Amrita VishwaVidyapeetham

Department of Sciences

Amrita School of Arts and Science

Mysuru Campus, Mysuru

BSc (Physics, Chemistry and Mathematics) Syllabus

Semester I

21ENG101 Communicative English 2 0 2 3

Objectives:

To help students obtain an ability to communicate fluently in English; to enable and enhance the students skills in reading, writing, listening and speaking; to impart an aesthetic sense and enhance creativity

COs	Course Outcomes	Justification
CO 1	Demonstrate competency in all the four linguistic skills, viz. listening, speaking, reading and writing	Assignments, Reading Comprehension, Speaking and Listening Activities
CO 2	Apply different styles of communication in professional context	Group Discussion, debates
CO 3	Participate in different planned & extempore communicative activities	Extempore speeches, presentations
CO 4	Interpret and discuss facts and information in a given context	Reading Comprehension, writing tasks involving critical analysis

CO 5	Develop an appreciation for human values	Literary Analysis and Discussion of Ethical Precepts

Unit I

Kinds of sentences, Word Order,usage of preposition, use of adjectives, adverbs for description, Determiners- Agreement (Subject – Verb, Pronoun- Antecedent) collocation

Unit II

Tenses

Reported speech

Active and passive Voice

Phrasal Verbs, Linkers/ Discourse Markers, Question Tags

Unit III

Paragraph writing – Cohesion - Development: definition, comparison, classification, contrast, cause and effect - Essay writing: Descriptive and Narrative

Unit IV

Reading Comprehension – Skimming and scanning- inference and deduction – Reading different kinds of material –Speaking**:** Narration of incidents / stories/ anecdotes- Current News Awareness

Unit V

Nirad C Chaudhuri "Indian Crowds" **[Non-Detailed**]

Dr S Radhakrishnan "The Shaping of my Character"[**Detailed**]

Charles Lamb" Dream Children" [**Detailed**]

Ruskin Bond "Night Train at Deoli" **[Non-Detailed**]

Rabindranath Tagore "Subha" **[Non-Detailed**]

Agra Gra " And you call me coloured" [**Detailed**]

Alfred Lord Tennyson "Ulysses" [**Detailed**]

CORE READING:

1. Ruskin Bond, *Time Stops at Shamli and Other Stories,* Penguin Books India Pvt Ltd, 1989
2. Syamala, V. *Speak English in Four Easy Steps*, Improve English Foundation Trivandrum: 2006
3. Online sources
4. M Nagarajan, T Sashisekaran, S Ramamurthy *Indian Prose for Effective Communication : A Practical Programme for Colleges* Trinity Press (An imprint of Laxmi Publications Pvt. Ltd.

References:

5. Ruskin Bond, *Time Stops at Shamli and Other Stories,* Penguin Books India Pvt Ltd, 1989
6. Martinet, Thomson, *A Practical English Grammar*, IV Ed. OUP, 1986.
7. Murphy, Raymond, *Murphy's English Grammar,* CUP, 2004

21CUL101 CULTURAL EDUCATION I 2-0-0 2

Introduction to Indian Culture
Introduction to Amma's life and Teachings
Symbols of Indian Culture
Science and Technology in Ancient India
Education in Ancient India
Goals of Life – Purusharthas
Introduction to Vedanta and Bhagavad Gita
Introduction to Yoga
Nature and Indian Culture
Values from Indian History
Life and work of Great Seers of India (1)

TEXTBOOKS:

1. The Glory of India (in- house publication)
2. The Mother of Sweet Bliss. (Amma's Life & Teachings)

PHYSICS PAPER - I

21PHY106MECHANICS 3-0-2 4

Course Objectives: To enable students to understand Newtonian mechanics and apply Newton's laws to explain natural physical phenomena.

Course Outcomes (CO):

CO1	Acquire basic knowledge of vector analysis and particle dynamics and its application.
CO2	To understand the basic knowledge of work power and energy and collision process.
CO3	Ability to understand the gravitation and laws of planetary motion, centre of mass.
CO4	To gain knowledge about the rotational kinematics and rigid body dynamics.
CO5	To gain basic understanding of the fluid dynamics.
CO6	Ability to do experiment on mechanics and analysis of results.

Unit - I

Vector Analysis: Integrals (line, surface and volume), Physical significance of Gradient, Divergence and curl, statement of Gauss's and Stroke's theorems.

Particle dynamics: Review of the equations of motion, projectile motion, Newton's First, Second and Third Law of Motion, Newton's I Law as a basic kinematical law defining a frame of reference, Newton's II Law as a basic dynamical law of mechanics and Newton's III law as an interaction law, Frames of reference, inertial and non-inertial, pseudo forces, Force laws, weight and mass, Application of Newton's law, importance of free body diagrams representing forces on the body in a free body diagram and frictional forces. Discussion of importance of friction in daily life.

Unit - II

Conservation Laws*:* Introduction, conservative forces, potential energy, complete solution for one, two and three dimensional systems, non-conservative forces, conservation of energy, conservation of energy to be seen as a spreading out and appearing in different forms, mass and energy.

Conservation of Linear Momentum: Centre of mass, motion of the center of mass, linear momentum of a particle, linear momentum of a system of particles, conservation of linear momentum, some applications of momentum principle, systems of variable mass – Rocket equation.

Collisions: Elastic and Inelastic, Collision in one and two dimensions.

Unit - III

Gravitation: Historical Introduction, Newton's law of Universal Gravitation, Universal Gravitation constant 'G', inertial and gravitational mass, variation in acceleration due to gravity with altitude and depth, motion of planets and satellites, gravitational field and potential, gravitational potential energy, potential energy for many particle systems, calculations of field and potential for (a) a spherical shell, (b) a sphere, energy consideration in the motion of planets and satellites.

Central Force*:* Kepler's laws of planetary motion, the inverse square law, Rutherford's problem, derivation of Kepler's Law from Universal law of Gravitation.

Unit - IV

Rotational Kinematics

Rotational variables, angular velocity, angular acceleration. Rotation with constant angular acceleration, Linear and angular variables, kinetic energy of rotation, rotational inertia, calculation of rotational inertia – of a rod, sphere and cylinder, torque, Newton's laws of rotation, work, power and work – kinetic energy theorem.

Dynamics of Rigid bodies

Angular momentum and moment of inertia, Theorem on moment of inertia, moment of inertia for (i) solid cylinder, (ii) rectangular slab, (iii) solid sphere and (iv) circular hoop.

Unit - V

Fluid Mechanism

Fundamental Definitions, Flow characteristics, Classifications of fluids, Fluid properties, Ideal fluids, Equation of Continuity,Irrational and rational Flow, Potential and stream functions, Viscous fluids, critical velocity, Derivation of Poiseuille's Equation.

PRACTICALS

(A minimum of ten experiments to be done from the list given below)

1. To Determine the Momentum of Inertia and Mass of a Flywheel.
2. Study of the motion of an air bubble.
3. Study of the motion of a freely falling body.
4. Study of the acceleration of a body subjected to different unbalanced forces.
5. Study of accelerations of different masses under a constant unbalanced force.
6. Study of conservation of energy and momentum in head-on-collision between two spheres of equal mass.
7. Conservation of momentum in an explosion.
8. Determination of Surface tension of liquid by capillary rise method.
9. To study the relation between length and time period of a simple pendulum.
10. Study of the rate of flow of water through a capillary tube under different pressure heads.
11. Momentum of inertia of a rod by torsional oscillation.
12. Determination of Acceleration due to Gravity and radius of gyration by Bar Pendulum.

Mapping of CO's and PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	1	3	3	3		1				3	2	3	
CO2	3	1	3	3	3		1				3	2	3	
CO3	3	1	2	1	3		1				3	2	3	
CO4	3	1	3	3	3		1				3	2	3	
CO5	3	2	2	3	3		1				3	2	3	
CO6	3	2	3	3	3	2	2			3	2	2	3	

TEXTBOOKS:

1. J C Upadhyaya, "*Classical Mechanics*", Himalaya Publishing house, Reprint-**2013**.
2. D S Mathur, "*Mechanics*", S Chand and company, New Delhi, Reprint-**2001**.
3. BrijLal, N Subrahmanyam, "*Properties of matter*", 6th edition, Eurasia publishing house Ltd.New Delhi, Reprint-**1993**.

REFERENCES:

1. Halliday, Resnick, Jearl Walker, "*Principles of Physics"* 9th edition, Wiley, **2013**.
2. Berkeley Physics Course, Vol-1 "*Mechanics"*, 2nd edition, Charles Kittle, Walter D Knight,Malvin A Ruderman, Carl A Helmholz, Burton J Moyer, Tata McGraw Hill Education Private Limited, New Delhi, (SIE)-**2011**.
3. D S Mathur, *"Elements of properties of matter"*, S Chand and company, New Delhi, Reprint-**2007**.

MATHEMATICS PAPER - I

21MAT106CALCULUS **3-1-0 4**

OBJECTIVES:

- To understand parameterisation of curves and to find arc lengths.

- To familiarise with calculus of multiple variables.
- To use important theorems in vector calculus in practical problems.

Course Outcomes (CO):

CO1	To gain knowledge in the basic concepts of vector valued functions, limits, derivatives and its geometrical interpretations.
CO2	Understand the concept of scalar and vector fields.
CO3	Understand and apply the concepts extreme values and Lagrange multipliers for simple optimization problems.
CO4	Understand and apply the concepts line and double integrals to various problems including Green's theorem for plane
CO5	Understand the concepts of surface integrals, divergence theorem and Stokes theorem.

Unit I

The Precise definition of a Limit – One-Sided Limits and Limits at Infinity – Infinite Limits and Vertical Asymptotes – Continuity – Tangents and Derivatives.

(Sections 2.1, 2.3-2.7)

Unit II

Extreme values of Functions – The Mean Value Theorem – Monotonic Functions and the First Derivative Test – Concavity and Curve Sketching – Integration-Riemann Sum – Definite integrals – The Fundamental Theorem of Calculus.

(Sections 4.1-4.4, 5.2-5.4)

Unit III

Functions in Several Variables – Limits and Continuity in Higher Dimensions – Partial Derivatives – Chain Rule – Directional Derivatives and Gradients – Tangent Planes and Differentials – Extreme Values and Saddle Points – Lagrange Multipliers.

(Sections 14.1-14.8)

Unit IV

Line integrals – Vector fields, Work, Circulation and Flux – Path Independence, Potential Functions and Conservative Fields – Green's Theorem in the Plane.

(Sections 16.1-16.4)

Unit V

Surface Areas and Surface Integrals – Parameterized Surfaces – Orientation of Surfaces – Stoke's Theorem and Divergence Theorem.

(Sections 16.5-16.8)

TEXTBOOKS:

1. G.B. Thomas and R.S. Finney, *Calculus*, 11th Edition, Pearson, 2009.

REFERENCES:

1. Monty J. Strauss, Gerald J. Bradley and Karl J. Smith, *Calculus*, 3rd Edition, 2002.
2. Dennis G. Zill and Michael R.Cullen, *Advanced Engineering Mathematics*, 2nd edition, CBS Publishers, 2012.
3. Srimanta Pal and Subhodh C Bhunia, *Engineering Mathematics*, 9th edition, John Wiley and Sons, 2012.
4. James Stewart, *Calculus: Early Transcendentals*, 8th Edition, Cengage (India), 2016.

Mapping of CO's and PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	1	2	-	2	3	3	4	2	2	3	
CO2	1	3	-	2	4	3	4	3	3	2	
CO3	1	2	1	2	3	3	3	2	2	3	
CO4	2	3	2	1	4	2	4	2	3	2	
CO5	1	3	1	1	4	2	4	3	2	3	

CHEMISTRY PAPER - I

21CHY106 ATOMIC STRUCTURE, CHEMICAL BONDING AND ANALYTICAL CHEMISTRY 3-0-2 4

OBJECTIVES: To develop an understanding of principles of Atomic structure, Bonding and Analytical Chemistry. To develop an understanding of the Periodic trends and to relate the properties of compounds in terms of their chemical bonding.

Course Outcome:

CO1	Describe the atomic level structure of elements, and interaction between atoms and electromagnetic radiation.
CO2	Describe the periodic trends in the properties of elements and to explain these trends based on the principles of atomic structure.
CO3	Apply theories of chemical bonding to explain and predict the structure, stability and properties of molecules.
CO4	Distinguish the various techniques for quantitative analysis and analyse the accuracy of the results of these analyses.
CO5	Identify and carry out quantitative analysis of the strength of solutions and composition of mixtures.

Unit I

Atomic Structure : Bohr model of hydrogen atom, Bohr's equation for the energy of electron in hydrogen atom, the hydrogen spectrum, limitations of Bohr theory, photoelectric effect, idea of de Broglie matter waves, Heisenberg's uncertainity principle and its significance, Schrodinger wave equation (derivation not expected), wave functions, significance of ψ (psi) and ψ^2, atomic orbitals, Nodal planes in atomic orbitals, quantum numbers (n, l, m), Zeeman effect, Stern-Gerlac experiment, spin quantum number (s), shapes of s, p and d orbitals. Aufbau and Pauli's exclusion principles, Hund's rule, energy level diagram of a multielectron atom, concept of effective nuclear charge, Slater's rules and applications, Electronic configuration of atoms.

