M.Sc. Year II (Semester-III)

Sr. No.	Course Code	Course	Teaching Scheme (Hours)			Credits	Examination Scheme			Total Marks
			L	T	P		Theory	Tutorial	Practical	
1	PH 201	Basic Electronics	3	1	0	4	100	25	00	125
2	PH 203	Classical Mechanics	3	1	0	4	100	25	00	125
3	MA 211	(Interdisciplinary – I): Mathematics-III	3	1	0	4	100	25	00	125
4	CY 213	(Interdisciplinary – II): Solid State Chemistry and Spectroscopy	3	1	0	4	100	25	00	125
5	HU 201	English & Professional Communication - II	2	1	0	3	100	25	00	125
6	PH 205	Experimental Technique – I (electronics, classical mechanics & general physics)	0	0	6	3	00	00	100	100
	Total		**14**	**5**	**6**	**22**	**500**	**125**	**100**	**725**
	Total Contact Hours		**25**							
TOTAL Credits			**22**							

M.Sc. Year II (Semester-IV)

Sr. No.	Course Code	Course	Teaching Scheme (Hours)			Credits	Examination Scheme			Total Marks
			L	T	P		Theory	Tutorial	Practical	
1	PH 202	Electromagnetics-I	3	1	0	4	100	25	00	125
2	PH 204	Quantum Mechanics-I	3	1	0	4	100	25	00	125
3	PH 206	Solid State Physics	3	1	0	4	100	25	00	125
4	MA 212/ CY 214	Interdisciplinary Elective – I*	3	1	2	5	100	25	50	175
5	CY 202	Introduction to Life Sciences	3	0	0	3	100	00	00	100
6	PH 208	Experimental Technique – II (electromagnetics, quantum mechanics, solid state physics & general physics)	0	0	6	3	00	00	100	100
	Total		**15**	**4**	**8**	**23**	**500**	**100**	**150**	**750**
	Total Contact Hours		**27**							
TOTAL Credits			**23**							

***Interdisciplinary Elective – I** **MA 212: Computational Methods** **CY 210: ORGANIC CHEMISTRY – I**

Second year of Five Years Integrated M.Sc.(Physics) M.Sc. – II, Semester – III	L	T	P	C
PH 201: Basic Electronics	**3**	**1**	**0**	**4**

Course Outcomes **In the end of the semester students will able to:**	
CO1	Understand the basis concept of circuit analysis theorem
CO2	Demonstrate familiarity with basic electronic components and use them to design simple electronic circuits
CO3	Describe the application of transistors for Current and voltage amplification. Also to describe the characteristics of different configurations of the transistor
CO4	Discuss the ideal of operational amplifier and their electrical parameters
CO5	Analyze and Design the different types of Oscillators, and their applications

Syllabus	
BASIC CIRCUIT ANALYSIS	**(06 Hours)**
Kirchoff's current and voltage law, Network analysis, Superposition theorems.	
SEMICONDUCTOR JUNCTION DIODES & APPLICATIONS	**(08 Hours)**
The open circuit p-n junction, Energy bands in junction diode, I-V characteristics of p-n junction, diode as rectifier, Half-wave, full-wave, and bridge rectifier. Various applications of diode	
SEMICONDUCTOR TRANSISTOR & APPLICATIONS	**(08 Hours)**
Junction transistor, transistor construction, CB, CE and CC configurations, cut-off and saturation regions, transistor load-line, Quiescent point, Transistor as an amplifier, Current gain and voltage gain.	
FREQUENCY RESPONSE OF AMPLIFIERS	**(06 Hours)**
The gain-bandwidth product, frequency response of CB, CE and CC amplifier, Classification of amplifiers, Feed-back in amplifiers and its classification, Study of different properties with feed-back Amplifier applications.	
OPERATIONAL AMPLIFIERS	**(08 Hours)**
The differential amplifier, The basic operational amplifier, The emitter-coupled differential amplifier, Transfer characteristics of a differential amplifier, Offset error voltage and currents, Parameters, Frequency response.	
OSCILLATORS	**(08 Hours)**
Criteria for oscillation, tank circuit, L-C oscillator, Hertley Oscillator, Colpitt oscillator, The phas shift oscillator, the Wien bridge oscillator, Crystal oscillator.	
(Total Contact Time: 42 Hours)	

BOOKS RECOMMENDED:

1. Ryder, J.D., Electronics fundamentals and applications: Integrated and Discrete Systems, Prentice – Hall of India, 1999.
2. Sze, S. M., Physics of Semiconductor Devices, John Wiley & sons, 1981.
3. Floyd, T.L., Electronic Devices (5th ed). Pearson education Asia (2001).
4. Malvino, A.P. Electronic Principles, Tata McGraw Hill, 1999.
5. Mottershed, A., Electronic Devices and circuits, Prentice Hall India, 1989.

