space lattice and know the significance of Brillouin zones.

CO2: Describe the dielectric properties and Polarizability and also its employability.

CO3: Explain various types of magnetic phenomenon, physics behind them, their propertie applications and understand the origin of dia-, para-, and ferro-magnetic properties solids.

CO4: Develop skills to understand superconductivity.

CO5: Understand the basics of Nanoscience and Nanotechnology

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	3	2	1	1	1	2	1	1	1	2	1
CO 2	1	2	2	3	1	2	1	1	1	1	2	1
CO 3	1	3	1	3	2	1	1	1	1	1	1	1
CO 4	1	2	3	2	1	2	1	1	2	1	1	1
CO 5	1	1	1	2	1	3	1	1	2	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	1	1	1
CO3	2	1	1
CO4	2	1	1
CO5	1	1	1

Website Sources:

- https://lampx.tugraz.at
- http://www.egyankosh.ac.in
- https://www.phys.sinica.edu.tw
- http://bvcoend.ac.in
- http://www.irm.umn.edu
- https://en.wikipedia.org
- http://ecoursesonline.iasri.res.in

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year V Semester
BPHY-551: Physics Laboratory – 5

Objective: The main goal of this subject is to share the knowledge to the students about the experiments. The students will get a better understanding of the concepts studied by them in the theory course and correlate with experimental observations for skill development.

List of Experiments **(20 Sessions)**

1. Measurement of Hybrid parameter of a transistor to understand its employability scopes.
2. To study the resonance in series LCR circuit with source of given frequency (A.C. mains).
3. To study and plot the characteristic of L.D.R to understand its employability scopes.
4. To study the FET amplifier in CS configuration.
5. To study the integrator circuit and observe the effect of RC upon fixed time form.
6. To draw the characteristic of Zener diode in reverse and forward bias voltage.
7. Obtain skills to measure certain UJT parameters and study the operation of UJT relaxation oscillator.
8. To Study the ripple factor in a D.C. power supply.
9. To study the characteristics of a Tunnel diode to understand its employability scopes.
10. To study emitter follower/ Darlington pair amplifier.
11. Determination of Young's modulus, modulus of rigidity and Poisson's ratio of material of a wire using Searle's method.
12. Determination of absolute capacity of a condenser.

Course Outcomes:

Students completing this course will be able to:

CO1: Evaluate hybrid parameters of transistors to understand its employability scopes.

CO2: Plot characteristics of L.D.R., FET, Tunnel diode and Zener diode to understand their employability scopes.

CO3: Evaluate ripple factor to understand its employability scopes.

CO4: Evaluate UJT parameters to understand its employability scopes.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	3	2	1	2	1	2	1	1	1	1	1
CO 2	3	1	3	2	3	1	1	2	1	1	1	1
CO 3	1	3	1	3	1	2	1	2	1	1	1	1
CO 4	1	2	2	2	1	1	1	1	1	1	1	1
CO 5	1	1	1	1	1	1	1	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	2	1	1
CO2	1	1	1
CO3	3	1	1
CO4	1	1	1

Suggested Books:

1. Solid State Physics- A. J. Dekkar, McMillan
2. Solid State Physics - S. L. Gupta & V. Kumar, K. Nath & Co. Meerut
3. Fundamentals of Solid State Physics-B. S. Saxena, R. C. Gupta & P. N. Saxena
4. Solid State Physics by R. K. Puri

Website Sources

- https://www.learncbse.in
- https://www.electronicshub.org
- http://amrita.vlab. edu
- https://www.niser.ac.in

Note: Latest editions of all the suggested readings must be used

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year V Semester
BCHE-501 -INORGANIC CHEMISTRY

Objectives: This course develops skills for production, chemistry and properties of the transition metals, lanthanides and actinides. Specifically, the class introduces electron configurations for the elements and oxidation state trends for each group. Including bonding and isomerism in coordination compounds, crystal field theory, and electronic properties of ligands. Also cover metal bonding in clusters, the HSAB concept, chelate effect, and complex stability.

Unit – I **(09 Sessions)**

Transition Metal Complexes:

Limitations of valance bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planner complexes, factors affecting the crystal-field parameters.

Stability of metal complexes and factors affecting the stability, stability constants of complexes and their determination. Role of transition metals in employability in manufacturing industries.

Unit – II **(09 Sessions)**

Magnetic Properties of Transition Metal Complexes:

Types of magnetic behavior, methods of determining magnetic susceptibility, spin-only formula, L-S coupling, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes.

Unit – III **(09 Sessions)**

Metal carbonyls, Silicones and Phosphazenes

Metal carbonyls: 18 electron rule, preparation, structure and nature of bonding in the mononuclear carbonyls. Silicones and phosphazenes as examples of inorganic polymers.

Unit – IV **(09 Sessions)**

Hard and Soft Acids and Bases (HSAB)

Classification of acids and bases as hard and soft, Pearson's HSAB concept, acid-base strength and hardness and softness, Symbiosis, theoretical basis of hardness and softness, electro negativity and hardness and softness. Water softening methods and its importance for employability in industries

Suggested Readings:

1. Inorganic Chemistry by J. E. Huheey.
2. Basic Inorganic Chemistry by Cotton and Wilkinson.
3. Concise Inorganic Chemistry by J. D. Lee.
4. The Organometallic Chemistry of Transition Metals: John Wiley.

Course Outcomes:

Students completing this course will able to:

CO1: Gain knowledge of crystal field theory &relative stability about coordination complexes.

CO2: Describe the magnetic behavior of transition metal complexes

CO3: Understand nature and bonding in metal carbonyl, silicones and phosphazenes.

CO4: Apply the concept of hard and soft acids and bases to explain feasibility of reactions for skill development to get local employability

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	3	2	3	2	2	3	2	2	2
CO2	2	2	3	3	2	3	2	2	3	3	2	2
CO3	2	2	3	3	2	3	2	2	3	2	2	1
CO4	2	1	3	3	3	3	1	1	3	3	2	2

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship
CO1	3	2	1
CO2	3	2	2
CO3	3	2	1
CO4	3	2	1

Web Sources:

- www.chem.tamu.edu
- www.academia.edu
- www.amu.ac.in
- www.chem.tamu

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year V Semester
BCHE-502: ORGANIC CHEMISTRY

Objective: To Predict and explain patterns in shape, structure of organic compounds. To give idea about synthesis and reactivity for carbohydrates. To provide explanation of the chemistry of amino acids and proteins to understand the concepts of organic chemical structure and bonding and stability found in fats and oils and its importance for employability in food & chemical sector.

Unit – I **(09 Sessions)**

Spectroscopy

Nuclear magnetic resonance (NMR) spectroscopy, Proton magnetic resonance (^{1}H- NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of 1H NMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1, 1, 2-tribromoethane, ethyl acetate, toluene and acetophenone, Problems pertaining to the structures elucidation of simple organic compounds using UV, IR and ^{1}H NMR spectroscopic, techniques. Application of NMR to develop employability in research and development.

Unit – II **(09 Sessions)**

Carbohydrates

Classification and nomenclature, Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Conversion of glucose intro mannose, Skill development in formation of glcosides, Determination of ring size of monosaccharides, Structures of ribose and deoxyribose.

An introduction to disaccharides (maltose, sucrose and lactose)

Unit – III **(09 Sessions)**

Amino Acids, Peptides and Proteins:

Classification, structure and stereochemistry of amino acids, Acid-base behavior isoelectric point and electrophoresis, Preparation and reactions of - amino acids, classification and structure of proteins, selective hydrolysis of peptides, Protein denaturation/renaturation.

Unit – IV **(09 Sessions)**

Fats, Oils and Detergents

Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils, Saponification value, iodine value, acid value, Soaps, synthetic detergents. Importance for employability in research and development and entrepreneurship.