Unit II

Periodic Properties: Classification of elements into s, p, d, and f-blocks, cause of periodicity. Atomic radius: Covalent, ionic and Vanderwaal's radii. Variation in a group and in a period. Variation of ionic radii in isoelectronic ions. Ionization enthalpy: Successive ionization enthalpy, factors affecting ionization enthalpy, variation in group and in a period. Electron gain enthalpy: Successive electron gain enthalpy variation in period and in a group. Electronegativity: Variation of electronegativity in a group and in a period. Factors determining electro negativity (charge on the atom and hybridization).

Pauling, Mulliken and Allred-Rochow scale of electronegativity. Applications of electronegativity.

Unit III

Chemical Bonding-I : Ionic bond: Factors that favor the formation of ionic bonds, Lattice energy, Born-Lande's equation (no derivation), Born-Haber cycle, setting up of Born-Haber cycle for 1:1 ionic solids. Numerical calculations of LE and EA based on Born-Haber cycle for 1:1 ionic solids, uses of Born-Haber cycle. Role of lattice energy and hydration energy and their importance in the context of stability and solubility of ionic solids. Covalent bond: Factors favoring the formation of covalent bond (ionization energy, electron affinity, electronegativity, nuclear charge, inter nuclear distance and number of valence electrons). Valence bond approach – explanation with examples to illustrate valence bond approach. Sigma and Pi bonds. Fajan's rules of polarization and their explanation. Bond length, bond order, bond energy and their significance, polarity of covalent bonds, polar and non-polar molecules, Dipole moment and polarity of molecules to be explained by taking HCl, CO_2, CCl_4 and H_2O as examples.

Unit IV

Chemical Bonding –II: Hybridization-directional property and geometry of sp, sp^2, sp^3, sp^3d and sp^3d^2 hybrid orbitals with examples respectively. VSEPR theory. Coordinate bond: with examples. Molecular Orbital Theory: An elementary account of MOT, linear combination of atomic orbitals (no mathematical approach). Bonding and antibonding molecular orbitals, conditions for the combination, energy levels of molecular orbitals, Molecular orbital structures and bond orders of simple molecules and ions, prediction of magnetic properties .

Unit V

Analytical Chemistry

Titrimetric analysis: fundamental concepts - mole, molarity, molality, ppm and ppb primary standard-secondary standard, quantitative dilution – problems. Acid base titrations- titration curves –pH indicators. Redox titrations – titration curve –titrations

involving MnO^{4-} and $Cr_2O_7^{2-}$ - redox indicators. Complexometric titrations – EDTA titrations - titration curves – indicators.

Statistical treatment of results of quantitative analysis: Classification of errors, accuracy, precision, minimization of errors (calibration of apparatus, running of blank determination, running parallel determination to be mentioned), significant figures and computation, mean and standard deviation (explanation with an example), distribution of random errors (explanation with the help of curve), reliability of results (F-test and t-test).

TEXTBOOKS:

1. J. D. Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science, London
2. B. R. Puri, L. R. Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi
3. B. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry, Vishal Pub. Co. Jalandhar
4. Vogel's Textbook of Quantitative Chemical Analysis 6th edn.,Pearsons Education Ltd

REFERENCES:

1. C. N. R. Rao, University General Chemistry, Macmillan, India
2. F. A. Cotton, G. Wilkinson and P.L. Gaus, Basic Inorganic Chemistry, 3 rdedn., John Wiley
3. D. F. Shriver and P. W. Atkins, Inorganic Chemistry, 3 rdedn., Oxford University Press
4. B. Douglas, D. Mc Daniel, J. Alexander, Concepts and models in Inorganic Chemistry
5. D. A. Skoog, D. M. West, and S. R. Crouch, Fundamentals of Analytical Chemistry 8th edn, Brooks/Cole Nelson
6. G. D. Christian, Analytical Chemistry, John Wiley and Sons

PRACTICALS

VOLUMETRIC ESTIMATIONS

1. Estimation of Sodium Carbonate and Sodium Bicarbonate in a mixture.
2. Estimation of Ammonia in Ammonium Salt by Back Titration.

3. Estimation of Ferrous ions using Potassium Permanganate
4. Estimation of Oxalic acid using Potassium Permanganate
5. Estimation of Ferrous ions Using Potassium Dichromate with Internal & External Indicators.
6. Standardisation of Sodium Thiosulphate using Potassium Dichromate and estimation of Iodine.
7. Estimation of Copper in a Copper salt by Iodimetry
8. Standardisation of EDTA solution using Zinc Sulphate and determination of Mg or Ca

REFERENCE:

A Text Book of Quantitative Inorganic Analysis, A. I. Vogel

Mapping of CO's and PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	-	3		1				3	2	3	
CO2	3	1	3	3	3		1				3	2	3	
CO3	3	1	2	1	3		1				3	2	3	
CO4	3	1	3	3	3		1				3	2	3	
CO5	3	2	2	3	3		1				3	2	3	

21ENV200 Environmental Science and Sustainability 3-0-0 3

Unit 1

State of Environment and Unsustainability, Need for Sustainable Development, Traditional conservation systems in India, People in Environment, Need for an attitudinal change and ethics, Need for Environmental Education, Overview of International Treaties an Conventions, Overview of Legal and Regulatory Frameworks.

Environment: Abiotic and biotic factors, Segments of the Environment, Biogeochemical Cycles, Ecosystems (associations, community adaptations, ecological succession, Food webs, Food chain, ecological pyramids), Types of Ecosystems – Terrestrial ecosystems, Ecosystem Services, Economic value of ecosystem services, Threats to ecosystems and conservation strategies.
Biodiversity: Species, Genetic & Ecosystem Diversity, Origin of life and significance of biodiversity, Value of Biodiversity, Biodiversity at Global, National and Local Levels, India as a Mega-Diversity Nation (Hotspots) & Protected Area Network, Community Biodiversity Registers. Threats to Biodiversity, Red Data book, Rare, Endangered and Endemic Species of India. Conservation of Biodiversity. People's action.
Impacts, causes, effects, control measures, international, legal and regulatory frameworks of: Climate Change, Ozone depletion, Air pollution, Water pollution, Noise pollution, Soil/ land degradation/ pollution

Unit 2

Linear vs. cyclical resource management systems, need for systems thinking and design of cyclical systems, circular economy, industrial ecology, green technology. Specifically apply these concepts to: Water Resources, Energy Resources, Food Resources, Land & Forests Waste management.
Discuss the interrelation of environmental issues with social issues such as: Population, Illiteracy, Poverty, Gender equality, Class discrimination, Social impacts of development on the poor and tribal communities, Conservation movements: people's movements and activism, Indigenous knowledge systems and traditions of conservation.

Unit 3

Common goods and public goods, natural capital/ tragedy of commons, Cost benefit analysis of development projects, Environment Impact Assessment (EIA), Environment Management Plan (EMP), Green business, Eco-labeling, Problems and solutions with case studies.

Global and national state of housing and shelter, Urbanization, Effects of unplanned development case studies, Impacts of the building and road construction industry on the environment, Eco-homes/ Green buildings, Sustainable communities, Sustainable Cities. Ethical issues related to resource consumption, Intergenerational ethics, Need for investigation and resolution of the root cause of unsustainability, Traditional value systems of India, Significance of holistic value-based education for true sustainability.

TEXTBOOKS/ REFERENCES:

1. R. Rajagopalan, Environmental Studies: From Crisis to Cure. Oxford University Press, 2011, 358 pages. ISBN: 9780198072089.
2. Daniel D. Chiras, Environmental Science. Jones & Bartlett Publishers, 01-Feb-2012, 669 pages. ISBN: 9781449645311.
3. Andy Jones, Michel Pimbert and Janice Jiggins, 2011. Virtuous Circles: Values, Systems, Sustainability. IIED and IUCN CEESP, London. URL:http://pubs.iied.org/pdfs/G03177.pdf
4. Annenberg Learner, The Habitable Planet, Annenberg Foundation 2015. URL: http://www.learner.org/courses/envsci/unit/pdfs/textbook.pdf.

Semester II

21ENG111 Professional Communication 1 0 2 2

Objectives:

To convey and document information in a formal environment; to acquire the skill of self projection in professional circles; to inculcate critical and analytical thinking.

COs	Course Outcomes	Justification
CO 1	Demonstrate competency in oral	Presentation, writing assignment

	and written communication	
CO 2	Apply different styles of communication in professional context	Business letters, circulars, memos, e-mails
CO 3	Participate in different planned & extempore communicative activities	Presentation, speech
CO 4	Interpret and discuss facts and information in a given context	Group discussion
CO 5	Develop critical and analytical thinking	Essays, book reviews

Unit I

Vocabulary Building: Prefixes and Suffixes; One word substitutes, Modal auxiliaries, Error Analysis: Position of Adverbs, Redundancy, modifiers (displaced**, d**angling etc)

Unit II

Instruction, Suggestion & Recommendation - Sounds of English: Stress, Intonation

- Essay writing: Analytical and Argumentative

Unit III

Circulars,Memos – BusinessLetters - e - mails

Unit IV

Reports: Trip report, incident report, event report - Situational Dialogue - Group Discussion

Unit V

Mini Project and Presentation

References

1. FelixaEskey. *Tech Talk*, University of Michigan. 2005
2. Michael Swan. *Practical English Usage*, Oxford University Press. 2005
3. Anderson, Paul. *Technical Communication: A Reader Centered Approach*,

V Edition, Hercourt, 2003.

4. Raymond V. Lesikar and Marie E. Flatley. *Basic Business Communication*, Tata

McGraw Hill Pub. Co. New Delhi. 2005. Tenth Edition.

5. Thampi, G. Balamohan. *Meeting the World: Writings on Contemporary Issues*. Pearson, 2013.
6. Lynch, Tony. *Study Listening*. New Delhi: CUP, 2008.
7. Kenneth, Anderson, Tony Lynch, Joan Mac Lean. *Study Speaking*. New Delhi: CUP, 2008.
8. Marks, Jonathan. *English Pronunciation in Use*. New Delhi: CUP, 2007.
9. Syamala, V. *Effective English Communication For You (Functional Grammar, Oral and Written Communication)*: Emerald, 2002.

21CUL111 CULTURAL EDUCATION II 2-0-0 2

Bhagavad Gita and Life Management
Historicity of Ramayana and Mahabharata
Overview of Patanjali's Yoga Sutras
Highlights of Indian Mythology
Indian Society: Its Strengths and Weaknesses
Role & Position of Women in Indian Society
Indian Models of Economy, Business and Management
Health and Lifestyle related issues
Conservation of cultural heritage
Life and work of Great Seers of India (2)

TEXTBOOKS:

1. The Glory of India (in- house publication)

2. Sanatana Dharma (A Compilation of Amma's teachings on Indian Culture)

PHYSICS PAPER - II

21PHY116HEAT AND THERMODYNAMICS 3- 0 -2 4

Objective: To enable students to see relation between linear and rotational motion and understand the production and propagations of waves in elastic media. And also understand the laws of thermodynamics and its applications.

Course Outcome:

CO1	Ability to explain the kinetic theory of gases.
CO2	To understand the basic concept of heat and first law of thermodynamics.
CO3	To gain the knowledge about Carnot's engine. Second law of thermodynamics and its application.
CO4	Interpretation thermodynamic potential and Maxwell's equation.
CO5	To analyse the statistical interpretation of laws of thermodynamics
CO6	Ability to do experiment on heat and thermodynamics.

Unit I

Kinetic Theory of Gases: Introduction, Kinetic Theory of Gases, kinetic theory as particle model and usefulness of the model in explaining the regular structure of crystals (Review), an ideal gas – a macroscopic description, an ideal gas – a microscopic description, kinetic calculation of pressure, kinetic interpretation of temperature, ideal gas scale, intermolecular forces, specific heat of an ideal gas, law of equipartition of energy.

Mean free path, van der Waal's equations of State, critical constants, application to liquefaction of gases.

Unit II

Heat and First Law of Thermodynamics: Thermal equilibrium, Zeroth law of thermodynamics, ideal gas temperature scale, heat as a form of energy, quantity of heat

and specific heat, molar heat capacities of solids, the mechanical equivalent of heat, heat and work; First law of thermodynamics, Discussion on usefulness of First Law of Thermodynamics in Meteorology, some special cases of the first law of thermodynamics – (i) adiabatic process, (ii) isothermal process, (iii) isochoric process, (iv) cyclic process, (v) free expansion.

Unit III

Entropy and Second Law of Thermodynamics: Introduction, reversible and irreversible processes, the Carnot cycle, Carnot engine, Carnot theorem, absolute scale of temperature, second law of thermodynamics, efficiency of engines, the thermodynamic temperature scale, entropy in reversible and irreversible processes, entropy and the II law, entropy and disorder, consequences of II and III law of thermodynamics, Second law of thermodynamics as a probabilistic statement.