Second year of Five Years Integrated M.Sc.(Physics) M.Sc. – II, Semester – III	L	T	P	C
PH 203:Classical Mechanics	**3**	**1**	**0**	**4**

Course Outcomes **In the end of the semester students will able to:**	
CO1	Understand the principles of Lagrangian mechanics and the concepts of generalized quantities to derive the Euler-Lagrange equation
CO2	Identify the relevance of variational principle in classical mechanics and extend the concept to explain the Hamiltonian dynamics
CO3	Interpret the central forces and apply to understand the two-body problem
CO4	Understand the Canonical transformations by applying the generating functions and Poisson brackets
CO5	Analyze the rigid body dynamics

Syllabus	
LAGRANGIAN MECHANICS	**(08 Hours)**
Principle of Virtual Work, d'Alembert's Principle, Degrees of Freedom, Constraints (scleronomic and rheonomic constraints), Generalized Coordinates and Velocity, Generalized Force, Kinetic Energy, Generalized Equation of Motion, Conservative Forces, Euler-Lagrange Equation	
VARIATIONAL PRINCIPLE AND CLASSICAL MECHANICS	**(05 Hours)**
Principle of Least Action, Euler's Equation, Hamilton's Principle, Method of Lagrange Multiplier, Euler equation with more than one independent variable, Non-holonomic constraints	
CENTRAL FORCES AND TWO-BODY PROBLEM	**(08 Hours)**
Central Force, Motion of Centre of Mass, Kepler's Planetary Motion, Equation of Orbit, Gravitational Force between two body, Elliptical Orbits, Rutherford's Scattering, Hyperbolic Orbits	
HAMILTONIAN DYNAMICS	**(08 Hours)**
Conservation Theorems, Generalized Momentum, Phase Space, Legendre Transformation, Hamilton's Equation of Motion, Definition of Hamiltonian, Accelerated Systems	
CANONICAL TRANSFORMATIONS	**(05 Hours)**
Point Transformations, Generating Functions, Poisson Brackets, Liouville's Theorem	
RIGID BODY MOTION	**(08 Hours)**
Damped oscillations, forced oscillations, coupled oscillations & resonance. Rotating Coordinate Systems and Reference Frames, Non-inertial system, Kinetic Energy of a Rigid Body, Inertia Tensor, Parallel and Perpendicular Axis Theorem, Angular Momentum of Rigid Body, Euler Equation for Rigid Body, Euler's Angle	
(Total Contact Time: 42 Hours)	

BOOKS RECOMMENDED:

1. Classical Mechanics, Herbert Goldstein, Charles P. Poole Jr., John L. Safko; (2013), Pearson Publication; 3rd Edition.
2. Analytical Mechanics, Louis N. Hand and Janet D. Finch, (2008), Cambridge University Press.
3. Classical Dynamics of Particle and Systems, Stephen T. Thornton and Jerry B. Marion. (2012), Cengage Publications
4. Landau, L. D., & Lifshitz, E. M. (1960). Course of theoretical physics. vol. 1: Mechanics. Oxford.
5. David Morin (September 2009), Introduction to Classical Mechanics With Problems and Solutions Cambridge University Press

Second year of Five Years Integrated M.Sc.(Physics) M.Sc. – II, Semester – III	L	T	P	C
MA 211: Mathematics-III	**3**	**1**	**0**	**4**

Course Outcomes **In the end of the semester students will able to:**	
CO1	understand the concept of convergence and divergence of infinite series
CO2	grasp the knowledge of metric space
CO3	expand the periodic functions in the form of Fourier series along with different cases and Fourier Integral
CO4	understand the concept of Integral transform with their applications
CO5	deal with complex variables and its properties with their application