Suggested Readings:

1. Biochemistry: L. Steyer, Freeman and Co. New York.
2. Organic Synthesis: M. B. Smith, McGraw Hill, New York.
3. Advanced Organic Chemistry Reaction, Mechanism and Structure, M.B. Smith and J. March, John Wiley and Sons, New York.

Course Outcomes:

Students completing this course will able to:

CO1: Development of skills to analyze the structure of organic compound based on UV, IR and ^{1}H NMR spectroscopy for employability in local and national industries

CO2: Understand classification, nomenclature, preparation of monosaccharides and its role in employability.
CO3: Learn the synthesis and properties of amino acids, peptides and proteins.
CO4: Explore the knowledge about effects of fats, oils and detergents for useful applications and and its role in entrepreneurship.

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	2	3	2	2	3	3	2	3
CO2	2	2	3	3	2	3	3	2	3	2	2	2
CO3	2	3	3	3	2	3	3	1	3	2	2	2
CO4	2	2	3	3	1	3	2	3	3	3	2	3

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship
CO1	3	2	2
CO2	3	2	2
CO3	3	2	2
CO4	3	3	3

Web Sources:

- www.structbio.ptt.edu>notes>nmr_ref_notes-2011
- www.academia.edu>CHE_320_organic_spectroscopy
- www.chtf.stuba.sk>files>Carbohydrates_Boudreaux
- https://nptel.ac.in/content/storage2/courses/104103071/pdf/mod11.pdf

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year V Semester
BCHE-503A: Surface Chemistry
Elective Course

Objectives: To familiarize students with the concepts of surface chemistry for their skill development. The students will learn about methods for the characterization of surfaces to get employability.

UNIT-I **(09 Sessions)**

The gas-solid interphase, types of adsorption. Heat of adsorption and its determination, differences between chemisorptions and physisorption for skill development.

UNIT-II **(09 Sessions)**

Adsorption isotherms - Freundlich and Langmuir isotherms. Thermodynamic and statistical derivation of Langmuir adsorption isotherm. Multilayer adsorption-the BET theory and Harkins-Jura theory.

UNIT-III **(09 Sessions)**

Determination of surface area of solids-Harkins–Jura absolute method, point B method, Langmuir method and BET method. Surface films-different types, surface pressure and its measurement.

UNIT-IV **(09 Sessions)**

Adsorption from solutions: Gibb's adsorption equation and its verification. Adsorption with dissociation. Adsorption with interaction between adsorbate molecules.

Suggested Readings:

1. The Surface Science of Metal Oxides, Victor E. Henrich, P. A. Cox, Cambridge University Press; New Ed edition, 1996.
2. Current Trends of Surface Science and Catalysis, Jeong Young (Ed.) Park (Author), Jeong Young Park(editor), 1st Edition, Springer, 2013.
3. Handbook of Heterogenous Catalysis, G. Ertl, H. Knozinger, F. Schuth, J. Weitkamp, WILEY-VCH Verlag GmbH & Co. KGaA, ISBN 978-3-527-31241-2
4. Nanotechnology in Catalysis, Spinger,; ISBN-0387-34687-2; Edited by G A Somorjai Vol-1-3
5. Nanostructures and Nanomaterials, Cao and Wang, 2nd Edition, World Scientific Publishing Company, 2011.

Course Outcomes:

Students completing this course will able to:

CO1: Develop skills to determine the heat of adsorption and differentiate chemisorption and physisorption

CO2: Understand Freundlich, Langmuir and BET isotherm and their role in employability.

CO3: Learn the methods of determination of surface area of solids.

CO4: Understand Gibb's adsorption equation and its verification and and its employability applications.

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	2	3	2	2	3	3	2	3
CO2	2	2	3	3	2	3	3	2	3	2	2	2
CO3	2	3	3	3	2	3	3	1	3	2	2	2
CO4	2	2	3	3	1	3	2	3	3	3	2	3

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship
CO1	3	2	2
CO2	3	2	2
CO3	3	2	2
CO4	3	3	3

Website Sources:

- http://www.chemguide.co.uk/
- https://freebookcentre.net/

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year V Semester
BCHE-504A: Metal-Pi Complex & Cluster
Elective Course

Objectives: After studying this module, students will be able to know about metal cluster compounds, preparative methods for metal cluster compounds, various types of reactions of metal cluster compounds for employability skills.

UNIT-I **(09 Sessions)**

Electronic Spectra and Magnetic Properties of Transition Metal Complexes -I Electronic arrangements of microstates, calculation of the number of microstates in various electronic arrangements, spectroscopic term symbols, vector diagrams to indicates coupling of orbital angular momenta in p^2 , p^3, d^2 configurations and spin orbit coupling for p^2 arrangement, spectroscopic terms, spectral terms of d^2 to d^8 metal ions, determining the ground state terms - Hund's rules, derivation of the term symbol for a closed subshell.

UNIT-II **(09 Sessions)**

Electronic Spectra and Magnetic Properties of Transition Metal Complexes -II Interpretation of electronic spectra, Orgel diagrams, Tanabe-Sugano diagrams for transition metal complexes (d^1 – d^9 states), calculations of Dq, B and β parameters, charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information, magnetic moment calculations spin only, orbital contribution quenching of magnetic moment, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

UNIT-III **(09 Sessions)**

Metal л-Complexes Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding, structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; Carbonyl cations and anions and carbonyl hydrides; tertiary phosphine as ligand.

UNIT-IV **(09 Sessions)**

Metal Clusters: Higher boranes, structure types, nido, arachano, closo etc structure prediction of boranes using STYX formulae, Wades rule, Wades Mingo rules, Isolobal analogy, carboranes, metalloboranes and metallocarboranes. Metal carbonyl and halide clusters, compounds with metal-metal

Suggested Readings:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harper & Row.
3. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
4. Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Pergamon.
5. Introduction to Ligand fields; B.N. Figgis, Wiley, New York.
6. Modern Aspects of Inorganic Chemistry; H.J. Emeleus and Sharpe.
7. Introduction to Ligand Field Theory; C. J. Ballahyen, McGraw Hill, New York.
8. Organometallic Chemistry; R.C.Mehrotra and A.Singh, New Age International.

Course Outcomes:

Students completing this course will able to:

CO1: Develop skills to determine the magnetic properties of transition metal complexes

CO2: Interprete electronic spectra, Orgel diagrams, Tanabe-Sugano diagrams for skill development.

CO3: Learn the vibrational spectra of metal carbonyls for bonding and structural elucidation.

CO4: Predict structure of boranes using STYX formulae.

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	2	3	2	2	3	3	2	3
CO2	2	2	3	3	2	3	3	2	3	2	2	2
CO3	2	3	3	3	2	3	3	1	3	2	2	2
CO4	2	2	3	3	1	3	2	3	3	3	2	3

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship
CO1	3	2	2
CO2	3	2	2
CO3	3	2	2
CO4	3	3	3

Website Sources:

- https://nptel.ac.in/course.html
- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year V Semester
BCHE-505A: Structure & Reactivity
Elective Course

Objectives: To develop an understanding and appreciation of both structure and chemical transformations of organic molecules. Students will acquire basic concepts of electronic structure and be able to apply them to solve problems from various areas of organic chemistry, including stereochemistry, reactivity patterns and synthesis for skill development.

UNIT-I **(09 Sessions)**

Nature of Bonding in Organic Molecules: Localised and Delocalized covalent bonds, Delocalised chemical bonding conjugation, cross conjugation, hyper conjugation, Tautomerism. Aromaticity: Concept of Aromaticity for skill development, Aromaticity of five membered, six membered rings and fused systems.- Non benzenoid aromatic compounds-cyclopropenylcation, Cyclobutadienyl dication, cyclopentadienyl anion-tropyllium cation and cyclooctatetraenyl dianion. Homo aromaticity, Anti aromaticity and pseudo aromaticity.