Low temperature Physics – Porous Plug experiment, temperature of inversion, principle of regenerative cooling, liquefaction of air by Linde's method.

UnitIV

Thermodynamic potentials: Internal Energy, Enthalpy, Helmholtz function, Gibbs function, relations among these functions, Gibbs-Helmholtz equations

Maxwell's Thermodynamic Relations: Derivation of Maxwell's thermodynamic relations, TdS equations, Internal energy equations, Heat capacity equations. Change of temperature during adiabatic process using Maxwell's relations

Unit V

The Statistical Physics: statistical basics of thermodynamics, probability distribution, micro and macro states, constraints, Distribution of particles and energy states. Statistical interpretation of second law of thermodynamics, Boltzmann's canonical distribution law and its application.

PRACTICALS

(A minimum of ten experiments to be done from the list given below)

1. Study of the oscillations of a column of water as a function of its length and study of damped oscillation.
2. To determine the velocity of sound at room temperature and the end correction by setting up a resonance column (first resonance length).
3. Study of torsional oscillations of a loaded wire and determination of the rigidity modulus of the material of the wire.
4. Verification of Stefan's Boltzmann law using Potentiometer.
5. Study of Newton's law of cooling.
6. Determination of Thermal conductivity of a bad conductor by Lee Charlton method.
7. Specific heat of a solid by the method of mixtures.
8. Determination of latent heat of fusion of ice by calorimetric method.
9. J by Joules Calorimeter.
10. Study of transverse vibrations on a sonometer. To determine the frequency by (i) absolute method, (ii) Comparison method
11. Melde's experiment – determination of frequency
12. Frequency of AC by a sonometer.

Mapping of CO's and PO's

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	2	3	3	2	1				3	2	3	
CO2	3	2	2	3	3	1	1				3	2	3	
CO3	3	2	3	3	3	1	1				3	2	3	
CO4	3		2	3	3	1	1				3	2	3	
CO5	3	2	3	3	3	1	1				3	2	3	
CO6	3	3	3	3	3	2	2			3	2	3	3	

TEXTBOOKS:

1. Halliday and Resnick: Fundamentals of Physics, 9th edition, Wiley India, 2011.

2. Brijlal,N. Subramanyam P.S. Hemne: Heat Thermodynamics and Statistical Physics, 1st Edition. S Chand Publishing, 2007.
3. S C Gupta: Thermodynamics, 1st edition, Pearson, 2005.

REFERENCES:

1. R. H. Dittaman and M. W. Zemansky: Heat and Thermodynamics, 7th edition, The McGraw - Hill companies, 2007.
2. S. J. Blundell and K. M. Blundell: Concepts in Thermal Physics, 2nd edition, Oxford University Press, 2006.

MATHEMATICS PAPER - II

21MAT116 LINEAR ALGEBRA 3-1-0 4

OBJECTIVES:

- Understand the basic concepts of vector space, subspace, basis and dimension.
- Familiar the inner product space. Finding the orthogonal vectors using inner product.
- Understand and apply linear transform for various matrix decompositions.
- Understand basic concepts of eigenvalues and eigenvectors.

Course Outcomes:

CO1	Understand and apply the basic concepts of matrix theory in to problems.
CO2	Understand the basic concepts of vector space, subspace, basis and dimension.
CO3	Understand the basic concepts of inner product space, norm, angle, Orthogonality and projection and implementing the Gram-Schmidt process, to obtain least square solution.
CO4	Understand the concept of linear transformations, the relation between matrices and linear transformations, kernel and range.
CO5	Understand the concepts of eigenvalue and eigenvector and apply to diagonalization problems.

Unit I

Matrices: Determinant and inverse of a matrix – Trace and Transpose – Determinants – Symmetric and Skew Symmetric Matrices – Hermitian and Unitary matrices – System of linear equations – consistency and solutions by Guess methods.
(Sections: 1.1-1.7,2.1)

Unit II

Vector Spaces: Real Vector spaces – Sub spaces – Linear independence – Coordinates and Basis – Dimension – Change of Basis – Row Space – Column Space and Null Space – Rank and Nullity.
(Sections: 4.1 – 4.8)

Unit III

Inner Product Spaces: Inner products – Orthogonality – Gram Schmidt Process – QR Decomposition – Best Approximation – Least Squares.
(Sections 6.1 – 6.4)

Unit IV

Eigen values and Eigen vectors: Problems in Eigen Values and Eigen Vectors – Diagonalization – Orthogonal Matrices – Orthogonal Diagonalization – Quadratic Forms.
(Sections 7.1 – 7.3)

Unit V

Linear Transformations: General Linear Transformations – Relation between matrices and linear transformations – Kernel and range of a linear transformation – Isomorphisms – Compositions and Inverse Transformations – Matrices for General Linear Transformations – Similarity.
(Sections 8.1 – 8.5, 5.1-5.2)

TEXTBOOKS:

1. Howard Anton and Chris Rorres, "*Elementary Linear Algebra*", Tenth Edition, John Wiley & Sons, 2010.
2. Kenneth Hoffmann and Ray Kunze, *Linear Algebra*, Second Edition, Prentice Hall, 1971.
3. I. N. Herstein, 'Topics in Algebra', Second Edition, John Wiley and Sons, 2000.

REFERENCES:

1. Nabil Nassif, Jocelyne Erhel, Bernard Philippe, Introduction to Computational Linear Algebra, CRC press, 2015.
2. Gilbert Strang, "*Linear Algebra and Its Applications*", Fourth Edition, Cengage, 2006.

Mapping of CO's to PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	2	-	2	4	4	3
CO2	1	3	-	2	4	2	4
CO3	1	2	-	1	3	4	3
CO4	1	2	2	2	3	4	4
CO5	2	3	2	1	4	4	4

CHEMISTRY PAPER - II

21CHY116 NUCLEAR CHEMISTRY, STATES OF MATTER AND CHEMISTRY OF S AND P BLOCK ELEMENTS 3- 0 -2 4

OBJECTIVES: To enable students to develop an understanding of properties of Solids, Liquids and Gases, understand the shapes of molecules in terms of symmetries and to relate the properties of the matter in solid state to the structure, develop an understanding of the periodic trends, preparations, properties and uses of s and p block elements and their compounds.

Course Outcome:

CO1	Explain the principles of nuclear chemistry and their application to the fields of medicine, agriculture and industry.

CO2	Apply the principles of physics to quantitatively describe the thermodynamic properties of ideal and real gases.
CO3	Exlplain the physical and chemical properties of liquids and demonstrate the application of experimental methods for the quantitative analysis of these properties.
CO4	Describe the structure of crystalline solids and explain the basic principles of heterogeneous catalysis.
CO5	Apply principles of atomic structure and chemical bonding to describe physical and chemical properties of the compounds of s and p block elements.
CO6	Apply qualitative analysis techniques to identify the chemical composition of inorganic salt mixtures.

Unit I

Nuclear Chemistry: Nuclear particles, nuclear forces, nuclear size, nuclear density, stability of nucleus, binding energy, packing fraction, n/p ratio. Nuclear models – liquid drop model and shell model. Natural radioactivity, modes of decay, decay constant, half-life period, average life, radioactive equilibrium, Geiger-Nuttall rule, units of radioactivity, radiation dosage. Induced radioactivity, nuclear reactions induced by charged projectiles, neutrons and γ rays, fission reactions, fusion reactions, spallation reactions, preparation of transuranic elements, Q values of nuclear reactions. Fertile and fissile isotopes, chain reaction, stellar energy. Application of Radioactivity and Radio isotopes as tracers in analysis, Reaction mechanism through tracer chemistry in medicines, in biological field, in agriculture and industry.

Unit II

Gases : Kinetic molecular model of gases: pressure of an ideal gas, derivation of gas laws, Maxwell's distribution of velocities – molecular velocities (average, root mean square and most probable velocities) Collision diameter, mean free path, viscosity of gases – temperature and pressure dependence. Relation between mean free path and coefficient of viscosity. Barometric distribution law, Law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

Real gases: compressibility factor z, van der Waals equation of state – derivation and application in explaining real gas behavior. Virial equation of state, van der Waals equation expressed in virial form – calculation of Boyle temperature, Isotherms of real

gases, continuity of states. Critical phenomena. Liquefaction of gases (based on Joule-Thomson effect)

Unit III

Liquids: Intermolecular forces in liquids (qualitative idea only)- viscosity, the viscometer method

Surface tension - structure of liquids. Unusual behavior of water. Non-aqueous Solvents- Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. Classification of acids and bases as Hard and Soft. Pearson's HSAB concept, acid-base strength, hardness and softness, symbiosis.

Unit IV

Solids: Elements of symmetry – plane, axis and centre, elements of symmetry in cubic crystals,

law of rational indices – Weiss and Miller indices, lattice planes in cubic crystals. Crystal lattice and unit cell, types of Lattice – Bravais lattices, X-Ray diffraction and Bragg's Law (to be derived), determination of crystal structure of rock salt by rotating crystal method using Bragg's spectrometer, application of X-ray studies – distance between lattice planes, density of crystals, determination of Avogadro Number (numerical problems on applications).

Study of Characteristics of Solid surface, surface phenomenon to explain various applications in daily life situations. Catalysis, characteristics of catalysed reactions, classification of catalysis, miscellaneous examples. Statement and explanation of BET and Gibbs Isotherms. Determination of surface area of adsorbent using Langmuir equation. Adsorption theory of Catalysts using Langmuir's Equation

Unit V

Chemistry of s and p block elements : General characteristics of elements- Electronic configuration, oxidation state, inert pair effect, melting points and boiling points, densities, metallic character, nature of bonds formed, , hydration of ions and ionic conductance in solution (only alkali metals), flame colouration. Reactivity, electrode potentials and reducing properties, reaction with water. Compounds – Oxides and

peroxides-formation and reaction with water, basic character of oxides and hydroxides. Carbonates-thermal stability. Reasons for anomalous behaviour of Li and Be, diagonal relationship of Li and Mg. Hydrides- classification of boron hydrides, diborane- preparation from BCl_3, properties(reactions with ammonia and Lewis acid properties) and structure (based on VBT). Halides- comparison of Lewis acid character of boron trihalides. Catenation, allotropic forms of carbon- diamond, graphite and fullerenes (C_{60}) and their structures, carbon nanotubes (brief mention without structural details). Silicates- Classification, structures of ortho and pyrosilicates.

TEXTBOOKS:

1. Puri B.R., Sharma L.R. and Kalia K.C., (2006). Principles of Inorganic Chemistry, 29thEdition, Milestone Publ., Delhi.
2. Puri, B.R., Sharma, L.R. and Pathania, M.S. (2005), 41st Edition, Principles of Physical Chemistry, Vishal Publ. Co., Jalandhar.
3. Arnikar. H. J., (1995), Essential of Nuclear Chemistry, 4th Edition, New Age International Publishers, New Delhi.

REFERENCES:

1. R. Gopalan, Elements of Nuclear Chemistry, Vikas Publ. House
2. K. L. Kapoor, A Textbook of Physical chemistry, Volumes 1, Macmillan India Ltd
3. P. Atkins and J Paula, The elements of Physical chemistry, 7th edn., Oxford University Press
4. F. A. Alberty and R J Silby, Physical Chemistry, 3 rdEdn, John Wiley

PRACTICALS

1. Systematic semi-micro qualitative analysis of a mixture of two simple salts (with no interfering radicals). Constituent ions in the mixture to be restricted to the following.
   Anions: HCO_3^- , CO_3^{2-}, SO^{3-}, Cl^-, Br^-, NO^{3-}, SO_4^{2-}, BO_3^{3-}, PO_4^{3-}
   Cations: Pb^{2+}, Bi^{3+}, Cd^{2+}, Al^{3+}, Fe^{2+}, Fe^{3+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Ca^{2+}, Sr^{2+}, Mg^{2+}, K^+, Na^+ and Mg^{2+}

   Note: Mixtures requiring elimination of borate and phosphate to be avoided. Combination of anions of 2nd group shall be avoided. The combination of two cations in the mixture should belong to different groups.

2. Determination of density by specific gravity bottle and viscosity of the given liquid by Ostwald's viscometer
3. Determination of density by specific gravity bottle and surface tension of the given liquid by stalagmometer.
4. Determination of refractive index of pure liquids and mixtures.

Mapping of CO's and PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	2	3	3	4	2	2	3	2
CO2	1	3	3	2	4	3	4	3	3	2	3
CO3	1	2	1	2	3	3	3	2	2	3	3
CO4	2	3	2	1	4	2	4	2	3	2	2
CO5	1	3	1	1	4	2	4	3	2	3	2
CO6	2	3	1	3	3	2	3	2	3	2	3

21LAW200 INDIAN CONSTITUTION 2-0-0 2

OBJECTIVE: The preliminary objective is to ensure that every student has some knowledge about Indian Constitution.