Syllabus	
INFINITE SERIES	**(07 Hours)**
Introduction, Positive term series, Comparison test, Cauchy's root test, D'Alembert's test, Raabe's test, Logarithmic test, Integral test, Gauss's test, Series with arbitrary terms, Rearrangement of terms.	
METRIC SPACE	**(07 Hours)**
Definition of metric space, example of metric space, open and closed balls, open and closed sets, theorems of open sets, limit points, sequences in a metric space, Cauchy sequences.	
LAPLACE TRANSFORMS	**(06 Hours)**
Introduction, Definition, Existence conditions, basic properties, Inverse Laplace transform and properties, Convolution Theorem and properties, Applications of Laplace transforms	
FOURIER SERIES	**(07 Hours)**
Definition, Fourier series with arbitrary period, in particular periodic function with period 2π. Fourier series of even and odd function, Half range Fourier series.	
FOURIER INTEGRAL & FOURIER TRANSFORMS	**(07 Hours)**
Fourier Integral theorem, Fourier sine and cosine integral complex form of integral, Inversion formula for Fourier transforms, Fourier transforms of the derivative of a function.	
COMPLEX VARIABLES	**(08 Hours)**
Basic mathematical concept, Analytic function, C – R equations, Harmonic functions, its applications, Linear transformation of complex domain, some special transformation, bilinear transformations, conformal mapping and its application, complex integration including contour integration.	
Tutorials will be based on the coverage of the above topics separately	**(14 Hours)**
(Total Contact Time: 42 Hours)	

BOOKS RECOMMENDED:

1. Kreyszing E., Advanced Engineering Mathematics, John Wiley, Int. Student Ed. 1995.
2. Wiley C. R., Advanced Engineering Mathematics, McGraw Hill, Int. Student Ed. 1993.
3. O'Neel Peter., Advanced Engg. Mathematics, Thompson, Singapore, Ind. Ed. 2002.
4. Ramana D. V., Higher Engg. Mathematics, The McGraw-Hill Inc., New Delhi, 2007.
5. Malik S. C., Arora Savita, Mathematical Analysis, New age International publishers, Delhi, 2006.

Second year of Five Years Integrated M.Sc.(Physics) M.Sc. – II, Semester – III	L	T	P	C
CY 213: Solid State Chemistry and Spectroscopy	**3**	**1**	**0**	**4**

Course Outcomes **In the end of the semester students will able to:**	
CO1	Acquire fundamental knowledge structure and bonding.
CO2	Learn basics of ionic structures and their bonding.
CO3	Acquire the knowledge of crystals and their diffraction techniques.
CO4	Discuss Electronic Transitions and apply Woodword Rule.
CO5	Calculate Vibrational Energy and study Selection Rules of Transitions in IR and Raman spectroscopy.

Syllabus	
STRUCTURE AND BONDING	**(08 Hours)**
Spectral series, Quantum numbers, Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. Valence bond theory, Valence shell electron pair repulsion (VSEPR) theory and MO theory, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.	
IONIC SOLIDS	**(08 Hours)**
Ionic structures (Zinc Blende and Wurtzite, Fluorite, anti-fluorite, spinel and inverse spinel), radius ratio calculation, limitation of radius ratio rule, lattice defects, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. Conductors, Semiconductors and Insulators. Superconductivity: Low Temperature superconductivity, High Temperature Super conductivity.	
THE CRYSTAL STRUCTURE	**(08 Hours)**
Symmetry of crystals, Cubic crystal system, Density & Packing Fraction; Miller Indices, The diffraction phenomenon: Bragg equation, X-ray diffraction Methods: Single crystal and Powder Method, Indexing of powder diffraction patterns.	
ELECTRONIC (UV-VIS) SPECTROSCOPY	**(08 Hours)**
Franck-Condon Principle, Beer-lambert’s law, Types of Electronic Transitions; Instrumentation; Applications; Woodword Rules.	
INFRARED AND RAMAN SPECTROSCOPY	**(10 Hours)**
Molecular Symmetry and Fundamental Modes of Vibrations, Quantum Aspects of Molecular Vibrational Energy and Selection Rules of Vibrational Transitions; Vibrational Rotational Spectra; Instrumentation; Applications; Raman Effect; Quantum Mechanical Description; Rotational and Vibrational Raman Spectra; Mutual Exclusion and Complementarity.	
(Total Contact Time: 42 Hours)	

BOOKS RECOMMENDED:

1. Puri, Sharma, Pathania, Principles of Physical Chemistry, 5th Ed. 2003, Vishal Publishing Co.
2. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 17th Ed. 2006, S. Chand & Co. Ltd.
3. P.W. Atkins, The elements of Physical Chemistry, 4th Edition, 1998, Oxford.
4. Fundamentals for Molecular Spectroscopy by C. N. Banwell and Elaine M. McCash.
5. Elementary Organic Spectroscopy by Y. R. Sharma.