UNIT-II **(09 Sessions)**

Reactive Intermediates: Generation, Structure, Stability, Detection and Reactivity of Carbocations, Carbanions, Free radicals, Carbenes, Nitrenes and Arynes. B) Reactive Species: Generation and reactivity of Electrophiles, Nucleophiles, Dienophiles, Ylids, Enophiles.

UNIT-III **(09 Sessions)**

Aliphatic Nucleophilic Substitutions: The SN^2 , SN^1 , mixed SN^1 and SN^2 and SN^i reactions: Mechanism, factors effecting substitution reactions. The neighbouring group mechanism, anchimeric assistance by σ and π bonds.

UNIT-IV **(09 Sessions)**

Additions: Addition to carbon – carbon multiple bonds, HX, X_2, stereo chemistry of addition, formation and reaction of epoxides, syn and anti-hydroxylation, hydrogenation (catalytic and Non catalytic), Cram's rule, Synthetic Reactions involving C-O and C-N bond.

Suggested Readings:

1. Advanced organic chemistry, Reaction, mechanism and structure, Jerry March, John Wiley.
2. Advanced organic chemistry, F.A.Carey and R.J.Sundberg, Springer , New York.
3. A guide book to Mechanism in organic chemistry, Peter Sykes, Longman.
4. Organic chemistry, I.L.Finar, Vol. I & II, Fifth ed. ELBS, 1975.
5. Organic chemistry, Hendrickson, Cram and Hammond (McGraw – Hill).
6. Modern organic Reactions, H.O.House, Benjamin.
7. Structure and mechanism in organic chemistry, C.K.Ingold, Cornell University Press.
8. Principles of organic synthesis, R.O.C.Norman and J.M.Coxon, Blakie Academic & Professional.

Course Outcomes:

Students completing this course will able to:

CO1: Develop skills to predict the aromatic nature of a molecule

CO2: Understand various kinds of reaction intermediates and their properties.

CO3: Learn various aspects of aliphatic nucleophilic substitution reactions for employability.
CO4: Understand the mechanism and reactions for addition to carbon – carbon multiple bonds.

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	2	3	2	2	3	3	2	3
CO2	2	2	3	3	2	3	3	2	3	2	2	2
CO3	2	3	3	3	2	3	3	1	3	2	2	2
CO4	2	2	3	3	1	3	2	3	3	3	2	3

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship
CO1	3	2	2
CO2	3	2	2
CO3	3	2	2
CO4	3	3	3

Website Sources:

- http://www.chemguide.co.uk/
- https://freebookcentre.net/

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year V Semester
BCHE-551-CHEMISTRY PRACTICAL

Objectives: Chemistry lab includes basic laboratory operation, separation and purification of organic compounds for honors students. Skill development to identify simple and fractional distillation, precipitation and crystallization, sublimation, solid-liquid and liquid-liquid extraction, and chromatography and role in entrepreneurship and employability.

(20 Sessions)

1. Estimation of Copper by gravimetric method.
2. Estimation of Nickel by gravimetric method.
3. Synthesis of hydrogel by co-precipitation method.
4. Synthesis of metal nanoparticles.
5. Determination of saponification value of an oil or Fat.
6. Determination of Iodine value of an oil or fat.
7. Preparation of Aspirin/Ibuprofen.
8. Preparation of Antacid.
9. Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide
10. Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

Course outcomes:

Students completing this course will able to:

CO1: Estimate metal ions in a solution using gravimetric analysis.

CO2: Skill development to understand the synthetic process of nano materials for employability at local and national industrial sector.

CO3: Learn the synthesis of drugs.

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**2**	**2**	**3**	**1**	**2**	**2**	**3**	**3**	**2**	**3**
CO2	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**2**	**3**
CO3	**3**	**3**	**3**	**2**	**1**	**1**	**3**	**2**	**3**	**3**	**2**	**3**

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship
CO1	3	3	1
CO2	3	3	2
CO3	3	3	2

Suggested readings:

1. A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
2. A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
3. A.I. Vogel: Textbook of Practical Organic Chemistry, Prentice Hall, 5th Edn.

4. F. G. Mann & B. C. Saunders: Practical Organic Chemistry, Orient Longman (1960). MUniversity.

Web Sources

- http://www.freebookcentre.net/Chemistry/InOrganic-Chemistry-Books.html
- http://www.freebookcentre.net/Chemistry/InOrganic-Chemistry-Books.html
- http://onlinelabs.in/chemistry

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year V Semester
BMAT-501: LINEAR ALGEBRA

Objective: - The main aims of this course are to enables the students to understand the basic ideas of vector algebra, linear dependent and independent set, basis, the fundamental properties of eigenvalue, eigenvectors of a linear transformation various types of real quadratic forms and their applications to be familiar with the notion of inner product space and orthogonal vectors to provide employability & skills.

UNIT-1 **(10 Sessions)**
Theory of sets, Relations and functions, Binary composition, Vector spaces and their elementary properties for skill development

UNIT-2 **(10 Sessions)**
Subspaces, Linear dependence and independence, Spanning set, Basis and dimension, Direct sum, Quotient space for skill development

UNIT-3 **(10 Sessions)**
Linear transformations and their algebra, Range and null space, Rank and nullity, Rank-nulity theorem, Matrix representation of linear transformations, Change of basis understanding for entrepreneurial skill,

UNIT-4 **(08 Sessions)**
Linear functions, Dual space, Bi-dual space, Natural isomorphism, Annihilators, Bilinear and quadratic forms for skill development and employability.

UNIT-5 **(12 Sessions)**
Inner product spaces, Cauchy-Schwarz's inequality, Bessel's inequality and orthogonality, Hermitian, Unitary, Normal transformations and their diagonalizations for skill development

Course Outcomes:

CO1: Define basic terms and concepts of matrices, vectors and complex numbers for skill development

CO2: Use of various forms of complex numbers to solve numerical problems for skill development

CO3: Apply the matrix calculus in solving a system of linear algebraic equations for entrepreneurship.

CO4: Use matrix algebra and the related matrices to linear transformation skill development and employability.

CO5: Calculate the area of planar shapes (triangle, parallelogram) and the volume of parallelepiped using vector algebra for skill development.

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	2	3	2	3	2	3
CO2	2	1	2	3	3	3	3	3	3	2

CO3	3	3	2	2	1	2	3	1	2	1
CO4	3	3	3	1	3	1	2	3	2	2
CO5	3	2	3	3	3	1	3	3	3	1

CO- Curriculum Enrichment Mapping

Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	**Employability**	**Entrepreneurship**
CO1	3	1	1
CO2	3	2	1
CO3	3	1	1
CO4	3	2	1
CO5	3	2	1

Suggested Readings:

1. A. R. Vashistha: Linear Algebra, Krishna Publication, Meerut.
2. N. P. Balli: Linear Algebra, Golden Book.
3. Hoffmann kunze: Linear Algebra, PHI Learning Pvt.
4. David C. Lay: Linear Algebra and its applications, Pearson India.

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year V Semester
BMAT-502: LINEAR PROGRAMMING

Objective: -The main aims of this course are to help in solving problems in different environments that needs decisions to formulate linear programming. This module aims to introduce students to use quantitative methods and techniques effective for assignment and transportation problems, game theory, model formulation and applications that are used in solving business decision problems as well as various fields of science to provide employability & skills.