Unit I

Meaning and Importance of Constitution, Preamble and Salient Features of the Constitution.

Unit II

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

Unit III

Union Government – LokSabha and RajyaSabha Composition, Powers and functions: The President, The Prime Minister and Supreme Court: Role Position and Powers/ functions.

Unit IV

State Government - Legislative Assembly and Legislative Council: Composition, Powers and functions: The Governor, Chief Minister and High Court: Role, Position and Powers/ functions.

Unit V

Local self-Government, Panchayat Raj System in India; Election Commission; Public Service Commissions, Role, powers and function

Skill development Activities:

- Court Visit & Report Presentation
- Group discussion(Fundamental rights and duties)

REFERENCES:

1. Introduction to The constitution of India – M V Pylee, Vikas publishing house Pvt LTD
2. Introduction to The constitution of India – Dr. Durga das Basu, 19th edition Reprint 2007

Semester III

21AVP201/	**AMRITA VALUES PROGRAMME - I**	**1-0-0 1**
21AVP211	**AMRITA VALUES PROGRAMME - II**	**1-0-0 1**

Amrita University's Amrita Values Programme (AVP) is a new initiative to give exposure to students about richness and beauty of Indian way of life. India is a country where history, culture, art, aesthetics, cuisine and nature exhibit more diversity than nearly anywhere else in the world.

Amrita Values Programmes emphasize on making students familiar with the rich tapestry of Indian life, culture, arts, science and heritage which has historically drawn people from all over the world.

Students shall have to register for any two of the following courses, one each in the third and the fourth semesters, which may be offered by the respective school during the concerned semester.

Insights into Indian Classical Mus

The course introduces the students into the various terminologies used in Indian musicology and their explanations, like Nadam, Sruti, Svaram – svara nomenclature, Stayi, Graha, Nyasa, Amsa, Thala,- Saptatalas and their angas, Shadangas, Vadi, Samavadi, Anuvadi. The course takes the students through Carnatic as well as Hindustani classical styles.

Insights into Traditional Indian Painting

The course introduces traditional Indian paintings in the light of ancient Indian wisdom in the fields of aesthetics, the Shadanga (Sixs limbs of Indian paintings) and the contextual stories from ancient texts from where the paintings originated. The course introduces the painting styles such as Madhubani, Kerala Mural, Pahari, Cheriyal, Rajput, Tanjore etc.

Insights into Indian Classical Dance

The course takes the students through the ancient Indian text on aesthetics the Natyasastra and its commentary the AbhinavaBharati. The course introduces various styles of Indian classical dance such as Bharatanatyan, Mohiniyatton, Kuchipudi, Odissy, Katak etc. The course takes the students through both contextual theory as well as practice time.

Indian Martial Arts and Self Defense

The course introduces the students to the ancient Indian system of self-defense and the combat through various martial art forms and focuses more on traditional Kerala's traditional KalariPayattu.

The course introduces the various exercise technique to make the body supple and flexible before going into the steps and techniques of the martial art. The advanced level of this course introduces the technique of weaponry.

Social Awareness Campaign

The course introduces the students into the concept of public social awareness and how to transmit the messages of social awareness through various media, both traditional and modern. The course goes through the theoretical aspects of campaign planning and execution.

Temple Mural Arts in Kerala

The traditional percussion ensembles in the Temples of Kerala have enthralled millions over the years. The splendor of our temples makes art enthusiast spellbound, warmth and grandeur of color combination sumptuousness of the outline, crowding of space by divine or heroic figures often with in vigorous movement are the characteristics of murals.

The mural painting specially area visual counterpart of myth, legend, gods, dirties, and demons of the theatrical world, Identical myths are popular the birth of Rama, the story of Bhīma and Hanuman, Shiva, as Kirata, and the Jealousy of Uma and ganga the mural painting in Kerala appear to be closely related to, and influenced by this theatrical activity the art historians on temple planes, wood carving and painting the architectural plane of the Kerala temples are built largely on the pan-Indians almost universal model of the vasthupurusha.

Organic Farming in Practice

Organic agriculture is the application of a set of cultural, biological, and mechanical practices that support the cycling of farm resources, promote ecological balance, and conserve biodiversity. These include maintaining and enhancing soil and water quality;

conserving wetlands, woodlands, and wildlife; and avoiding use of synthetic fertilizers, sewage sludge, irradiation, and genetic engineering.
This fact sheet provides an overview of some common farming practices that ensure organic integrity and operation sustainability.

Ayurveda for Lifestyle Modification

Ayurveda aims to integrate and balance the body, mind, and spirit which will ultimately leads to human happiness and health. Ayurveda offers methods for finding out early stages of diseases that are still undetectable by modern medical investigation. Ayurveda understands that health is a reflection of when a person is living in harmony with nature and disease arises when a person is out of harmony with the cycles of nature. All things in the universe (both living and non-living) are joined together in Ayurveda. This leaflet endow with some practical knowledge to rediscover our pre- industrial herbal heritage.

Life Style and Therapy using Yoga

Yoga therapy is the adaptation of yogic principles, methods, and techniques to specific human ailments. In its ideal application, Yoga therapy is preventive in nature, as is Yoga itself, but it is also restorative in many instances, palliative in others, and curative in many others. The therapeutic effect comes to force when we practice daily and the body starts removing toxins and the rest is done by nature.

PHYSICS PAPER - III

21PHY206ELECTRICITY AND MAGNETISM 3 -0- 2 4

Objective: To enable students to acquire a broad conceptual framework of electromagnetic phenomena.

Course Outcome:

CO1	To demonstrate basic knowledge in electrostatics and electric dipole.

CO2	Apply the basic principles of electrostatics solve the problems of Dielectric constant and polarizability.
CO3	Analysis of different laws of magneto statics.
CO4	Ability to implement basic principles of electromagnetic induction.
CO5	Explain the basic concepts of alternating current and filters.
CO6	Ability to do experiments on electricity and magnetism.

Unit I

Electrostatics: Electrical pressure on a charged surface. The path traced by a charged particle in a transverse electric field. The attracted disc electrometer – construction, theory and applications.

Review of concept of electric field and electric field due to point charge. Electric field due to (i) electric dipole, (ii) line of charge and (iii) charged disc

A dipole in an electric field, torque on a dipole in uniform and non-uniform E fields, potential energy of an electrical dipole.

Unit II

Electric Fields in matter: Capacitance, parallel plate capacitor, calculation of capacity of a spherical and cylindrical capacitor, energy stored in a capacitor, capacitor with dielectric, atomic view of dielectrics, polarization, electric field due to a polarised material, Gauss's law in dielectrics, Dielectric constant, Energy density of an electrostatic field (with and without dielectric). Polarisability and susceptibility – Frequency dependence of polarisability, Clausius- Mossotti equation.

Unit III

Magneto statics: Review of Ampere's law, B near a long wire, Magnetic lines of induction, force between two parallel conductors, definition of ampere, B for a solenoid, Biot-savart's law, and applications of Biot-savart's law.

The magnetic field, Lorentz force and definition of magnetic field, magnetic induction, magnetic force on a current element, circulating charges, Cyclotron resonance frequency, Cyclotron.Magnetisation, magnetization current density, magnetic field intensity, magnetic susceptibility and permeability.

Unit IV

Electromagnetic Induction: Review of Faraday's law, Faraday's experiment, Lenz's law, Time varying magnetic fields, Application in betatron.

Inductance*:* Self-inductance, LR circuit, energy in a magnetic field, magnetic energy density.

Alternating current and filter: R M S values, Response of LR, CR and LCR circuits to sinusoidal voltages (discussion using the j symbol), Series and parallel resonance, Half-power frequencies, bandwidth and Q-factor, Power in electrical circuits, power factor, Maximum power transfer theorem (with proof).

Unit V

Electromagnetic Theory And Maxwell's Equations (12 hrs.) : Displacement current, Setting up of Maxwell's equations in SI units, Hertz experiment, Travelling electromagneticwave, Wave equations (qualitative and quantitative) – Energy transport and Poynting vector,Poynting theorem. A radiation pressure (Normal and Oblique incidence). Concept of electricdipole, magnetic dipole, expression for energy radiated by a dipole (No derivation)

PRACTICALS

(A minimum of ten experiments to be done from the list given below)

1. Determination of Q factor by series resonance
2. Determination of Q factor by parallel resonance
3. Determination of self-inductance of a coil using Anderson's Bridge
4. Determination of capacitance by measuring impudence of RC circuit
5. Determination of Inductance by measuring impudence of RL circuit
6. De Sauty's Bridge.
7. Determination of resistivity of a material using low resistance
8. Study of decay of current in LR and RC circuit
9. Measurement of B by current balance
10. To show that the behavior of an inductance in an AC circuit is analogous to that of a resistor which obeys Ohm's Law and hence to measure inductance.

11. High pass filter.

12. Low pass filter.

Mapping of CO's and PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	3	3	1	2				3	2	3	
CO2	3	2	3	3	3	1	2				3	2	3	
CO3	3	2	3	3	3	1	2				3	2	3	
CO4	3	2	3	3	3	1	2				3	2	3	
CO5	3	2	3	3	3	1	2				3	2	3	
CO6	3	2	3	3	3	2	3				2	3	3	

TEXTBOOKS:

1. Electricity and Magnetism, Fewkes and Yarwood.

2. Electricity and Magnetism:A N Matveev, Mir Publishers, Moscow.

3. Electricity and Magnetism, F.W.Sears, Addison Wesley Co.

4. K. K. Tewari: Electricity and magnetism, S.Chand Co. Ltd., New Delhi, Reprint 2007.

REFERENCES:

1. Fundamentals of Physics, 6th Edition, David Halliday, Robert Resnick and Jearl Walker, John Wiley, Inc.

2. Fundamentals of Electricity and Magnetism:A F Kipp, McGraw Hill.

3. Halliday/Resnick/Walker: Fundamentals of Physics, 8th edition, John Wiley &Sons(Asia) Pvt. Ltd.

4. B. B. Laud: Electrodynamics, Wiley Eastern Limited, New Delhi.

5. David. J. Griffiths: Introduction to Electrodynamics, 3rd edition, Prentice-Hall of India Private Limited, New Delhi.

6. W.H. Hayt and J. A. Buck: Engineering Electromagnetism, 6th edition, Tata McGraw Hill, New Delhi.
7. BrijLal and N. Subrahmanyam: A text book of Electricity and Magnetism, 19th edition-RatanPrakashanMandir, Educational and University Publishers, Agra.
8. A.B.Bhattacharya and R.Bhattacharya, Under Graduate Physics, Volume II, New Central Book Agency(P) Ltd., Kolkata.
9. D.N. Vasudeva: Fundamentals of Magnetism and Electricity, 12th edition-S.Chand and Co. Ltd., New Delhi

MATHEMATICS PAPER - III

21MAT206 DIFFERENTIAL EQUATIONS 3-1-0 4

Objectives: To enable students to develop the knowledge of standard concepts of ordinary differential equations and apply analytical techniques to compute solutions to various differential equations.

Course Outcomes:

CO1	Understand and apply the basic concepts of differential equations in to problems.
CO2	Solve basic application problems described by second order linear differential equations with constant coefficients.
CO3	Create and analyze mathematical models using higher order differential equations to solve application problems
CO4	Understand the concept of Lagrange's linear equation, Methods to solve the first order partial differential equations
CO5	Understand the concepts of homogeneous andnon-homogeneous linear partial differential equations of higher order.

Unit I

Review of differential equations (order – degree – linear – nonlinear – implicit and explicit form of solution – general solutions – particular solution – singular solution) – Exactness – non-exact equations reduce to exact form.

(Part I: 1.1-1.9, 2.12-2.22)

Equations of first order but of higher degree: Equations solvable for $\frac{dy}{dx}$, y, x, equations in Clairaut's form – equations reducible to Clairaut's form.

(Part I: 4.1-4.11)

Unit II

Equations of Second order: Linear homogeneous differential equations with constant coefficients – Euler-Cauchy equation – Linear Non-homogeneous Differential Equations: Wronskian – linear independence – Method of undetermined coefficients – Method of variation of parameters.

(Part I: 5.1-5.5, 6.1-6.3, 1.12,1.13, 5.26-5.27, 7.1-7.5)

Unit III

Systems of first order linear equations: Conversion of nth order differential equation to n first order differential equations – homogeneous linear system with constant coefficients – fundamental matrices – complex eigenvalues – repeated eigenvalues – simultaneous linear differential equations with constant coefficients – simultaneous linear differential equations with variable coefficients.

(Part I : 8.1-8.3, 2.1- 2.7)

Partial Differential Equations
Review of partial differential equations (order, degree, linear, nonlinear).