Second year of Five Years Integrated M.Sc.(Physics) M.Sc. – II, Semester – III	L	T	P	C
HU 201: English & Professional communication - II	**2**	**1**	**0**	**3**

Course Outcomes **In the end of the semester students will able to:**	
CO1	express themselves using appropriate vocabulary and grammar
CO2	draft scientific reports and formal proposals
CO3	comprehend scientific and general content more skilfully and meaningfully
CO4	communicate effectively through various means and at varied levels

Syllabus	
FUNCTIONAL ENGLISH GRAMMAR	**(04 Hours)**
Language functions, Modals, Tenses, Active and Passive Voice, Conditional Sentences, Concord errors.	
TECHNICAL WRITING	**(04 Hours)**
Formal and informal report- Information and recommendation reports, Progress and Periodic Report, Feasibility and trip report. Proposal Writing- Types, logistics of proposals, the deliverables of proposals persuasion and proposal, the structure of the proposal.	
LISTENING AND READING COMPREHENSION	**(05 Hours)**
Listening and Note Taking, Paraphrasing, Reading using SQ3R, Predicting, Understanding Gist Reading and Listening General and Scientific Texts and Developing Vocabulary.	
LANGUAGE THROUGH LITERATURE	**(07 Hours)**
Short Stories: 1. The Remarkable Rocket by Oscar Wild 2. An Astrologer's Day by R. K. Narayan 3. The Case of the Lower Case Letter by Jack Delany	
GROUP COMMUNICATION & ACADEMIC WRITING	**(08 Hours)**
Transactional Analysis; SOP, LOR; Research Paper, Dissertation, Thesis; Types of Group Communication- Seminar, Conferences, Convention, Symposium, Panel Discussion etc.	
Tutorials will be based on the coverage of the above topics separately	**(14 Hours)**
(Total Contact Time: 28 Hours)	

BOOKS RECOMMENDED:

1. Mike Markel. Practical strategies for technical communication. Bedford/St. Martin's second edition. 2016.
2. Raymond V. Lesikar and Marie E Flatley. Basic Business Communication skills for Empowering the Internet generation. Tata McGraw Hill publishing company limited. New Delhi 2005.
3. Laura J. Gurak and John M. Lannon.Strategies for Technical Communication in the Workplace. Pearson 2013.
4. Courtland L Bovee, John V.Thill and MukeshChaturvedi. Business Communication Today 9th Edition. Pearson, 2009.
5. William Sanborn Pfeiffer and T. V. S. Padmaja. Technical Communication: A Practical Approach. Sixth Edition, Pearson 2013.

Additional books:

6. Bill Mascull. Business Vocabulary in Use. Cambridge University Press.2011.

Second year of Five Years Integrated M.Sc.(Physics) M.Sc. – II, Semester – IV	L	T	P	C
PH 202: Electromagnetics - I	**3**	**1**	**0**	**4**

Course Outcomes **In the end of the semester students will able to:**	
CO1	Understand the basics of vector algebra, coordinate transformations and differential operators
CO2	Interpret the Coulomb's and Gauss's law and their application in electrostatics
CO3	Classify the electric fields in conductors and dielectrics and extend it to understand the polarization effects and apply to boundary value problems
CO4	Interpret the Lorentz force, Biot-Savert's and Ampere's law and their applications in magnetostatics
CO5	Interpret the Legendre polynomials and Bessel functions and relate their applications
CO6	Understand the magnetization in materials and explain the magnetic fields in matter

Syllabus	
VECTOR CALCULUS	**(06 Hours)**
Vector Algebra, Coordinate Systems and Transformations, Differential Length, Differential Area and Differential Volume; Line, Surface and Volume Integrals, Gradient, Divergence, Curl and Laplacian (Cartesian & Polar Coordinates)	
ELECTROSTATICS	**(06 Hours)**
Coulomb's Law, Intensity of Electric field, Gauss's Law and its Application, Divergence and curl of Electric Field, Electric Potential, Work and Energy in Electrostatics.	
ELECTRIC FIELDS IN MATTER	**(06 Hours)**
Conductors, Dielectrics, Polarization, The Field of Polarized Object, The Electric Displacement, Boundary Conditions, Conduction and Convection Currents, Ohms Law	
BOUNDARY VALUE PROBLEMS	**(08 Hours)**
Laplace equation in one-, two- and three-dimensions, 1st and 2nd uniqueness theorem, Classic image problem, Induced surface charge, Force and energy, Other image problems, Separation of variables, Multipole expansion.	
MAGNETOSTATICS	**(08 Hours)**
The Lorentz Force Law, Biot-Savert's law, The Divergence and Curl of Magnetic Field, Magnetic vector potential, Magnetic flux density, Ampere Circuital Law and its Application.	
MAGNETIC FIELDS IN MATTER	**(08 Hours)**
Magnetization in Materials, The field of a Magnetized Object, The auxiliary field H, Linear and non-linear media, Magnetic Boundary Conditions	
(Total Contact Time: 42 Hours)	