UNIT – 1 **(12 Sessions)**
Linear Programming Problems: Definition of Linear Programming (LP), Terminology and requirements of LP, Advantages of LP, Limitations of LP, Application areas of LP, General mathematical formulation of LPP, Graphical method for solving LPP, Simplex method, and Big-M method understanding for entrepreneurial skill,

UNIT – 2 **(10 Sessions)**
Duality in Linear Programming: Definition, Formulation of dual problems, Advantages of duality, Characteristics of dual problem, Construction of the dual problem, Solution of the prime and dual problems and Dual simplex method for skill development.

UNIT – 3 **(10 Sessions)**
Transportation Problem: Definition, Transportation models, Linear programming formulation of transportation problem, Method for finding the initial solution by North -West corner method, least cost entry method, Row minima method, Column minima Method, Vogel's approximation method, unbalanced problem, Degeneracy problem, Test for optimality knowledge for better employability in industry

UNIT – 4 **(10 Sessions)**
Assignment Problems: Definition, Assignment models, Hungarian method of assignment problem (minimization case), Maximization case in assignment problem, unbalanced assignment problem and Restrictions on assignments.
Job Sequencing Problem: Definition, Notations, Terminology, Assumptions, Processing n jobs through two machines, processing n jobs through three machines, processing n jobs through m machines knowledge for better employability in industry

UNIT – 5 **(08 Sessions)**
Game Theory: Definition, Pay-off, Types of games, The maximine - minimax principle, Principles of dominance to develop skill Games without saddle points (Mixed strategies), Solution of games by Graphical method and Linear programming method for skill development.

Course Outcomes:
CO1: Formulate real-world problems as a linear programming model and describe the theoretical workings of the graphical and simplex method to demonstrate the solution process for entrepreneurship.
CO2: Explain the relationship between a linear program and its dual, including strong duality for skill development.

CO3: Formulate specialized linear programming problems as transportation problems for entrepreneurship

CO4: Formulate specialized linear programming problems as assignment problems for skill development and employability.

CO5: Demonstrate solution methods including graphs and linear programming to analyze and solve the Two-person, zero-Sum Games for skill development and employability.

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	2	3	2	2	2	3
CO2	2	1	2	3	3	3	3	3	3	2
CO3	3	3	2	2	1	2	3	1	2	3
CO4	3	3	3	1	3	3	2	3	2	2
CO5	3	2	3	3	3	1	3	3	3	1

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	2
CO3	3	2	2
CO4	3	2	1
CO5	3	1	1

Suggested Readings:

1. H. A. Taha: Operations Research an introduction, Macmillan.
2. J. K. Sharma: Operations Research Theory and Applications, Macmillan India Ltd.
3. V. K. Kapoor: Operations Research, Sultan Chand and Sons, New Delhi.
4. S. D. Sharma: Operations Research, Kedarnath & Ramnath and Company.

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year VI Semester
BPHY-601: Solid State and Nano Physics

Objective: The aim of the course is to impart knowledge of basic theory of solid state structure and nano physics.

UNIT -I **(10 Sessions)**

Crystalline and glassy forms, liquid crystal, Crystal structure, periodicity, lattice and basis, Crystal translational vector, Unit cell and primitive cell, Wigner Seitz cell, Develop Skills to understand Bravais lattices in two or three Dimensional, packing fraction. Crystal structures of s.c., b.c.c, f.c.c, diamond and h.c.p. Reciprocal lattices: s.c., b.c.c, and f.c.c. lattices, Brillouin Diffraction conditions in reciprocal lattice, Bragg's law.

UNIT II **(10 Sessions)**

Crystal Planes and Miller indices, Interplaner Spacing, Crystal structures-NaCl, Diamond, CsCl and ZnS.

Develop Skills to understand X-ray diffraction, Bragg's law and Bragg's diffraction conditions in direct and reciprocal lattice, K-Space.

UNIT -III **(10 Sessions)**

Develop Skills to understand Reciprocal lattice, Reciprocal Lattice Vectors, Reciprocal Lattice to the simple cubic lattice, b.c.c and f.c.c., Specific heat of solids, Einstein's theory of specific heat, Debye model of specific heat of solids.

UNIT -IV **(12 Sessions)**

Introduction to NanoScience and Nanotechnology, Difference between nanomaterials and bulk materials, Reduction of dimensions 3D, 2D, 1D, 0D materials, various morphologies of Nanomaterials, Bottom up and top down approaches, size dependent physical properties, Develop Skills to understand Nano-cluster and its employability.

Course Outcomes:

Students completing this course will be able to:

CO1: Understand crystal structure, Bravais lattices in two and three dimensions for local/global employability opportunities

CO2: Study crystal structure of NaCl, Diamond, CsCl and ZnS for skill development.

CO3: Relate crystalline structure to X-ray diffraction data and the reciprocal lattice and understand the influence of crystal binding energy on crystalline structure for skill development.

CO4: Understand NanoScience and Nanotechnology, properties and applications of nanomaterials for employability.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	2	3	1	1	2	2	1	1	1	1	1
CO 2	3	3	2	2	1	1	1	1	1	2	1	1
CO 3	1	3	2	2	1	1	2	1	1	2	1	1
CO 4	3	2	3	1	3	2	1	2	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1
CO4	2	1	1

Suggested Readings:

1. Introduction to solid state Physics by Kittel .John Wiley & Sons Inc. Publication
2. Solid State Physics- A. J. Dekkar, McMillan students Ed.
3. Solid State Physics - S.L. Gupta & V. Kumar
4. Fundamentals of Solid State Physics-B. S. Saxena, R.C.Gupta & P. N. Saxena
5. Introduction to Nanotechnology, by Charles P. Poole, Jr. Frank J. Owens, John Wiley &Sons Inc. Publication.
6. Solid State Physics by R K Puri

Website Sources

- http://www.uou.ac.in
- http://solid.fizica.unibuc.ro
- https://www.chem.uci.edu
- http://shodhganga.inflibnet.ac.in
- https://www.nanowerk.com

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year VI Semester
BPHY-602A: Electronics and Fiber Optics

Objective: The aim of this course is to provide knowledge of various network theorems, transistors, diodes, optical fiber and their importance to improvise additional skills to generate employability and entrepreneurship.

UNIT - I **(10 Sessions)**

Concept of Network (Active and Passive Network, T & π Network, Symmetric and Asymmetric Network), Characteristic Resistance, Thevenin's theorem, Develop Skills to understand Norton's theorem and its employability, Superposition theorem, Maximum power transfer theorem, Millman's theorem.

UNIT - II **(10 Sessions)**

Transistors parameters, base width modulation transit time and life-time of minority carriers, Emitter resistance, Collector conductance, Base spreading resistance, Diffusion capacitance, Reverse Feedback ratio, Equivalent circuit for transistors, hybrid model, Input and output impedances, Field effect transistors and their characteristics, Develop Skills to understand Biasing of FET.

UNIT – III **(10 Sessions)**

Tunnel Diodes, Zener and Avalanche diodes, Point contact diode, Develop Skills to understand LED Photo diode, Thermistor, Effect of Temperature on junction diode thermistor, Phototransistors, Silicon Controlled rectifiers, Uni-junction transistor and their simple uses, SCR**.** Diffusion of minority carrier in semiconductor, work function in metals and semiconductors Junctions between metal and semiconductors, Semiconductor and semiconductor, Depletion layer, Junction Potential Width of depletion layer, Field and Capacitance of depletion layer, Forward A.c. And D.C. resistance of junction Reverse Breakdown.

UNIT-IV **(12 Sessions)**

Structure optical fiber, Importance of optical fiber, Propagation of light waves in optical fiber, Types of fiber, Acceptance angle and acceptance cone, Develop Skills to understand Numerical aperture, Fiber losses and their units (basic concept), Band width, Bandwidth length product, Dispersion in optical fiber.