Unit IV

Formation of equations by eliminating arbitrary constants and arbitrary functions.
Solutions of partial differential equations: General – particular and complete integrals –Lagrange's linear equation – Charpit's method – Methods to solve the first order partial

differential equations of the forms f(p,q) = 0, f(z,p,q) = 0, $f_1(x,p) = f_2(y,q)$ and Clairut's form z = px + qy + f(p,q) where $p = \frac{\partial z}{\partial x}$ and $q = \frac{\partial z}{\partial y}$.

(Part III: 1.1 – 1.5, 2.3-2.12, 3.1-3.2, 3.7-3.8, 3.10-3.18)

Unit V

Classification of partial differential equations of second order – Homogeneous linear partial differential equations with constant coefficient of higher order – Non-homogeneous linear partial differential equations of higher order.

(Part III: 8.1, 4.1-4.12)

TEXTBOOKS:

1. M.D. Raisinghania, *Ordinaryand Partial Differential Equations*, 18th edition, S.Chand, 2016.

REFERENCES:

1. William E. Boyce and Richard C.DiPrima, *Elementary differential equations and boundary value problems*, 9th edition, Wiley India, 2012.
2. Nita H, Shah, *Ordinary and Partial Differential Equations: Theory and Applications*,2nd edition, PHI learning, 2015.
3. Dennis Zill, *A First Course in Differential Equations*, 9th edition, Cengage Learning, 2009.

Mapping of CO's to PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	1	2	-	2	4	4	3	2	2	3	2
CO2	1	3	-	2	4	2	4	3	3	2	2
CO3	1	2	-	1	3	4	3	3	2	3	3
CO4	1	2	2	2	3	4	4	3	2	3	3
CO5	2	3	2	1	4	4	4	2	3	2	3

CHEMISTRY PAPER - III

21CHY206 HYDROCARBONS, ALKYL AND ARYL HALIDES 3-0-2 4

OBJECTIVES: To enable students to develop an understanding of chemistry of hydrocarbons and their halogenated derivatives.

Course Outcome:

CO1	Explain the mechanism of organic reactions and to predict the products formed in a reaction.
CO2	Recognize and assign stereo chemical designations of organic compounds.
CO3	Describe the formation, physical and chemical properties of aliphatic hydrocarbons.
CO4	Apply the concept of aromaticity to explain the structure, stability and properties of aromatic hydrocarbons.
CO5	Describe chemical reactions involving alkyl and aryl halides and their synthetic applications.
CO6	Apply qualitative methods for identification of mono functional organic compounds.

Unit I

Fundamentals of organic reaction mechanism: Types of reagents – Electrophiles and Nucleophiles. Substitution, Addition, Elimination and Rearrangement. Reactive intermediates with examples – Carbocations, Carbanions and Free radicals. Electron displacement effects - Inductive, inductomeric, electromeric, mesomeric, resonance, hyper conjugation and steric effects. Aliphatic nucleophilic substitutions, mechanism of S_N1,S_N2- effects of structure substrate, solvent, nucleophile and leaving groups - Stereochemistry- Walden inversion Elimination Reactions:-Hoffmann and Saytzeff rules-cis and trans eliminations – mechanisms of E1 and E2 reactions. Elimination versus substitution.

Addition reactions- mechanisms of addition of Bromine and hydrogen halides to double bonds- Markownikoff's rule and peroxide effect. Polymerisation reactions-Types of polymerisation - free radical, cationic and anionic – polymerisations –including mechanism.

Unit II

Stereochemistry of Organic Compounds : Optical Isomerism: Structural changes responsible for properties: elements of symmetry, molecular chirality, enantiomers, stereogeniccentre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogeniccentres, diastereomers, threo and erythrodiastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization and asymmetric synthesis. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. Geometric isomerism: Determination of configuration of geometric isomers. Cis – trans and E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Difference between configuration and conformation. Conformational analysis of ethane and n-butane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono alkyl substituted cyclohexane derivatives.

Review of Newman projection and Sawhorse formulae, Fischer and flying wedge formulae.

Unit III

Aliphatic Hydrocarbons - Alkanes: Methods of formation (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation), physical properties and chemical reactions of alkanes (halogenation, nitration, sulphonation, oxidation and isomerisation reactions) Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity. Cycloalkanes: methods of formation (from acetoacetic ester / malonic ester and Dieckmann reaction), chemical reactions (halogenation), Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rings.

Alkenes: Accounting for Reactions due to unsaturation in compounds. Regioselectivity in alcohol dehydration. Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes – mechanism of hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration followed by oxidation, oxymercuration – reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with KMnO4. Substitution at the allylic and vinylic positions of alkenes. Cycloalkenes: Methods of formation and chemical reactions of cycloalkenes. Alkadienes: Isolated, conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, polymerization. Chemical reactions – 1,2 and 1,4 additions. Diels-Alder

reaction. Alkynes: Methods of formation (alkylation of acetylene and by elimination reactions). Acidity of alkynes. Chemical reactions of alkynes: Mechanism of electrophilic and nucleophilic addition reactions, hydroboration – oxidation, metal-ammonia reductions, oxidation

UnitIV

Aromatic Hydrocarbons: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: The Huckel rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of - and - complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/ para ratio. Side chain reactions of benzene derivatives. Birch reduction. Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl.

Unit V

Alkyl and Aryl Halides:A study of Alkyl halides highlighting its synthetic applications. Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution reactions of alkyl halides S_N2 and S_N1 reactions with energy profile diagrams. Polyhalogen compounds:chloroform, carbon tetrachloride. Aryl halides: Methods of formation of aryl halides, nuclear and side chain reactions. The addition- elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides vsallyl, vinyl and aryl halides. Synthesis and uses of DDT and BHC

TEXTBOOKS:

1. R. T. Morrison and R. N. Boyd, 'Organic Chemistry', 6thEdition (1994) - Prentice Hall of India
2. M. K. Jain and S. C. Sharma 'Modern Organic Chemistry' 3rdEdition (2003), Vishal Publishing Company Co.

REFERENCES:

1. K. S. Tewari; N. K. Vishnoi; S. N. Mehrotra, A Text Book of Organic Chemistry, 2nd Edition (2003), Vikas Publishing Pvt. Ltd.
2. S. C. Pal, Nomenclature of Organic Compounds (2016), Narosa Publishing Company
3. Peter Sykes, A Guide book to Mechanism in Organic Chemistry: 6thEdition (2003), Pearson Education.
4. P. S. Kalsi, 'Organic Reactions and their Mechanisms' New Age International Publishers, (2004).
5. I. L. Finar, Organic Chemistry, 6thEdition (1982). Vol-I, Pearson Education.

PRACTICALS

COURSE CONTENT:

1. Qualitative analysis of mono functional organic compounds through functional group analysis. Determination of physical constant. Preparation of suitable derivative.

Acids
Alcohols
Aldehydes
Amides
Amines
Halogenated hydrocarbons
Hydrocarbons
Ketones
Nitro compounds
Phenols

Mapping of CO's to PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	1	2	3	2	4	4	3	2	2	3	2
CO2	2	3	2	2	4	2	4	3	3	3	3
CO3	2	2	2	3	3	4	3	3	3	3	3

CO4	2	2	2	2	3	4	4	2	2	3	3
CO5	2	3	2	-	4	4	4	2	3	2	3

21SSK201 **LIFE SKILLS I** **1-0-2 2**

Soft skills and its importance: Pleasure and pains of transition from an academic environment to work-environment. Need for change. Fears, stress and competition in the professional world. Importance of positive attitude, self-motivation and continuous knowledge upgradation.

Self Confidence: Characteristics of the person perceived, characteristics of the situation, Characteristics of the Perceiver. Attitude, Values, Motivation, Emotion Management, Steps to like yourself, Positive Mental Attitude, Assertiveness.

Presentations: Preparations, Outlining, Hints for efficient practice, Last minute tasks, means of effective presentation, language, Gestures, Posture, Facial expressions, Professional attire.

Vocabulary building: A brief introduction into the methods and practices of learning vocabulary. Learning how to face questions on antonyms, synonyms, spelling error, analogy etc. Faulty comparison, wrong form of words and confused words like understanding the nuances of spelling changes and wrong use of words.

Listening Skills: The importance of listening in communication and how to listen actively.

Prepositions and Articles: A experiential method of learning the uses of articles and prepositions in sentences is provided.

Problem solving; Number System; LCM &HCF; Divisibility Test; Surds and Indices; Logarithms; Ratio, Proportions and Variations; Partnership; Time speed and distance; work time problems;

Data Interpretation: Numerical Data Tables; Line Graphs; Bar Charts and Pie charts; Caselet Forms; Mix Diagrams; Geometrical Diagrams and other forms of Data Representation.

Logical Reasoning: Family Tree; Linear Arrangements; Circular and Complex Arrangement; Conditionalities and Grouping; Sequencing and Scheduling; Selections; Networks; Codes; Cubes; Venn Diagram in Logical Reasoning.

TEXTBOOKS:

1. A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.
2. Adair J (1986) - "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
3. Gulati S (2006) - "Corporate Soft Skills", New Delhi, India: Rupa& Co.
4. The Hard Truth about Soft Skills, by Amazone Publication.

REFERENCES:

1. Quantitative Aptitude, by R S Aggarwal, S Chand Publ.
2. Verbal and Non-verbal Reasoning, R S Aggarwal, S Chand Publ.
3. Data Interpretation, R S Aggarwal, S Chand Publ.
4. Nova GRE, KAPAL GRE, Barrons GRE books;
5. Quantitative Aptitude, The Institute of Chartered Accountants of India.
6. More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.
7. The BBC and British Council online resources
8. Owl Purdue University online teaching resources
9. www.thegrammarbook.com online teaching resources
10. www.englishpage.com online teaching resources and other useful websites.

21CSA205 PC SOFTWARE 1-0-1 2

OBJECTIVE: IT is revolutionizing the way, in which we live and work. It is changing all aspect of our life and lifestyle. The digital revolution has given mankind the ability to treat information with mathematical precision, to transmit it at very high accuracy and to manipulate it at will; to survive in this information world one must keep pace with these changes.

Unit I

MS word for communication: Window parts – Menu Bar, Tool Bar, Status Bar, Scroll Bars. Understanding and arranging windows. Creating simple word documents – Saving files, Opening existing files, creating copies of files, Page set up options - Exiting word. Text Editing – Selection, deletion, cut, copy, Find &Replace, Using Undo & Redo. Document Views, Customizing toolbars, Inserting header & Footer, Zoom options. Inserting Page number, date & time, Symbols, Comments, Auto texts, Footnotes, Picture, Files & Objects, Bookmarks, Hyperlink, Cross references. Formatting Texts – Font, Paragraph, Columns, Bullets &Numbering, Borders & shading, Drop Cap, Auto format options, creating styles, Table of contents. Language Utilities – Spelling & Grammar – Mail merge Options - Creating Macros – Inserting tables, applying formula and sorting tables – Arranging windows and splitting windows.

Unit II

MS Excel for data analysis and communication: Familiarizing with workbooks, work sheets and cells – Excel window – working with cells – moving around in excel – Using the Toolbars – Using Formula bar - Entering and editing data – Selecting ranges, copying and moving cells – Paste special options – Fill options – Clearing formats – Move, copy and delete sheets – finding and replacing texts – Inserting header and footer – Inserting cells, rows, columns and work sheet

– Chart options- Inserting functions - Giving names to cell ranges – Manipulating hyperlink –Formatting cells, rows, columns and sheet – Practicing auto formatting and conditional formatting – Creating & merging styles – Spelling and Auto correct – Creating macros, protecting sheet - Sorting and filtering list - creating a form – validation – Creating subtotals - Manipulating pivot table - Consolidating data - arranging windows - Freeze panes – Hiding windows.

Unit III

MS Power-point for Communication and Presentation: Inserting slides – new slide, existing slides, duplicate slide, slides from Auto layout. Slide show – start with first slide, current Slide, customized show. Slide views - normal, slide sorter. Slide Layouts, Design Templates. Deleting slides, Paste special. Inserting Header & Footer, Date & Time, Hyperlink, Picture, Object, Symbols, Text, Table, Chart, and Diagram. Paste as hyperlink, Format – Font, Bullets & Numbering. Custom animation, Slide Transitions.Action Buttons.

PC SOFTWARE LAB

Unit I MS Word Exercises:

1. Open a new document and set page size to A4, margins to left (2 cm), right (2cm), top (2.5m),
bottom (2.5cm)

a. Type the following text:

Through Her extra ordinary acts of love and self-sacrifice, Amma has endeared Herself tomillions. Tenderly caressing everyone who comes to Her, holding them close to Her heartin a loving embrace, Amma shares Her boundless love with all. Be they young or old, sickor poor everyone who comes to her receives the same unconditional love.