BOOKS RECOMMENDED:

1. Griffiths D. J., Introduction to Electrodynamics, 3rd Ed. Prentice – Hall of India Private Limited 1999.
2. Edminister J. A., Schaum's Outline series, Theory and Problems of Electromagnetics, McGraw Hill, 1993.
3. Sadiku M. N. O., Elements of Electromagnetics, 3rd Ed., Oxford University Press, 2003.
4. Stewart J. V., Intermediate Electromagnetic Theory, Allied Publishers (with World Scientific), 2005.
5. Jackson J. D., Classical Electrodynamics, Wiley Eastern, 2012

Second year of Five Years Integrated M.Sc.(Physics) M.Sc. – II, Semester – IV	L	T	P	C
PH 204 : Quantum Mechanics-I	**3**	**1**	**0**	**4**

Course Outcomes **In the end of the semester students will able to:**	
CO1	understand the origin of quantum theory and interpret the wave function properties
CO2	understand and apply the Schrodinger's time-dependent and time-independent equations
CO3	interpret the Fourier transform and delta functions
CO4	examine the central potential theory and apply it to understand the energy spectrum of hydrogen atom
CO5	identify various symmetries in quantum mechanics and interpret the angular momentum and spin in general
CO6	inspect the Pauli's exclusion principle and perturbation theory

Syllabus	
ORIGINS OF QUANTUM THEORY & APPLICATIONS	**(06 Hours)**
The conceptual aspect, The state vectors, Bra and Ket notations, Eigenstates and eigenvalues, The postulates of quantum mechanics, Interpretation of the wave function, Operators, Commutation relations.	
SCHRÖDINGER EQUATION AND RELATED PROBLEMS	**(10 Hours)**
Equation of motion, Hamiltonian, Time dependent Schrodinger equation, Time independent Schrodinger equation, Schrodinger equation for particle in a potential well.	
FOURIER TRANSFORM, DELTA FUNCTIONS	**(06 Hours)**
Position representation of a state, momentum representation of a state, Plancherel's theorem, The Kronecker delta, Dirac delta function	
CENTRAL POTENTIALS; HYDROGEN ATOM	**(05 Hours)**
Spherically symmetric potentials, The two body problem, Bound states, Scattering states, Energy spectrum of Hydrogen atom	
SYMMETRIES IN QUANTUM MECHANICS, GENERAL TREATMENT OF ANGULAR MOMENTUM; SPIN	**(07 Hours)**
The invariance principles, Symmetry groups and their representation, Space-time symmetry, Rotation symmetry, Eigenvalues of angular momentum, Parity, Time reversal invariance.	
IDENTICAL PARTICLES; PAULI EXCLUSION PRINCIPLE.	**(04 Hours)**
The identity of particle, Quantum numbers, Spins and Statistics, Pauli's exclusion principle and the Slatter determinant.	
INTRODUCTION TO I^{ST} ORDER TIME-INDEPENDENT PERTURBATION THEORY	**(04 Hours)**
The WKB approximation, Variational methods, Non-degenerate Perturbation Theory, Degenerate Perturbation Theory, Two-fold Degeneracy	
(Total Contact Time: 42 Hours)	

BOOKS RECOMMENDED:

1. Schiff L.I., Quantum Mechanics: McGraw Hill Education; 4 edition (1 July 2017)
2. Ghatak A.K., & Loknathan S. Quantum Mechanics: Theory & Applications Laxmi Publications (1 January 2015)
3. Shankar R., Principles of Quantum Mechanics: Springer; 2nd ed. 1994. Corr. 14th printing 2014 edition (19 October 2011)
4. Zettili N., Quantum Mechanics: Concepts and Applications; Wiley india Pvt. Ltd; 2nd edition edition (12 October 2016)
5. Mathews P.M., and Venkateshan K.,A Text book of Quantum Mechanics; McGraw Hill Education; 2 edition (1 July 2017)

Second year of Five Years Integrated M.Sc.(Physics) M.Sc. – II, Semester – IV	L	T	P	C
PH 206 : Solid State Physics	**3**	**1**	**0**	**4**

Course Outcomes **In the end of the semester students will able to:**	
CO1	Explain the basics of crystallography and identify the crystal structures
CO2	Understand the concept of free electron theory and band theory of solids
CO3	Interpret the lattice vibrations and thermal properties of solids
CO4	Extend concept of energy band theory by various methods and apply to understand optical properties
CO5	Examine the properties of superconductors and understand the concept of liquid crystals