Course Outcomes:

Students completing this course will be able to:

CO1: Understand concept of network and study various network theorems for skill development.
CO2: Understand various diodes and their characteristics for skill development.
CO3: To study the working and characteristics of tunnel diode, Zener diode and avalanche diode etc for skill development and local/global employability.
CO4: Study of structure of optical fiber, types of fibers and their importance for skill development.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	1	2	1	2	2	1	1	2	1	1
CO 2	3	2	3	3	1	1	1	1	1	3	1	2
CO 3	1	3	3	3	1	1	1	1	1	1	1	1
CO 4	3	1	2	3	2	1	1	1	1	2	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	1	1	1
CO2	1	1	1
CO3	2	1	1
CO4	1	1	1

Suggested Readings:

1. Networks, Lines and Fields- John D Ryder (Prentice-Hall)
2. Electronic Principles – Malvino.
3. Principles of Electronics - V.K. Mehta
4. Optical Fiber and Optical Fiber Communication Systems - S. K. Sarkar
5. Optical Fiber Communication- G. Keiser (Mc Graw Hill)
6. Electronic Devices & Circuit Theory - Bodystead / Nashels

Website Sources:

- https://circuitglobe.com
- https://ecee.colorado.edu
- https://ecee.colorado.edu
- https://en.wikipedia.org
- http://www.sasurieengg.com

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year VI Semester
BPHY 602B: Digital Communication

Objective: The aim of this course is to know the principles of sampling & quantization, study the various waveform coding schemes, learn the various baseband transmission schemes, understand the various band pass signalling schemes and know the fundamentals of channel coding to provide employability & skills.

UNIT - I **(5 Sessions)**

Information theory

Discrete Memoryless source, Information, Entropy, Mutual Information – Discrete Memoryless channels – Binary Symmetric Channel, Channel Capacity – Hartley – Shannon law – Source coding theorem – Shannon – Fano & Huffman codes for skill development.

UNIT - II **(5 Sessions)**

Waveform coding & representation

Prediction filtering and DPCM – Delta Modulation – ADPCM & ADM principles-Linear Predictive Coding- Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ & NRZ – Bipolar NRZ – Manchester for skill development.

UNIT - III **(5 Sessions)**

Baseband transmission & reception

ISI – Nyquist criterion for distortion less transmission – Pulse shaping – Correlative coding – Eye pattern – Receiving Filters- Matched Filter, Correlation receiver, Adaptive Equalization understanding for employability skill.

UNIT - IV **(7 Sessions)**

Digital modulation scheme and error control coding

Geometric Representation of signals – Generation, detection, PSD & BER of Coherent BPSK, BFSK & QPSK – QAM – Carrier Synchronization – Structure of Non-coherent Receivers – Principle of DPSK.

Channel coding theorem – Linear Block codes – Hamming codes – Cyclic codes – Convolutional codes – Viterbi Decoder knowledge for better employability in industry and research lab.

Course Outcomes:

Students completing this course will be able to:

CO1: To develop skills for better knowledge in Design of PCM systems

CO2: Design and implement base band transmission schemes for skill development and employability.

CO3: Design and implement band pass signaling schemes for skill development.

CO4: Analyze the spectral characteristics of band pass signaling schemes and their noise performance and design error control coding schemes for skill development and employability.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	1	2	1	1	1	1	1	1	1	1
CO 2	2	2	1	1	2	1	1	1	1	1	1	1
CO 3	1	2	1	1	1	1	1	1	1	1	1	1
CO 4	1	3	2	1	1	1	1	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	1	1	1
CO2	2	1	1
CO3	1	1	1
CO4	1	1	1

Suggested Readings:

1. S. Haykin, ―Digital Communications, John Wiley, 2005
2. B. Sarkar, "Digital Communication Fundamentals and Applications", Pearson Education, 2009.
3. B. P. Lathi, "Modern Digital and Analog Communication Systems", Oxford University Press 2007.
4. H P Hsu, Schaum outline Series, "Analog and Digital Communications", TMH 2006.

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year VI Semester
BPHY 602C: Introductory Astrophysics

Objective: The aim of this course is to provide a general introduction to astrophysics for incoming graduate students. It is intended to introduce students with physics backgrounds to a wide range of astrophysical topics. Topics covered will include stellar classification - Henry-Draper and modem M-K Classification schemes, Different optical configurations for Astronomical telescopes, Babcock model of sunspot formation, solar atmosphere and Astero-seismology to provide employability & skills.

UNIT - I **(6 Sessions)**

Observational Data: Astronomical Coordinates for skill development- Celestial Sphere, Horizon, Equatorial, Magnitude Scale- Apparent and absolute magnitude, distance modulus. Determination of mass, luminosity, radius, temperature and distance of a star, Colour Index, Stellar classification - Henry-Draper and modem M-K Classification schemes, H-R Diagram, H-R Diagram of Clusters for employability.

UNIT - II **(6 Sessions)**

Telescopes & Instrumentation: Different optical configurations for Astronomical telescopes, Mountings, plate scale and diffraction limits, telescopes for gamma ray and radio astronomy, Stellar Photometry - solid state and CCD based photometers, Spectroscopy and Polarimetery using CCD detectors for skill development.

UNIT - III **(5 Sessions)**

Sun: Physical Characteristics of sun- basic data, solar rotation, solar magnetic fields, Photosphere - granulation, sunspots, Babcock model of sunspot formation, solar atmosphere - chromosphere and Corona, prominences, solar wind, activity cycle for skill development.

UNIT - IV **(5 Sessions)**

Asteroseismology: Photometry of variable stars, differential photometry, extinction coefficients, Classes of variable stars, Period-Mean density relationship, Classical Cepheids as distance indicators for skill development.

Course Outcomes:

Students completing this course will be able to:

CO1: Define the concepts of Observational Data in terms of Henry-Draper and modem M-K Classification schemes etc. for skill development and employability.

CO2: Describe and discuss different types of Telescopes & Instrumentation for skill development.

CO3: Provide information relating to physical characteristics of sun for skill development

CO4: To skill development and better knowledge in variable stars & Astero-seismology.

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	1	2	1	2	2	1	1	2	1	1
CO 2	3	2	3	3	1	1	1	1	1	3	1	2
CO 3	1	3	3	3	1	1	1	1	1	1	1	1
CO 4	3	1	2	3	2	1	1	1	1	2	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	1	1	1
CO2	1	1	1
CO3	2	1	1
CO4	1	1	1

Suggested Readings:

1. An Introduction to Astronomical Photometry by E. Budding (Cambridge Univ. Press, 1993)
2. Universe by R. A. Freedman & W. J. Kaufmann (W.H.Freeman & Co., 2008)
3. Fundamental Astronomy by H. Karttunen et al. (Springer, 2003)
4. Solar Astrophysics by P. V. Foukal (Wiley-VCR, 2004)
5. Fundamentals of Solar Astronomy by A. Bhatnagar & W.C. Livingston (World Scientific, 2005)

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year VI Semester
BPHY-651: Physics Laboratory – 6

Objective: The main goal of this subject is to share the knowledge to the students about the various network theorems. The students will get a better understanding of the concepts studied by them in the theory course and correlate them with experimental observations for skill development and employability.

List of Experiments **(20 Sessions)**

1. To verify superposition theorem and determine the current flowing through the load resistance.
2. Develop Skills to verify Thevenin theorem and determine the current flowing through the load resistance.
3. Develop Skills to verify Norton theorem and determine the current flowing through the load resistance.
4. To Plot the V-I characteristics of P-N junction diode.
5. To plot the input and output characteristics of transistor in Common Emitter Configuration.
6. To plot the input and output characteristics of transistor in Common Base Configuration.
7. To study a push Pull amplifier using transistor.
8. Develop Skills to understand and verify the condition of oscillation in Phase shift oscillator.
9. Develop Skills to measure the self-inductance of a given coil by Anderson's bridge method.
10. To study the differentiator circuit and obtain differentiated pulse from it at different frequencies
11. Determination of thermal conductivity of a card-board by Lee's disc method.
12. Determination of internal resistance of micro ammeter and conversion of micro ammeter into voltmeter, milliammeter and Ohmmeter.