Amma's compassion has given rise to a vast network of charitable and spiritual activities,which is drawing attension throughout the world. At the root of these services lies Amma'steaching that the divine exists in everything-in every person, plant and animal. Perceivingthis unity is the essence of spirituality and the means by which to end all suffering. It isthrough this simple, yet powerful message that Amma is transforming our world, oneembrace at a time.

b. Make the document error free using Spelling and Grammar

c. Replace the word 'compassion' using Thesaurus utility.

d. Practice Cut, Copy and Paste.

e. Apply Page Borders, Paragraph Borders and shade the paragraphs.

f. Give appropriate heading in the Header and Page number, date in the Footer.

g. Apply paragraph settings to the document.
h. Format the text and apply bullets and numbering using menu.
i. Insert a picture in the document (use OLE feature)
j. Change one paragraph of the document into newspaper layout.
k. Practice tab settings.

2 Insert a table containing 6 rows and 7 columns: Headings – Student No, name, Mark1, Mark2, Mark3, Total, and Average.

a. Enter the details of 5 students.
b. Calculate Total & Average using 'Formula' option.
c. Sort the details of students in the order of Average.

3. Generate 10 copies of interview letters to candidates from different statesinforming the place and time of interview. (Mail Merge)

Unit II MS Excel for data analysis exercises:

1. Open a new work book and enter the details:

Employee No Name Basic Pay DA HRA PF Net Pay
E001 Anu 6000
E002 Anju 8000
E003 Pavan 4500
E004 Jyothy 7600
E005 Manu 6500
Calculate DA as 7.5% of Basic Pay, HRA as 5% of Basic Pay PF as 6% of Basic Pay and Net Pay = Basic Pay + DA + HRA – PF.

2. Create a series using AutoFill handle.
3. Save the workbook & give suitable title in the Header and date in the Footer, Preview the file.
4. Create a name for a range of cells in the work sheet.
5. Practice Rows, columns, Cells and work sheet format options.
6. Clear the formats of 5 the row.
7. Delete the last sheet of the workbook
8. Make a copy of the first sheet and rename it.

9. Practice paste special options.

Spread Sheet Application – MS Excel:

1. Find the Sum of Net Pay using function.
2. Write a function to find the count of employees in G20 cell.
3. Insert comments in different cells and practice hyperlinks.
4. Create your own style for worksheets.
5. Create a database having the headings Roll No, Name, Mark1, Mark2, Mark3 and Total. Before entering data give validation rules:
a. For roll no – Enter numbers between 1 and 50
b. For name – Enter names that have text length between 3 and 15.
c. For marks – Enter marks between 0 and 99
6. Insert records and Sort the records.
7. Create a chart for the above details.
8. Create a pie chart for the student with highest mark.
9. Practice Auto Filter and advanced Filter.

Unit III MS Power-point for business presentation and Communications:

1. Open a new Presentation and insert a new slide.
2. Apply appropriate slide transition to it.
3. Insert a number 4 more slides and set up the show for all.
4. Text and Word art into slides and apply custom animations.
5. Format the text and word art in the slides and apply design templates to slides.
6. Hyper link the slides (use text for link).
7. Use action buttons for hyperlink.
8. Create a PowerPoint presentation that contains News Headlines for a TV channel.
9. Create a presentation with minimum 5 slides regarding the programmes on Annual Day celebrations.
10. Create a presentation with minimum 5 slides regarding various products offered by a particular company.

TEXTBOOKS:

1. Alexis Leon & Mathews Leon: Fundamentals of Information Technology,Vikas Publishing
2. Photoshop® CS3 Layers Bible by Matt Doyle (Author), Simon Meek (Author)

REFERENCE BOOKS:

1. Microsoft Office 2000 Complete, BPB publications
2. Dennis P.Curtin, Kim Foley, KunalSen, Cathleen Morin: Information Technology The Breaking Wave, TATA McGraw-Hill Edition

---

Semester IV

PHYSICS PAPER – IV

21PHY216OPTICS **3 -0 -2 4**

OBJECTIVE: To enable students to understand that light is a wave phenomenon and apply the understanding of wave phenomenon to light.

Course outcomes:

CO1	Ability to understand and analyze the wave nature of light and interference.
CO2	Gain the knowledge about classification of diffraction and its application.
CO3	Understand the basic concept of polarization and its devices.
CO4	Understand the basic phenomenon of scattering of light with different examples.
CO5	Study laser and its applications are to import knowledge and to develop skills and to use modern instruments in the day-to-day life.
CO6	Ability to do experimentation on wave optics.

Unit I

Wave Nature of Light and Interference: Light-electromagnetic spectrum, Rotating mirror method of determination of speed of light, Huygen's principle, explanation of

reflection and refraction, Fermat's Principle, Phase change on reflection, total internal reflection. Young's experiment - coherence, intensity distribution and visibility of fringes, Newton's rings, Fresnel's Biprism, interference in thin films, colours of thin films, interference at an air wedge, Michelson's interferometer.

Unit II

Diffraction: Fraunhoffer and Fresnel: Diffraction, Diffraction at a single slit, double slit, Diffraction by multiple slits, Diffraction grating, Resolving power – Rayleigh's criterion, Resolving power of a grating and telescope. Fresnel diffraction, half period zone, zone plate, diffraction at a circular aperture and at a straight edge (qualitative treatment only).

Unit III

Polarization : Polarization by reflection, Brewster's law, Mauls law, Double refraction, Production and detection of linearly, circularly and elliptically polarized light, Quarter and half wave plates, Polaroid's, Discussion on use of Polaroid sheets in preparing tinted sunglasses, Optical activity.

Unit IV

Scattering of Light: A brief discussion on Tyndall effect, Rayleigh scattering and Raman effect. Blue of the sky and ocean. A qualitative account of fluorescence and phosphorescence. Raman effect: Classical and quantum theory of Raman effect, experimental method for studying Raman spectra, Raman spectrum, study of Raman effect using Lasers, intensity of Raman lines, Polarization of Raman lines, characteristic properties of Raman lines, applications of Raman effect.

Unit V

Introduction to Lasers: Spontaneous and stimulated emission, density of states, Einstein's A and B coefficients. Ratio of stimulated to spontaneous transitions in a system in thermal equilibrium, condition for amplification, population inversion, methods of optical pumping, energy level schemes of He-Ne and Ruby Laser. Properties and uses of Lasers.Basic concepts of holography – construction of hologram – Discussion on the use of holograms in daily life - Recording and reproduction of holograms.

PRACTICALS:

1. Determination of wavelength of mercury spectral lines using Diffraction Grating by normal incidence method
2. Determination of the refractive index of the material of a prism by minimum deviation method
3. Determination of Cauchy's constants using a prism, grating and spectrometer
4. Determination of the resolving power of a telescope
5. Determination of wave length of monochromatic light source using Bi-Prism
6. Resolving power of a grating
7. Wavelength and wavelength difference using a Michelson's interferometer
8. Determination of the thickness of paper by interference at a wedge
9. Determination of the radius of curvature of the lens by Newton's Rings
10. Determination of the refractive index of a liquid by Newton's rings
11. Verification of Brewster's Law
12. Refractive index of a prism by i-d curve

Mapping of CO's and PO's

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO 1	3	2	3	3	3	1	1				2	3	3	
CO 2	3	2	3	3	3	1	1				2	3	3	
CO 3	3	2	3	3	3	1	1				2	3	3	
CO 4	3	2	3	3	3	1	1				2	3	3	
CO 5	3	2	3	3	3	1	1				2	3	3	
CO 6	3	3	3	3	3	2	2			3	2	3	3	

TEXTBOOKS:

1. N SubramanyamBrijlal: Waves and Oscillations, 2nd edition, VikasPublishing house Pvt. Ltd. New Delhi.
2. A.B.BhattacharyaR.Bhattacharya, Under Graduate Physics, Volume I, New Central BookAgency(P) Ltd., Kolkata.
3. N. SubrahmanyamBrijlal and Dr. M.N. Avadhanulu: A text book of Optics, 24threvisededition-S.Chand& company Ltd, New Delhi

REFERENCES:

1. Halliday/Resnick/Walker: Fundamentals of Physics, 8th edition, John Wiley &Sons(Asia) Pte.
Ltd.
2. F A Jenkins and H E White: Optics, McGraw-Hill, 3rd Edition, (1957)
3. Khanna and Bedi: Sound
4. S K Gupta, O P Varma: Waves and Oscillations, 3rd edition, R.Chand& Co., New Delhi.
5. R.L. Saihgal, A Text Book of Sound, S.Chand& Company Ltd. New Delhi, Reprint 1990.
6. P.K.Mittal& Jai DevAnand, A Text Book of Sound, Har-Anand Publications, New Delhi.
7. N V Suryanarayana: Electrical Measurements and Measuring Instruments, 1st edition, S.Chand& Co. Ltd., New Delhi.
8. H S Kalsi: Electronic Instrumentation, 2nd edition, Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
9. D.R. Khanna and H.R. Gulati: Fundamentals of Optics, 15thedition- R. Cjand publishers, New Delhi.
10. R. MurugeshanKiruthigaSivaprasath: Optics and Spectroscopy, 17th revised edition-S.Chand& company Ltd, NewDelhi.

MATHEMATICS PAPER - IV

21MAT216 **MODERN ALGEBRA** **3-1-0 4**

Objectives: To enable students to understand fundamental concepts of algebra and apply results from elementary group theory to solve contemporary problems.

Course Outcomes:

CO1	Effectively write abstract mathematical proofs in a clear and logical manner
CO2	Locate and use theorems to solve problems in number theory and theory of polynomials over a field
CO3	Demonstrate ability to think critically by interpreting theorems and relating results to problems in other mathematical disciplines
CO4	Demonstrate ability to think critically by recognizing patterns and principles of algebra and relating them to the number system
CO5	Work effectively with others to discuss homework problems put on the board. This will be assessed through class discussions.

Unit I

Introduction to Groups – Symmetries of a Square – The Dihedral Groups – Definition and Examples of Groups – Elementary Properties of Groups – Finite Groups – Subgroups: Terminology and Notation – Subgroup Tests – Examples of Subgroups.

(Chapters 1-3)

Unit II

Cyclic Groups – Properties of Cyclic Groups – Classification of Subgroups of Cyclic Groups – Permutation Groups – Properties of Permutations – Isomorphisms: Definition and Examples – Cayley's Theorem – Properties of Isomorphisms – Automorphisms.

(Chapters 4-6)

Unit III

Cosets and Lagrange's Theorem – Application of Cosets to Permutation Groups – Normal Subgroups – Factor Groups – Applications of Factor Groups – Group Homomorphisms:

Definition and Examples – Properties of Homomorphisms – The First Isomorphism Theorem.

(Chapters 7, 9, 10)

Unit IV

Rings – Motivation and Definition – Examples of Rings – Properties of Rings – Subrings – Integral Domains – Fields – Characteristic of a Ring.

(Chapters 12, 13)

Unit V

Quotient Rings and Ideals – Homomorphism of rings and rings of polynomials.

(Chapters 28-30)

Ideals – Factor Rings – Prime Ideals and Maximal Ideals – Ring Homomorphisms: Definition and Examples – Properties of Ring Homomorphisms – The Field of Quotients – Polynomial Rings: Notation and Terminology – The Division Algorithm and Consequences.

(Chapters 14-16)

TEXTBOOKS:

1. Joseph A. Gallian, *Contemporary Abstract Algebra*, 4th edition, Narosa, 2008.
2. Johan B. Fraleigh, *A First course in abstract algebra*, 3rd edition, Narosa, 2000.

REFERENCES:

1. Garrett Birkoff and Saunders Mac Lane, *A Survey of Modern Algebra*, 1st edition, Universities Press, 2003.
2. I. N. Herstein, *Topics in Algebra*, 2nd Edition, John Wiley and Sons, 2000.
3. M. Artin, *Algebra*, 2nd Edition, Prentice Hall inc., 1994.

Mapping of CO's to PO's

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	2	-	2	4	4	3	2	2	3	2
CO2	1	3	-	2	4	2	4	3	3	2	2
CO3	1	2	-	1	3	4	3	3	2	3	3

CO4	1	2	2	2	3	4	4	3	2	3	3
CO5	2	3	2	1	4	4	4	2	3	2	3

CHEMISTRY PAPER - IV

21CHY217 THERMODYNAMICS, CHEMICAL EQUILIBRIUM AND ELECTROCHEMISTRY 3-0-2 4

OBJECTIVE: To develop an understanding of Thermodynamics, Chemical Equilibrium and Phase Equilibria, Solutions and Electrochemistry.

Course Outcome:

CO1	Explain the basic principles of classical thermodynamics and apply these principles in the context of chemical and physical processes.
CO2	Apply the principles of chemical equilibrium and chemical thermodynamics to analyze the phase diagram of one and two component systems.
CO3	Apply principles of thermodynamics to explain the properties of solutions.
CO4	Describe the fundamental principles of electrochemistry and their application to calculate properties of electrochemical systems.
CO5	Explain the laws of thermodynamics and describe the concepts of photosensitized reaction using a molecular perspective.
CO6	Measure changes in thermodynamic properties accompanying chemical reactions.
CO7	Apply concepts of physical chemistry for experimental study of the properties of chemical systems.