Syllabus	
Crystallography	**(08 Hours)**
Symmetry elements in crystals, Single crystals and usage, Defects in crystals, techniques of growing, and studying different crystals, Determination of crystal structures by X-ray diffraction, formulations of Bragg and Von Laue, their equivalence, Laue condition and Ewald's construction, Laue, rotating crystal, power methods, geometrical structure factor, atomic form factors	
Free Electron Theory	**(08 Hours)**
Drude Theory of Metals, Somemerfeld Theory of Metals, Sommerfeld Theory of Conduction, Failure of The Free Electron Model, Band Theory of Solids, Distinction between Conductors, Insulators and Semiconductors, Electrical Resistance of Materials, Energy Bands, Equation of Motion of an Electron, Resistivity and Conductivity	
Lattice Vibrations and thermal properties	**(08 Hours)**
Vibrations of Monoatomic Lattice, normal mode frequencies, dispersion relation, Quantization of lattice vibrations, phonon momentum, Inelastic scattering of neutrons by phonons, Surface vibrations, Inelastic Neutron scattering. Anharmonic Crystal Interaction. Thermal conductivity, Lattice Thermal Resistivity	
Energy band theory	**(08 Hours)**
Periodic potentials and Schrodinger equation, Bloch theorem, Kronig-Penney model, Origin of band gap, Brillouin zones, electron motion in one dimension, effective mass, concept of a hole, mobility and temperature dependence, cyclotron resonance and hall effect, Tight binding method, Band structure of real semiconductors, High electric field and hot electrons, The Gunn effects, Optical properties: absorption processes, Photoconductivity, Luminescence	
Superconductivity:	**(10 Hours)**
Superconductivity: type-I and type-II superconductors. Josephson junctions. Superfluidity. Defects and dislocations. Ordered phases of matter: translational and orientational order, kinds of liquid crystalline order. Quasi crystals	
(Total Contact Time: 42 Hours)	

BOOKS RECOMMENDED:

1. C. Kittle, Introduction to Solid State Physics, John Willey, 1976.
2. M. A. Omar, Elementary Solid State physics, Addison-Wesley Pvt. Ltd, New Delhi, 2000.
3. A. J. Dekker, Solid State Physics, Macmillan India Ltd, 2000.
4. N. W. Ashcroft and N.D. Mermin, Solid State Physics, Holt-Saunders International Editing 1981.
5. W. A. Harrison, Solid State Theory, Tata McGraw Hill Education, 1970.

Second year of Five Years Integrated M.Sc.(Physics) M.Sc. – II, Semester – IV	L	T	P	C
MA 212:Computational Methods	**3**	**1**	**2**	**5**

Course Outcomes **In the end of the semester students will able to:**	
CO1	devise an algorithm to solve a mathematical problem numerically.
CO2	analyze an algorithm's accuracy, efficiency and convergence properties.
CO3	implement this algorithm and write computer code.
CO4	describe classic techniques and recognize common pitfalls in numerical analysis.

Syllabus	
PRELIMINARIES OF COMPUTING	**(02 Hours)**
Errors, Types of errors, Propagation of Error, Floating point arithmetic. Approximation using Taylor's series.	
SOLUTION OF NON-LINEAR EQUATIONS	**(08 Hours)**
Bisection Method, Methods of false position, Newton's method, Modified Newton's method, Fixed point iterative method, Newton's and fixed point iterative method for system of nonlinear equations. Roots of polynomials, Error and convergence analysis of these methods	
SOLUTION OF SYSTEM OF LINEAR EQUATIONS	**(08 Hours)**
Direct Methods: Gauss elimination with pivoting. LU decomposition method, Cholesky decomposition method, Error analysis for direct methods. Iterative methods: Jacobi, Gauss Seidel method, SOR method, Vector and matrix norm, Convergence of iterative methods. Eigen values problems: Jacobi's and Power method	
INTERPOLATION	**(12 Hours)**
Finite difference operators, divided difference operators, Relation between difference operators, Application of difference operators. Polynomial Interpolation, Existence and uniqueness of interpolating polynomials, Lagrange and Newton's interpolation. Newton's forward and backward difference formula, Error in interpolation.	
DIFFERENTIATION AND INTEGRATION	**(06 Hours)**
Numerical differentiation: Methods based on interpolation, finite differences, Error in approximation, order of approximation. Numerical Integration: Quadrature formula, Newton Cotes Methods, Trapezoidal and Simpson's rules with error analysis. Gauss quadrature methods with error analysis.	
INITIAL VALUE PROBLEMS (ODE)	**(06 Hours)**
Picard's method, Taylor's series method, Euler and Runge-Kutta methods for initial value problems of order one and higher and system of first order ODEs with error analysis.	
(Total Contact Time: 42 Hours)	