Course Outcomes:
Students completing this course will be able to:
CO1: Verify various network theorems for skill development.
CO2: Plot V-I characteristics of diode for skill development and employability.
CO3: Evaluate characteristics of transistor for skill development and local/global employability

CO/PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	1	2	1	1	1	1	1	1	1	1
CO 2	3	2	1	2	2	1	1	1	1	1	1	1
CO 3	1	2	1	1	1	1	1	1	1	1	1	1
CO 4	1	3	3	1	1	1	1	1	1	1	1	1

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship Development
CO1	1	1	1
CO2	2	1	1
CO3	1	1	1
CO4	1	1	1

Suggested Readings:

1. Practical Physics by Navneet Gupta
2. Practical Physics by S. K. Gupta
3. Hand book of Electronics by Gupta Kumar
4. Practical Physics by S. L. Gupta
5. Networks, Lines and Fields- John D Ryder (Prentice-Hall)
6. Electronic Principles – Malvino.

Website Courses:

- https://www.electronics-tutorials.ws
- http://itmgoi.in
- https://www.electronics-tutorials.ws
- https://www.electronicshub.org

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year VI Semester
BCHE-601: PHYSICAL CHEMISTRY

Objectives: To develop basic skills to understand concepts regarding the physical properties and molecular structure. To derive the expressions for Schrödinger wave equation and its importance. To study the concept, interaction of radiation with matter and Laws of photochemistry and role in employability.

Unit – I **(09 Sessions)**

Physical Properties and Molecular Structure:

Optical activity, polarization – (Clausius-Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment-temperature method and refractivity method, dipole moment and structure of molecules, magnetic properties paramagnetism, diamagnetism and ferromagnetism.

Unit – II **(09 Sessions)**

Quantum Mechanics:

Schrödinger wave equation and its importance, postulates of quantum mechanics, particle in a one dimensional box., calculation of energy levels from wave functions, Hybrid orbitals – sp, sp^3, sp^2, calculation of coefficients of A.O's used in sp and sp^2 hybrid orbitals and interpretation of geometry.

Unit – III **(09 Sessions)**

Spectroscopy:

Introduction: electromagnetic radiation, regions of the spectrum.

Rotational *Spectrum*-

Diatomic Molecules:

energy levels of a rigid rotor (semi-classical principles), selection rules, determination of bond length, qualitative description of non-rigid rotor, isotope effect.

Infrared Spectrum:Energy levels of simple harmonic oscillator, selection rules, determination of force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion& isotope on the spectrum, idea of vibrational frequencies of different functional groups.

Unit – IV **(09 Sessions)**

Photochemistry:

Interaction of radiation with matter, Laws of photochemistry: Grothus–Drapper law, Stark – Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non- radiative processes (internal conversion, intersystem crossing), quantum yield.

Course outcomes:

Students completing this course will able to:

CO1: Develop basic and advance concepts of the physical properties & molecular structure for employability at local and national level.

CO2: Skill development to derive mathematical expressions for different energy levels from wave functions.
CO3: Explain the Infra Red spectra of diatomic molecules.
CO4: Explain the concept of Jablonski diagram depicting various processes occurring in the excited state.

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	3	3	2	2	3	2	1	2
CO2	2	3	3	3	3	3	3	2	3	2	2	2
CO3	1	2	3	3	3	3	2	2	3	3	2	2
CO4	2	2	3	3	3	3	2	1	3	3	2	2

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship
CO1	3	2	1
CO2	3	2	2
CO3	3	2	1
CO4	3	1	2

Suggested Readings:

1. Text Book of Physical Chemistry by S. Glasstone.
2. Advanced Physical Chemistry by Gurudeep Raj.
3. Modern Electrochemistry J.O. M. Bockris and A. K. M. Reddy,Plenium Press New York.
4. Physical Chemistry: Atkins, Oxford University Press, New York.
5. Physical Chemistry, I.N.Livine: Tata McGraw Hill Publication New Delhi.

Web Sources:

- http://www.freebookcentre.net/Chemistry/Chemistry-Books-Online.html
- https://guides.lib.umich.edu/c.php?g=282900&p=1885122

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year VI Semester
BCHE-602: -POLYMER CHEMISTRY

Objectives: To develop skills for polymeric materials and their classification and to learn about different mechanisms of polymerization along with polymerization techniques To determine chain length of polymers based on their kinetic mechanism To learn about different methods of finding out average molecular weight of polymers and transition temperature (Tg) and crystalline melting point (Tm) Determination of Tg and Tm.

Unit – I (**09 Sessions)**

Introduction and nomenclature:

Characteristic, Classification, Nomenclature of Polymer, Functionality, Physical Properties of Polymer, Mechanism of Polymerization (Addition Polymerization) and application in industries and employability.

Unit-II **(09 Sessions)**

Molecular Weight Determination:

Molecular weight, Determination of molecular weight of polymers by osmotic pressure and viscosity method and its practical significance, Viscometry, Chemical and geometrical structure of Polymers.

UNIT-III **(09 Sessions)**

Characterization:

Glass-transition temperature (T_g) of polymer, factors that affect the value of T_g,$T_g$and molecular weight, melting point,Importance of T_g,Brief idea of crystallinity.

Unit-IV **(09 Sessions)**

Processing of Polymers:

Processing of Polymers (Calendaring, Die casting, Film casting, Moulding), High Performance Polymers (PPS, PES, PEEK, Polyamides), Classification and application of composites. Importance of polymer in employability in research and development.

Course Outcomes:

Students completing this course will able to:

CO1: Understand the importance of macromolecules/polymers in day to day life and apply their knowledge in sustainable development.

CO2: Development of skills to apply the learned fundamental instrumental techniques in the polymer characterization for employability at local and national level.

CO3: Explain crystalline melting temperature and glass transition temperature, including the flow properties of polymer melts and polymer solutions, with respect to temperature and molecular weight both.

CO4: Acquire knowledge of processing of polymers, high performance polymers and new polymer related applications.

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	2	3	2	2	3	2	2	2
CO2	3	2	3	3	2	3	2	3	3	3	2	3
CO3	2	2	3	3	2	3	2	2	3	2	1	2
CO4	2	2	3	3	2	3	2	2	3	3	2	3

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship
CO1	3	2	3
CO2	3	3	2
CO3	3	3	2
CO4	3	3	3

Suggested Readings:

1. Text Book of Polymer Science, F. W. Billmeyer, Wiley Science New York.
2. Principles of Polymerization, J. Odien, John Wiley, Singapore
3. Principles of Polymer Science, P. Bahadur and N. V. Shashtri, Narosa Publishing House, New Delhi.
4. Polymer Sciences, V.R. Gowarikar and J. Sridhar, Wiley Eastern New Delhi.

Web Sources

- https://guides.lib.umich.edu/c.php?g=282900&p=1885122
- http://www.freebookcentre.net/Chemistry/Chemistry-Books-Online.html

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year VI Semester
BCHE-603A: Statistical Mechanics
Elective Course

Objectives: To understand the properties of macroscopic systems using the knowledge of the properties of individual particles for skill development and employability.

UNIT-I **(09 Sessions)**

The Statistical Basis of Thermodynamics: The macroscopic and microscopic states, contact between statistics and thermodynamics, classical ideal gas, Gibbs paradox and its solution.