Unit I

Thermodynamics : Introduction, definition of thermodynamic terms, intensive and extensive properties, path and state functions, exact and inexact differentials, zeroth law of thermodynamics First law of thermodynamics, reversible and irreversible processes, internal energy and enthalpy, heat capacity, Cp and Cv relation in ideal gas systems, change in thermodynamic properties of an ideal gas during (i) isothermal/adiabatic,

reversible/irreversible processes. Joule-Thomson experiment, Joule-Thomson coefficient, inversion temperature.

Second law: Limitations of first law – statements of second law, Carnot's cycle – efficiency of heat engines, Carnot theorem. Entropy – entropy change for various reversible/irreversible processes, spontaneous and non-spontaneous processes. Change in entropy of an ideal gas with pressure, volume and temperature.

Third law of thermodynamics-statement and significance.

Helmholtz energy and Gibbs energy – variation of Gibbs energy with T and P. Criteria for reversible and irreversible processes. Gibbs-Helmholtz equation. Clasius- Clapeyron equation, applications. Partial molar properties – chemical potential, Gibbs-Duhem equation, chemical potential in a system of ideal gases, concept of activity.

Unit II

Chemical Equilibrium and Phase Equilibria: Recognising a system at Chemical Equilibrium. Attributes of Chemical Equilibrium,Thermodynamic derivation of law of mass action, Equilibrium constant and free energy. Factors that affect the chemical equilibrium and Le Chatelier's principle. Calculations involving equilibrium constant, Ionic equilibria in aqueous solutions, sparingly soluble salts, solubility product common ion effect, selective precipitation, applications in qualitative analysis.

Ionisation of water, pH scale, weak acids and bases, hydrolysis, buffer solutions, acid Base indicators, acid base titrations and multi stage equilibria. Reaction isotherm and reaction isochore. Statement and meaning of the terms – phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system – water, CO_2 and S systems. Phase equilibria of two component system – solid-liquid equilibria – simple eutectic –Pb-Ag.

Unit III

Solutions: Solutions of Gases in liquids. Henry's law and its applications, solutions of solids in liquids. Distribution law, application of distribution law to association, dissociation and extraction.

Dilute Solution: Colligative properties, Osmosis, Osmotic pressure, Vant Hoff Theory, Lowering of Vapour Pressure, Depression in Freezing point and Elevation in Boiling Point, Vant Hoff Factor.

Solid solutions – compound formation with congruent melting point (Mg – Zn) and incongruent melting point (NaCl – H_2O), ($FeCl_3$ – H_2O) and ($CuSO_4$ – H_2O) system. Freezing mixtures, acetone dry ice. Liquid – liquid mixtures: Ideal liquid mixtures, Raoult's and Henry's law. Non-ideal system – Azeotropes – HC – H_2O and ethanol – water systems. Partially miscible liquids – Phenol-water, trimethylamine – water, nicotine – water systems. Immiscible liquids, steam distillation. Nernst distribution law – thermodynamic derivation, applications.

Unit IV

Electrochemistry: Migration of ions Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law, its uses and limitations.

Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only).Transport number, definition and determination by Hittorf method and moving boundary method. Applications of conductivity measurements: Determination of degree of dissociation, determination of Ka of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations. Electrode reactions, Nernst equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode-reference electrodes – standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells – reversible and irreversible cells, conventional representation of electrochemical cells. EMF of a cell and its measurements. Computation of cell EMF, Calculation of thermodynamic quantities of cell reactions (G, H and K), Chemical cells with and without transport.

TEXTBOOKS:

1. R. P. Rastogi, R. R. Misra, An Introduction to Chemical Thermodynamics, 6th edn., Vikas Pub. Pvt. Ltd. (2003).

2. B. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry,, Vishal Pub. Co. Jalandhar.

REFERENCES:

1. P. Atkins and J Paula, The elements of Physical chemistry, 7th edn., Oxford University Press.

2. K. K. Sharma, L. K. Sharma, A Textbook of Physical Chemistry, 4th edn, Vikas publishing House.

PRACTICALS

1. Determination of heat of neutralization of acids and bases.
2. Verification of Hess's law of constant heat summation.
3. Determination of solubility of sparingly soluble salt at various temperature, calculation of enthalpy of solution.
4. pH titration of acid versus base (observation of change in pH).
5. Determination of dissociation constant of a weak acid.
6. Determination of solubility product constant (Ksp) of a sparingly soluble salt.
7. Determination of percentage composition of NaCl by critical solution temperature method (phenol-water system).
8. Determination of distribution coefficient of benzoic acid between water and toulene or acetic acid between water and 1-butanol.
9. Determination of transition temperature of a given salt hydrate.

Mapping of CO's to PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	1	2	-	2	4	4	3	2	2	3	2
CO2	2	3	-	2	4	2	4	3	3	2	2
CO3	2	2	-	1	3	4	3	3	2	3	3
CO4	1	2	2	2	3	4	4	3	2	3	3
CO5	2	3	2	1	4	4	4	2	3	2	3
CO6	3	3	3	2	3	3	4	3	3	3	3
CO7	3	3	2	3	3	2	3	2	3	2	2

CHEMISTRY PAPER - V

21CHY216 PHOTOCHEMISTRY AND PERICYCLIC REACTIONS 3-0-0 3

OBJECTIVES: To develop an understanding of reaction mechanism through photochemistry.

Course Outcome:

CO1	Explain the basic concepts of photochemistry.
CO2	Apply the principles of photochemistry to study the different chemical processes during chemical reaction.
CO3	Apply principles of photochemistry to explain the reaction mechanism.
CO4	Describe the different reactions in photochemistry.
CO5	Explain the molecular orbital symmetry and Frontier orbital concepts.
CO6	Explain pericyclic reactions.

Unit I

Photochemistry: Laws of photochemistry – Grothus-Draper law, Stark-Einstein law, examples of photochemical reactions. Beer law and Beer-Lambert's law. Jablonsky diagram, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing). Quantum yield, primary and secondary processes.

Unit II

Basic concepts of photosensitized reactions – photosynthesis, dissociation of hydrogen molecule, isomerization of 2-butene, and chemiluminescence.

Unit - III

Molecular orbital symmetry, frontier orbitals of ethylene, 1,3 Butadiene, 1,3,5-Hexatriene,allylsystem, classfication of pericyclic reactions FMO approach, Woodwrd-Hoffman correlationdiagram method and perturbation of molecular (PMO) approach for the explanation of pericyclic reactions under thermal and photochemical conditions.

Unit – IV

Cycloadditions: Antarafacial and suprafacial additions, notation. ofcycloadditions, (4n) and (4n+2) systems with a greater emphasis on (2+2) and (4+4) - cycloadditions, (2+2) - additions of ketones secondary effects of substitutes on the rates of cycloadditions and chelotropic reactions.

TEXTBOOKS:

1. Fleming, Pericyclic Reactions, Oxford University Press, Oxford, 1999.
2. Mukherjee, S.M. and Singh, S.P., Pericyclic Reactions, MacMillan India, New Delhi.

REFERENCE:

1. Turro, N. J., Scaiano, J. C., and Ramamurthy, V., Modern Molecular Photochemistry of Organic Molecules, University Science Books, 2010.

Mapping of CO's to PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	1	2	-	2	4	4	3	2	2	3	2
CO2	1	3	-	2	4	2	4	3	3	2	2
CO3	1	2	-	1	3	4	3	3	2	3	3
CO4	1	2	2	2	3	4	4	3	2	3	3
CO5	2	3	2	1	4	4	4	2	3	2	3

21SSK211 LIFE SKILLS II 1-0-2 2

Professional Grooming and Practices: Basics of Corporate culture, Key pillars of Business Etiquette. Basics of Etiquette: Etiquette – Socially acceptable ways of behaviour, Personal hygiene, Professional attire, Cultural Adaptability. Introductions and Greetings: Rules of the handshake, Earning respect, Business manners. Telephone Etiquette: activities during the conversation, Conclude the call, To take a message. Body Language: Components, Undesirable body language, Desirable body language. Adapting to Corporate life: Dealing with people.

Group Discussions: Advantages of Group Discussions, Structured GD – Roles, Negative roles to be avoided, Personality traits to do well in a GD, Initiation techniques, How to perform in a group discussion, Summarization techniques.

Listening Comprehension advanced: Exercise on improving listening skills, Grammar basics: Topics like clauses, punctuation, capitalization, number agreement, pronouns, tenses etc.
Reading Comprehension advanced: A course on how to approach middle level reading comprehension passages.

Problem solving – Money Related problems; Mixtures; Symbol Based problems; Clocks and Calendars; Simple, Linear, Quadratic and Polynomial Equations; Special Equations; Inequalities; Functions and Graphs; Sequence and Series; Set Theory; Permutations and Combinations; Probability; Statistics.

Data Sufficiency: Concepts and Problem Solving.

Non-Verbal Reasoning and Simple Engineering Aptitude: Mirror Image; Water Image; Paper Folding; Paper Cutting; Grouping Of Figures; Figure Formation and Analysis; Completion of Incomplete Pattern; Figure Matrix; Miscellaneous.

Special Aptitude: Cloth, Leather, 2D and 3D Objects, Coin, Match Sticks, Stubs, Chalk, Chess Board, Land and geodesic problems etc., Related Problems

TEXTBOOKS:

1. A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.
2. Adair J (1986) - "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
3. Gulati S (2006) - "Corporate Soft Skills", New Delhi, India: Rupa& Co.
4. The Hard Truth about Soft Skills, by Amazone Publication.

REFERENCES:

1. Quantitative Aptitude, by R S Aggarwal, S Chand Publ.
2. Verbal and Non-verbal Reasoning, R S Aggarwal, S Chand Publ.
3. Quantitative Aptitude by AbjithGuha, Tata McGraw hill Publ.
4. More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.
5. The BBC and British Council online resources

6. Owl Purdue University online teaching resources
7. www.thegrammarbook.com online teaching resources
8. www.englishpage.com online teaching resources and other useful websites.

Semester V

PHYSICS PAPER - V

21PHY306 **BASIC ELECTRONICS** **3 -1 -0 4**

Objective: To enable students to understand the physics of semiconductors and their applications in basic electronic circuits.

Course outcomes:

CO1	Understand the basic concept of semiconductors its characteristics and application.
CO2	Apply different configuration of transistor to study its uses.
CO3	Ability to understand and apply different type of sinusoidal oscillator.
CO4	Understand basic logic gates and OP-AMP and its application.
CO5	Understand the basic process in communication electronics.

Unit I

Semiconductor Characteristics and Applications Review: Intrinsic and extrinsic semiconductors, electrons and holes in intrinsic and extrinsic semiconductors, conduction by electrons and holes, conductivity of a semiconductor, Energy bands in semiconductors. Carrier concentrations in intrinsic and extrinsic semiconductors, Fermi level, donor and acceptor levels in extrinsic semiconductors. P-N junction diode – depletion layer, conduction in PN junction diode, characteristics, diode resistance.
Half wave and full wave rectifiers, power output and efficiency, Ripple factors.

Breakdown in diodes – Zener breakdown, Zener diode characteristics and application in voltage regulation.LEDs, photo diodes, LDRs and Solar cells.

Unit II

Transistors and Applications : Bipolar junction transistor (PNP and NPN) transistors, different configurations and characteristics, current components in CE configuration, large signal and small signal dc current gains, transistor biasing – self bias circuit, Load line and operating point. Transistor as an amplifier : Transistor as a two port device, h-parameters and analysis of CE amplifier using h parameter equivalent circuit, simplified h-parameter circuit, stabilization of voltage gain in CE amplifiers, Two stage amplifiers, RC coupling, frequency response of CE amplifier. Comparison of transistor configurations.Emitter follower circuit and its use. Transistor as Power amplifier.
FET construction and its characteristics – MOSFET characteristics.Concept of feedback in amplifiers and advantages of negative feedback

Unit III

Basic Principlesof sinusoidal oscillators, Statement and explanation of Barkhausen criterion for sustained oscillations, RC phase –shift Oscillator, explanation of: tank circuit and Development of oscillations in an LC circuit, Hartley Oscillator, Colpitt's Oscillator, Wien Bridge Oscillator, Piezoelectric effect, Piezoelectric Oscillator.

Unit IV

Digital Electronics: Binary to decimal and decimal to binary conversion, Binary addition and subtraction, Octal number system, Hexadecimal system and conversions.
Construction and working of AND and OR logic gates using diodes. Construction of NOT gate using transistor. Symbols and truth table for AND, OR, NOT, NAND NOR and Ex-OR logic gates. Boolean algebra, Boolean laws, D'morgan's theorem. NAND and NOR as universal gates. Introduction to OP-AMP. Differential amplifiers, principle of OP-AMP, OP-AMP parameters, Applications – Addition, Subtraction, differentiation and integration.

Unit V

Communication Electronics: Basic theory of amplitude modulation, Power in modulated carrier, single side band transmission, Basic idea of frequency and phase modulation. Modulated class C amplifier, demodulation, and PN diode as demodulator linear and square law detection. Propagation of radio waves, different layers of ionosphere and their functions, Radio communication: Role of ionosphere in radio communication. Block diagram of Radio transmission. The block diagram and diagram of super heterodyne AM Receiver.