Practical:

Students can use MATLAB, PYTHON, Octave, SciLab, to write computer program

1. To solve the nonlinear equation.
2. To solve system of nonlinear equations
3. To solve the system of linear equations using direct methods
4. To solve the system of linear equations using indirect methods
5. To find the eigenvalue of a matrix
6. To make a difference table
7. For interpolating arbitrary spaced and equally spaced data.
8. To approximate the derivative numerically
9. To integrate function numerically
10. To solve the initial value problems of order one and more and system of first order ODEs

BOOKS RECOMMENDED:

1. Kendall E. Atkinson, An introduction to numerical analysis, 2nd Edition, 2008, John Wiley & sons, ISBN-13: 9788126518500
2. Richard L. Burden and J. Douglas Faires, Numerical Analysis, 9th Edition, 2011, Cengage Learning, ISBN-13: 978813151654-6
3. Samuel D. konte and Cark de Boor, Elementary Numerical Analysis-An Algorithmic Approach, 3rd Edition, 1981, McGraw-Hill, ISBN: 0-07-012447-7
4. Mahendra K. Jain, Satteluri, R. K. Iyengar and Rajinder K. Jain, Numerical Methods : For Scientific And Engineering Computation, 6th Edition, 2014, New Age International Publishers, ISBN: 978-81-224-3323-4
5. John H. Mathews and Kurtis D. Fink, Numerical Methods using MATLAB, 4th Edition, 204, Pearson Education Inc., ISBN: 978-93-325-4935-7

Second year of Five Years Integrated M.Sc.(Physics) M.Sc. – II, Semester – IV	L	T	P	C
CY 210:ORGANIC CHEMISTRY-I	**3**	**1**	**2**	**5**

Course Outcomes **In the end of the semester students will able to:**	
CO1	Impart knowledge in fundamental aspects of organic chemistry.
CO2	Acquire knowledge on chemical properties of heterofunctional groups.
CO3	Acquaint basic knowledge in the chemical properties of carbohydrates and heterocyclic compounds.
CO4	Understand basic knowledge in stability and chemical properties of cycloalkanes.
CO5	Interpret the structural confirmation of carbohydrates.

Syllabus	
HETERO FUNCTIONAL GROUP – I	**(12 Hours)**
Aliphatic and aromatic halides, hydroxy derivatives, aliphatic alcohols and phenols. Ethers – aliphatic, and aromatic carbonyl compounds. Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. Preparation and synthetic applications of ethyl acetoacetate and diethyl malonate, tautomerism.	
HETERO FUNCTIONAL GROUP – II	**(08 Hours)**
Aliphatic and aromatic carboxylic acids and their functional derivatives. Nitrogen containing compounds - preparations and reaction mechanisms.	
CYCLOALKANES	**(06 Hours)**
Nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations, theory of strainless ring. Reactions and stereochemistry of substituted cyclohexane.	
HETEROCYCLIC COMPOUNDS	**(08 Hours)**
Nomenclature, aromaticity, synthesis, properties, reactivity, uses and canonical structures of; pyrrole, furan, thiophene, pyridine, quinoline and isoquinoline.	
CARBOHYDRATES	**(08 Hours)**
Introduction, basic structural features and types of carbohydrates, reactions and conversions, role in biological systems. Introduction to disaccharides, glycosidic bond, structure determination of sucrose, lactose, maltose and cellobiose.	
(Total Contact Time: 42 Hours)	

PRACTICALS:

1. Purification of liquid organic compounds

a. Distillation
b. Fractional distillation
c. Steam distillation/Vaccum distillation
d. Determination of boiling point using distillation
d. Distillation at reduced pressure

2. Purification of solid organic compounds

a. Crystallization
b. Sublimation
c. Fractional recrystallization

BOOKS RECOMMENDED:

1. M. Anne Fox, James K. Whitesell**,** Organic Chemistry, 3rd Edition, Jones & Bartlett Learning, 2004.
2. P. Y. Bruice**,** "Organic Chemistry", 3rd Edition, Prentice-Hall, International Edition, 2009.
3. R. T. Morrison, R. N. Boyd**,** Organic Chemistry', 7th Edition, Prentice Hall, 2011.
4. A. Streitwieser, Jr., C. H. Heathcock**,** Introduction to Organic Chemistry 4th Edition, MacMillan, New York, 1998
5. R. R. Gupta, M. Kumar, V. Gupta, Heterocyclic Chemistry, Volume 2, 1st Edition, Springer India Pvt. Ltd - New Delhi, 2009.