UNIT-II **(09 Sessions)**

Ensemble Theory: Phase space and Liouville's Theorem, The microcanonical ensemble theory and its application to ideal gas of monatomic particles, Partition function, Classical ideal gas in canonical ensemble theory, Energy fluctuations, Equipartition and virial theorems, A system of harmonic oscillators as canonical ensemble, Thermodynamics of magnetic systems and negative temperatures, The grand canonical ensemble and significance of statistical quantities. Classical ideal gas in grand canonical ensemble theory. Density and energy fluctuations.

UNIT-III **(09 Sessions)**

Ideal Bose Systems: Basic concepts and thermodynamic behavior of an ideal Bose gas, BoseEinstein condensation, Discussion of gas of photons (the radiation fields) and phonons (The Debye field), Liquid helium and super fluidity.

UNIT-IV **(09 Sessions)**

Ideal Fermi Systems: Thermodynamic behavior of an ideal Fermi gas, Discussion of heat capacity of a free-electron gas at low temperatures, Pauli paramagnetism.

Course outcomes:

Students will have achieved the ability to:

CO1: find the connection between statistics and thermodynamics.
CO2: differentiate between different ensemble theories used to explain behavior of systems.
CO3: differentiate between classical statistics and quantum statistics.
CO4: explain the statistical behavior of ideal Bose and Fermi systems

CO/PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	3	3	2	3	2	2	3	2	2	2
CO2	3	2	3	3	2	3	2	3	3	3	2	3
CO3	2	2	3	3	2	3	2	2	3	2	1	2
CO4	2	2	3	3	2	3	2	2	3	3	2	3

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship
CO1	3	2	3
CO2	3	3	2
CO3	3	3	2
CO4	3	3	3

Suggested Readings:

1. Pathria, R.K., Statistical Mechanics, Butterworth-Heinemann, (1996).
2. Reif, F., Fundamentals of Statistical and Thermal Physics, Waveland, (2008).

Website Sources:

- http://www.chemguide.co.uk/
- https://freebookcentre.net/

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year VI Semester
BCHE-604A: Paper & Pulp Technology
Elective Course

Objectives: Gain a more complete understanding of papermaking terms, equipment, process technology, science, and engineering fundamentals, operations, and variables for skill development and employability in paper industries.

Unit-I **(08 Sessions)**

Wood Chemistry: Chemical composition- cellulose, hemi cellulose, lignin, wood extractives, raw material. Quality parameters under evaluation for skill development. Yield of raw material. Pulping: General principle of pulping. Types of pulping processes: mechanical, chemical, semi-chemical, sulphate process, Kraft process. Process calculations. Raw material utility requirements. Process flow sheet and description. Washing and bleaching. Common unit operation. Wood treatment, digestion, evaporation, drying with equipment used.

Unit -II **(08 Sessions)**

Treatment of Pulp: Screening, washing, refining, thickening of pulp. Bleaching- conventional and non-conventional bleaching techniques. Paper Making: Preliminary operations on pulp. Beating and refining of pulp. Non-fibrous materials. Fillers and loading material. Internal sizing. Wet and additive surface treatment. Paper coloring. Surface sizing for skill development and employability in paper industries.

Unit-III **(10 Sessions)**

Paper Quality of Grades: Different grades of paper quality. Parameters and their evaluation. Saturation of paper. Special grade papers. Recycling of waste papers for skill development and employability.

Unit –IV **(10 Sessions)**

Supportive Operations: Chemical recovery-water balance, oxidation, evaporation of black liquor, lime recovery. Quality control and safety aspects. Environmental Aspects: Effluent characteristics of pulp and paper industries. Treatment methods.

Course outcomes:

Students will have achieved the ability to:

CO1: Understand the chemical composition and quality parameters of wood and paper.
CO2: Learn screening, washing, refining, thickening of pulp for skill development and employability in paper industries
CO3: differentiate between different grades of paper quality and evaluation parameters.
CO4: explain the characteristics of effluent of pulp and paper industries

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	2	3	2	2	3	2	2	2
CO2	3	2	3	3	2	3	2	3	3	3	2	3
CO3	2	2	3	3	2	3	2	2	3	2	1	2
CO4	2	2	3	3	2	3	2	2	3	3	2	3

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship
CO1	3	2	3
CO2	3	3	2
CO3	3	3	2
CO4	3	3	3

Suggested Readings:

1. Pulp and Paper Chemistry and Technology, Casey, J.P., 2nd edn, Inter Science, 1960.
2. Handbook For Pulp & Paper Technologists, 3rd Edition.

Website Sources:

- http://www.chemguide.co.uk/
- https://freebookcentre.net/

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year VI Semester
BCHE-605A: Food Analysis
Elective Course

Objectives: To provide an optimum environment for students to develop skills to examine chemical bases of food components. To provide an opportunity for students to test various approaches for manipulating the chemical and/or functional properties of foods for employability in food industries.

Unit-I **(08 Sessions)**

Human nutrition, Basic food groups, Balanced diet. Food processing, preservation and storage for skill development. Physico-chemical properties of food, enzymes in food

Unit – II **(08 Sessions)**

Food adulteration, toxication of food, prevention of food borne diseases
Nutritional value of food. AGMARK, ISI and FPO importance and license obtaining procedures.

Unit-III **(10 Sessions)**

Fermented food products. Production of nutrient rich foods. Agro-product preservation methods for skill development and employability.

Unit –IV **(10 Sessions)**

Quality of animal feed and poultry feed Quality control in food processing. Quality control for exportable foods.
Food microbiology – Contamination of food, spoilage of food & their prevention.

Course outcomes:

Students will have achieved the ability to:

CO1: Understand the methods of food processing, preservation and storage.
CO2: Learn about food adulteration, toxication of food, prevention of food borne diseases for skill development and employability in food industries
CO3: Understand the production of nutrient rich foods for employability in food industries.
CO4: Explain the contamination of food, spoilage of food & their prevention.

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	2	3	2	2	3	2	2	2
CO2	3	2	3	3	2	3	2	3	3	3	2	3
CO3	2	2	3	3	2	3	2	2	3	2	1	2
CO4	2	2	3	3	2	3	2	2	3	3	2	3

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship
CO1	3	2	3
CO2	3	3	2
CO3	3	3	2
CO4	3	3	3

Suggested Readings:

1. A first course in food analysis by A. Y. Sathe.
2. Hand book of analysis and quality control for fruit & vegetable products by S. Ranganathan.
3. Handling and storage of food grains by S. V. Pingale.
4. Food science chemistry & experimental food By Dr. M. Swaminathan.
5. Food chemistry by William Hogland Meyer.
6. Food adulteration By Thankamma Jacob.
7. Food Microbiology by William C. Frazier.
8. Preservation of Fruits and Vegetables by Giridharilal.

Website Sources:

- https://nios.ac.in/media/documents/srsec321newE/321-E-Lesson-4.pdf
- https://www.learnchem.net/

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year VI Semester
BCHE-651: CHEMISTRY PRACTICAL

Objectives: Development of skills to understand the objective of their chemical experiments, properly carry out the experiments, and appropriately record and analyze the results. Students will be able to use standard laboratory equipment, modern instrumentation, and classical techniques to carry out experiments.

PRACTICALS

(20 Sessions)

1) Determination of rate constant of acid catalyzed hydrolysis of an ester.
2) Determination of order of hydrolysis of an ester by sodium hydroxide.
3) Verify Beer – Lambert Law for $KMnO_4$ / $K_2Cr_2O_7$ and determining the concentration of the given solution of the substance from absorption measurement.
4) Preparation of a Rubber Ball from Rubber Latex and its importance in employability in research and manufacturing sector.
5) Preparation of casein glue from milk and testing of its activity.
6) Preparation of talcum powder/face cream.
7) Preparation of nail polish and nail polish remover
8) Preparation of shampoo.
9) Paper chromatographic separation of
   Fe^{3+}, Al^{3+} and Cr^{3+} OR Ni^{2+}, Co^{2+}, Mn^{2+} and Zn^{2+}
10) Preparation of any of the following complexes
    I. Tetraamminecarbonatocobalt (III) nitrate
    II. Tetraamminecopper (II) sulphate
    III. Potassium trioxalatoferrate (III) trihydrate

Course outcomes:

Students completing this course will able to:

CO1: Understand the qualitative and quantitative analysis.