Additional Books:

6. T. W. G. Solomons, C. B. Fryhle**,** Organic Chemistry, 9th Edition, Wiley India Pvt. Ltd., 2009.
7. B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchell, Vogel's Textbook of Practical Organic Chemistry, Pearson India, 5th Edition, 2005.

Second year of Five Years Integrated M.Sc.(Physics) M.Sc. – II, Semester – IV	L	T	P	C
CY202:Introduction To Life Sciences	**3**	**0**	**0**	**3**

Course Outcomes **In the end of the semester students will able to:**	
CO1	Basic understanding of life science.
CO2	Discuss on interfaces between chemistry and biology.
CO3	Study about prokaryotic Diversity.
CO4	Understand cell structure and metabolisms.
CO5	Gain fundamental knowledge on bacteria and microorganisms.

Syllabus	
INTRODUCTION TO CELL BIOLOGY	**(09 Hours)**
Origin of life, Discovery of cell and Cell Theory; Comparison between plant and animal cells; Cell wall; Plasma membrane; Cytoskeleton; Protoplasm; Mitochondria; Chloroplast; ER; Golgi complex; Lysosome, Ribosome; Nucleus; Chemical components of a cell; Cell division and cell cycle: Mitosis and meiosis (different phases in cell division), their regulation, steps in cell cycle, and control of cell cycle.	
HEREDITY AND VARIATION	**(09 Hours)**
Mendelian inheritance; deviations from Mendelism – incomplete dominance, co-dominance, (example of heredity and variation multiple alleles and inheritance of blood groups), chromosome theory of inheritance; chromosomes and genes. DNA as genetic material; Structure of DNA and RNA; DNA packaging; DNA replication; Central dogma; transcription, genetic translation.	
PROKARYOTIC DIVERSITY	**(09 Hours)**
Prokaryotic Diversity: Importance of Taxonomy, Nomenclature and Bergey's Manual; **Archaea:** Archaea as earliest Life forms; Halophiles; Methanogens; Hyperthermophilic archaea; Thermoplasma; **Bacteria:** Purple and green bacteria; Cyanobacteria; Acetic acid bacteria; Spirilla; Spirochaetes; Pseudomonads; Lactic and propionic acid bacteria; Mycobacteria; Rickettsias, Chlamydias and Mycoplasms; **Viruses:** Bacterial, Plant, Animal and Tumor viruses; Discovery, classification and structure of viruses; **Eukarya:** Algae, Fungi, Slime molds and Protozoa.	
STRUCTURE AND FUNCTION OF BACTERIAL CELL	**(05 Hours)**
The cell wall of bacteria containing peptidoglycan and related molecules; the outer membrane and cytoplasmic membrane. Water and ion transport across membrane. Membrane structure & transport – Models of membrane structure, Membrane lipids, proteins and carbohydrates; Solute transport by Simple diffusion, Facilitated diffusion and Active transport.	
METABOLIC DIVERSITY AND SYNTROPY AMONG MICROORGANISMS	**(10 Hours)**

Bacterial Growth and Diversity, Bacterial cell cycle, Measurements and Isolation of Microorganism – Different Cultures – Media and Techniques of Staining (Gram-negative and Gram-positive bacteria); Introduction to photosynthesis in microorganisms (Role of Chlorophylls, carotenoids and phycobilins); Calvin cycle; Chemolithotrophy; Oxidation-reduction by bacteria: (Hydrogen - iron - nitrite – oxidizing bacteria; Nitrate and sulfate reduction); Methanogenesis and acetogenesis: Fermentations – diversity and syntropy.

(Total Contact Time: 42 Hours)

BOOKS RECOMMENDED:

1. D. O. Morgan, The cell cycle: Principle of controls, New Science Press, 2007.
2. D. M. Prescott, Reproduction in Eukaryotic cells, Academic press.
3. R.Y. Stainer, J. L. Ingraham, M. L. Wheelis, Painter, P. R. General Microbiology, The MacMillan Press Ltd.
4. D. L. Nelson, M. M. Cox, Lehninger's Principles of Biochemistry (5th edition), CBS Publications, 2008.
5. M. J. Jr. Peiczar, E.C.S. Chan, N. R. Kreig, Microbiology, Tata McGraw Hill.