CO2: Perform the synthetic process of commercial chemical materials like cosmetics for employability at local and national level.

CO3: Skill development to prepare transition metal complexes.

CO4: Determine rate constant/order in hydrolysis of ester. Determine concentration of the given solution using Beer–Lambert Law.

CO/PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	2	3	2	2	3	3	2	3
CO2	2	2	3	3	2	3	2	3	3	3	2	3
CO3	3	2	3	3	2	3	2	2	3	3	3	2
CO4	1	3	3	3	3	3	2	2	3	3	2	2

CO- Curriculum Enrichment Mapping

	Skill Development	Employability	Entrepreneurship
CO1	3	3	1
CO2	3	3	3
CO3	3	2	2
CO4	3	2	2

Suggested readings:

1. A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
2. A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
3. A.I. Vogel: Textbook of Practical Organic Chemistry, Prentice Hall, 5th Edn.
4. F. G. Mann & B. C. Saunders: Practical Organic Chemistry, Orient Longman (1960).M University

Web Sources:

- https://sp-sg.libguides.com/c.php?g=377339&p=6724406
- https://chemistscorner.com/top-10-book-cosmetic-science-book-resources/

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year VI Semester
BMAT-601: COMPLEX ANALYSIS

Objective: The main aims of this course are to introduce the fundamental ideas of the functions of complex variables and developing a clear understanding of the fundamental concepts of Complex Analysis such as analytic functions, complex integrals and a range of skills which will allow students to work effectively with the concepts of analysis and evaluation to provide employability & skills.

UNIT-1 **(12 Sessions)**
Functions of a complex variable, Analytic function, Necessary and sufficient conditions of analytic function, C-R equations (Cartesian and polar forms), Harmonic functions, Milne's Thomson method, Orthogonal system for skill development.

UNIT-2 **(10 Sessions)**
Mapping by elementary function, Linear and bilinear transformation, fixed point, Cross ratio, Critical point for skill development.

UNIT-3 **(10 Sessions)**
Complex integration, Line integral, Cauchy fundamental theorem, Cauchy's integral formula, Cauchy's integral formula for higher derivatives, Liouville theorem, Taylor and Laurent series to develop skill

UNIT-4 **(08 Sessions)**
Singularities and zeros of an analytic function, Rouche's theorem, Fundamental theorem of algebra understanding for entrepreneurial skill,

UNIT-5 **(10 Sessions)**
Cauchy residue theorem, Jordan lemma, Calculus of residues-integration round the unit circle, Roots lie in improper integral form, Poles lie on the real axis understanding for entrepreneurial skill,

Course Outcomes:

CO1: Becoming familiar with the concepts Complex numbers and their properties and operations with Complex number skill development and employability.
CO2: Finding domain and range of complex functions and sketching their graphs skill development and employability**.**
CO3: Evaluating limits and checking the continuity of complex function skill development and employability**.**
CO4: Checking differentiability and Analyticity of functions for skill development
CO5: Evaluate Complex integrals and applying Cauchy integral for entrepreneurship

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	3	2	3	3	3
CO2	3	3	2	3	3	3	3	1	3	3
CO3	3	1	3	3	2	1	3	3	3	3
CO4	3	3	3	3	3	3	3	1	2	1
CO5	3	3	3	3	3	3	1	3	3	3

CO- Curriculum Enrichment Mapping

Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	1
CO3	3	1	1
CO4	3	2	1
CO5	3	1	1

Suggested Readings:

1. Ruel V. Churchill: Complex Variables and Applications, TMH Publication.
2. T. Path: Function of Complex Variable, Pothisala Pvt.Ltd, Allahabad.
3. A. R. Vasistha: Complex Analysis, Krishna Prakashan Media (P) Ltd, Meerut.
4. Conway: Complex of one variable, Nrosa Publication.
5. Kasana : Complex variable, Theory and Application, PHI Publication.

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

Note: Latest editions of all the suggested readings must be used.

IFTM University, Moradabad
Bachelor of Science Programme
B. Sc. (PCM) III Year VI Semester
BMAT-602: DIFFERENCE EQUATIONS

Objective: -The main aims of this course are to understand application of sequences and series of numbers and functions, partial difference equations, Discrete boundary value problem, Application with different engineering problem, Discrete mathematical models to provide employability & skills.

UNIT-1 **(10 Sessions)**

Introduction, Difference Calculus – The Difference Operator Summation, Generating functions a approximate summation.

Linear Difference Equations – First order equations, General results for linear equation. Equations with constant coefficients Applications, Equations with variable coefficients, nonlinear equations that can be linearized and the z-transform for skill development.

UNIT-2 **(10 Sessions)**

Stability Theory- Initial value problems for linear systems, Stability of linear systems, Stability of nonlinear systems, Chaotic behavior to develop skill

Asymptotic methods – Introduction, Asymptotic analysis of sums, Linear equations, Nonlinear equations for skill development.

UNIT-3 **(10 Sessions)**

The self-adjoint second order linear equation – Introduction Sturmian Theory, Greens functions, Disconjugacy, The Riccati Equations and Oscillation.to develop skill

The Sturm-Liouville problem- Introduction, Finite Fourier Analysis, A non-homogeneous problem for better skilling of entrepreneurship

UNIT-4 **(08 Sessions)**

Discrete Calculus of variations- Introduction, Necessary conditions, Sufficient conditions and Disconjugacy for skill development and entrepreneurship

UNIT-5 **(10 Sessions)**

Boundary Value Problems for Nonlinear equations- Introduction, The Lipschitz case, Existence of solutions, Boundary value Problems for differential Equations, Partial differential Equations, Discretization of Partial Differential Equations, Solution of partial differential equations for skill development.

Course Outcomes:

CO1: Apply the theory to study the qualitative theory of solutions of difference equations and partial difference equations of higher order for skill development.

CO2: Apply the theory to study the quantitative and qualitative study of solutions of different discrete models in Engineering for skill development.

CO3: Difference between the qualitative and quantitative behavior of solutions of the difference equations and the

corresponding differential equations skill development and entrepreneurship

CO4: Apply the theory to study the solution in discrete boundary value problems skill development and entrepreneurship

CO5: Apply difference equations to find solution of boundary value problems for Nonlinear equations for skill development

Mapping Course Outcomes (COs) leading to the achievement of Programme Outcomes (POs):
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	1	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	1	3	3	3	2	3	3	3	3	3
CO4	3	2	2	1	3	3	3	2	2	3
CO5	3	3	1	3	3	3	3	3	3	1

CO- Curriculum Enrichment Mapping
Note: 3 for highly mapped, 2 for medium mapped and 1 for low mapped

	Skill Development	Employability	Entrepreneurship
CO1	3	1	1
CO2	3	2	2
CO3	3	2	2
CO4	3	2	2
CO5	3	2	1

Suggested Readings:

1. M. D. RaiSinghaniya : Differential equations, S. chand Publications.
2. Difference equations :Schaum'sOutlines, TMH.
3. Fulford Glenn R. :Modelling with Differential and Difference Equations, Cambridge University Press.
4. Youssef N.Raffoul : Qualitative Theory of Volterra Difference Equations, Springer International Publishing AG.

Website Sources:

- www.pdfdrive.com
- www.dmi.gov.in
- www.yourarticlelibrary.com
- onlinecourses.nptel.ac.in
- en.wikipedia.org

Note: Latest editions of all the suggested readings must be used.