Mapping of CO's and PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO04
CO1	3	2	3	3	3	2	1				3	2	3	
CO2	3	2	3	3	3	2	1				3	2	3	
CO3	3	2	3	3	3	2	1				3	2	3	
CO4	3	2	3	3	3	2	1				3	2	3	
CO5	3	2	3	3	3	2	1				3	2	3	

TEXTBOOKS:

1. V.K. Mehta: Electronics.
2. BapatYN: Electronic circuits and Systems, TMH, New Delhi.
3. RamakantGaekwad: Operational amplifiers and Linear Integrated Circuits, Prentice hall of India ltd, New Delhi.

REFERENCES:

1. Concepts of modern physics, 6th Edition- A Beiser
2. Resnick: Special theory of relativity
3. A.P French: Special relativity
4. Malvino: Electronic principles, Fifth edition
5. C. Kittel: Introduction to solid state physics

6. A J. Dekkar: Solid State physics
7. J.B. Blackmore: Introduction to solid state physics
8. S V Subramanyam : Experiments in Electronics
9. R P Jain: Modern Digital Electronics
10. Malvino and Leach: Digital principles and applications
11. Grob B: Basic Electronics
12. Boylestead: Network analysis

PHYSICS PAPER-VI

21PHY386 **PRACTICALS** **0- 0 -2 1**

Objective: To gain hands-on experience with the basic electronic equipment

Course outcomes:

CO1	To analyze experimental I-V characteristics of different diodes, transistors and oscillators.
CO2	To analyze op-amp characteristics by constructing different logical circuits.
CO3	To verify inverse square law using phototransistor.

(A minimum of ten experiments to be performed from the following list)

1. Junction diode characteristics
2. Zener diode characteristics
3. Junction Transistor characteristics
4. FET characteristics
5. Wien Bridge Oscillator.
6. UJT characteristics.
7. Full adder using AND, OR and XOR gates
8. Study of op-amp characteristics.
9. Measurement of efficiency and output power of LED.
10. Verification of the inverse square law for light intensity using a phototransistor.
11. Study of Optocoupler.

12. Study of Divergence of Diode laser.
13. Amplitude demodulator.
14. Logic gates – AND, OR, NOT, NOR and XOR using IC 7402

Mapping of CO's and PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	3	3	2	2			3	2	3	3	
CO2	3	2	3	3	3	2	2			3	2	3	3	
CO3	3	2	3	3	3	2	2			3	2	3	3	

MATHEMATICS PAPER - V

21MAT307 REAL ANALYSIS **3 -1 -0 4**

Objectives: To enable students to understand the basic properties of the field of real numbers and understand notion of continuous functions and their properties.

Course Outcomes:

CO1	To understand the concept of Absolute value. Know the concept of supremum.
CO2	Know the concept of Convergence, Divergence and Oscillatory sequence.
CO3	Know the concept of continuous function, discontinuity, uniformly continuous.
CO4	Application of derivative like Taylor's theorem and Maclaurin's theorem.
CO5	To apply the concept Riemann integral to analyze problem.

Unit I

Review: Sets and Functions – Mathematical Induction – Finite and Infinite Sets. **The Real Numbers:** The Algebraic and Order Properties of R – Absolute Value and the Real Line – The Completeness Property of R – Applications of the Supremum Property – Intervals.

Chapter-1 (Sec.1.1-1.3), Chapter-2 (Sec.2.1-2.5)

Unit II

Sequences and Series: Sequences and Their Limits – Limit Theorems – Monotone Sequences – Subsequences and the Bolzano-Weierstrass Theorem – The Cauchy Criterion – Properly Divergent Sequences – Introduction to Infinite Series – Absolute Convergence of Infinite series – Tests for Absolute convergence – Tests for Non-absolute convergence.

Chapter-3 (Sec.3.1-3.7), Chapter-9 (Sec.9.1-9.3)

Unit III

Limits and Continuous Functions: Limits of Functions – Limit Theorems – Some Extensions of the limit concept – Continuous Functions – Combinations of Continuous Functions – Continuous Functions on Intervals – Uniform Continuity.

Chapter-4 (Sec.4.1-4.3), Chapter-5 (Sec.5.1-5.4)

Unit IV

Differentiation: The Derivative – The Mean Value Theorem – L'Hospital's Rules – Taylor's Theorem.

Chapter-6 (Sec.6.1-6.4)

Unit V

The Riemann Integral: Riemann Integral – Riemann Integrable Functions – The Fundamental Theorem - Approximate Integration.

Chapter-7 (Sec.7.1-7.4)

TEXTBOOK:

1. Robert Gardner Bartle, Donald R. Sherbert, *Introduction to Real Analysis*, 4th Edition, John Wiley & Sons, 2011.

REFERENCES:

1. Tom M. Apostol, *Mathematical Analysis,* 2nd Edition, Narosa publishing house, New Delhi,1989.
2. Rudin. W, *Principles of Mathematical Analysis,* 3rd Edition, McGraw-Hill International Editions, 1976.
   H.L. Royden and P.M. Fitzpatrick, *Real Analysis*, 4th Edition. Pearson Education Asia Limited, 2010.

MATHEMATICS PAPER - VI

21MAT308 DISCRETE MATHEMATICS 2-1-0 3

Objectives: To enable students to understand the basics of logic, permutations and combinations and use effectively algebraic techniques to analyze basic discrete structures and algorithms

Course Outcomes:

CO1	To understand the basic concepts of Mathematical reasoning, set and functions.
CO2	To understand various counting techniques and principle of inclusion and exclusions.
CO3	Understand the concepts of various types of relations, partial ordering and equivalence relations.
CO4	Apply the concepts of generating functions to solve the recurrence relations.
CO5	Familiarize the fundamental concepts of graph theory and shortest path algorithm.

Unit I

Logic: Logic – Prepositional Equivalence – Predicate and Quantifiers – Theorem Proving.

Chapter-1 (Sections: 1.1.-1.7)

Unit II

Basics of Counting – Pigeonhole Principle – Permutation and Combinations.

Chapter-5 (Sections: 5.1-5.3)

Unit III

Advanced Counting Techniques and Relations: Recurrence Relations – Solving Linear Recurrence Relations – Solutions of Homogeneous Recurrence Relations.

Chapter-6 (Sections: 6.1-6.2)

Unit IV

Relations and Their Properties: Representing Relations – Closure of Relations – Equivalence Relations – Partial Ordering.

Chapter-7 (Sections: 7.1, 7.3-7.6)

Unit V

Graph Theory: Introduction to Graphs – Graph Operations – Graph and Matrices – Graph Isomorphism – Connectivity – Euler and Hamilton Paths – Shortest Path Problems.

Chapter-8 (Sections: 8.1, 8.3-8.6)

TEXTBOOKS:

1. Kenneth H. Rosen, *Discrete Mathematics and its Applications*, 6th edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007.

REFERENCES:

1. R.P. Grimaldi, *Discrete and Combinatorial Mathematics*, 5th Edition, Pearson Education, 2007.
2. Thomas Koshy, *Discrete Mathematics with Applications*, 1st edition, Academic Press, 2004.
1. Liu, *Elements of Discrete Mathematics*, 2ndedition, Tata McGraw- Hill Publishing Company Limited, 2004.

CHEMISTRY PAPER - VI

21CHY306 TRANSITION ELEMENTS, COORDINATION COMPOUNDS, CHEMICAL KINETICS AND SPECTROSCOPY 3-0-0 3

OBJECTIVES: To develop an understanding of Transition elements, Coordination compounds, Chemical kinetics, Spectroscopy and Surface Phenomena.

Course Outcome:

CO1	Explain the general characteristics, physical and chemical properties of d and f block elements.
CO2	Apply various bonding theories to explain the structure and properties of coordination compounds.
CO3	Explain the various metallurgical processes and their application in the extraction of metals.
CO4	Apply the concepts of chemical kinetics to determine the order and rate of reactions from analysis of experimental data.
CO5	Apply concepts of collision theory and actication energy to study the kinetics of chemical reactions.
CO6	Describe the fundamental principles and applications of spectroscopic techniques and their applications to obtain qualitative and quantitative information about molecules.

Unit I

Chemistry of d and f block Elements: General characteristics of d-block elements with special reference to electronic configuration, oxidation states, variable valency, metallic character, color, magnetic properties, catalytic properties and ability to form complexes. Comparison of the properties of second and third transition series with first transition series. Chemistry of lanthanides – electronic structure, oxidation states, lanthanide contraction, consequences of lanthanide contraction, magnetic properties, spectral properties and separation of lanthanides by ion exchange and solvent extraction methods (Brief study). Chemistry of actinides – electronic configuration, oxidation states, actinide contraction, position of actinides in the periodic table, comparison with lanthanides in

terms of magnetic properties and spectral properties (Brief study). Extraction of Thorium, Uranium and Plutonium from burnt nuclear fuels.

Unit II

Coordination Compounds: Werner's coordination theory and its experimental verification, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. Limitations of VBT. Elementary treatment of crystal field theory, splitting of d-orbitals in square planar, tetrahedral and octahedral complexes, factors affecting crystal field parameters, Explanation of magnetic behaviour and colour of complexes using CFT, effective atomic number concept. Metal carbonyl, 18 electron rule, Preparation, structure and reactions of $Ni(CO)_4$, $Fe(CO)_5$ and $V(CO)_6$, nature of bonding in metal carbonyls

Unit III

Metallurgy: Types of metallurgy: Pyrometallurgy - Extraction of Nickel from sulphide ore – general metallurgy followed by Mond's process (purification), manganese from oxide ores – reduction by the Aluminothermite process – refining by electrolytic process. Hydrometallurgy: Extraction of gold from native ore by cyanide process and refining. Electrometallurgy: Extraction of lithium by fusion method followed by electrolysis of lithium chloride. Powder metallurgy: Importance, metal powder production and applications, production of tungsten powder. Extraction of (1) Thorium from monazite sand – purification by iodine method, (2) uranium from pitch blende – production of U_3O_8 by carbonate method, U_3O_8 to UO_2 by reduction, UO_2 to U by fluoride method.

Unit IV

Chemical Kinetics : Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction – concentration, temperature, pressure, solvent, light, catalyst. Concentration dependence of rates, mathematical characteristics 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, method of half-life period and isolation method.

Radioactive decay as a first order phenomenon. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy. 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

Unit V

Spectroscopy : UV and Visible spectroscopy: Introduction, absorption laws, instrumentation, formation of absorption bands, types of electronic transitions, chromophores, auxochromes, absorption and intensity shifts, solvent effects, Woodward – Fieser rules for calculating absorption maximum in dienes and α,β-unsaturated carbonyl compounds. IR spectroscopy: Introduction, theory of molecular vibrations, vibrational frequency, factors influencing vibrational frequencies, finger print region and applications of IR spectroscopy. NMR spectroscopy: Introduction, instrumentation, number of signals, position of signals (Chemical shift),shielding and deshielding effects, factors influencing chemical shifts- inductive effect, anisotropic effect and hydrogen bonding. Splitting of signals, spin-spin coupling, chemical exchange and coupling constant. Structural determination of simple organic compounds using UV, IR and NMR spectral data.

TEXTBOOKS:

1. B. R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi

REFERENCES:

1. J. D. Lee, Concise Inorganic Chemistry 5 thedn., Blackwell Science, London.
2. F. A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry 5th edn., John Wiley, New York.
3. J. E. Huheey, E. A. Keiter, R. L. Keiter, O K Medhi, Inorganic Chemistry, Pearson 2006

21CHY386CHEMISTRY PAPER-VII PRACTICALS 0-0-2 1

Course Outcome:

CO1	Apply principles of electrochemistry to measure the properties of electrolyte solutions.
CO2	Conduct volumetric analysis of solutions by applying principles of electrochemistry.
CO3	Conduct quantitative estimation of elements by applying the principle of gravimetric analysis.
CO4	Perform synthesis of simple metal complexes and analyze the properties of these complexes.
CO5	Practice the application of concepts in physical chemistry for quantitative analysis.

1. To study the effect of dilution on Molar Conductivity of weak and strong electrolytes.
2. Conductometric titrations
3. Potentiometeric is titrations.
4. Acid Hydrolysis of Ester
5. Base Hydrolysis of an Ester by Titration and Conductometry
6. Preparation and analysis of simple metal complexes.
7. Gravimetric estimation of Barium as barium sulphate.
8. Gravimetric estimation of Iron as ferric oxide.

21SSK301 LIFE SKILLS III 1-0-2 2

Team Work: Value of Team work in organizations, Definition of a Team, Why Team, Elements of leadership, Disadvantages of a team, Stages of Team formation. Group Development Activities: Orientation, Internal Problem Solving, Growth and Productivity, Evaluation and Control. Effective Team Building: Basics of Team Building, Teamwork Parameters, Roles, Empowerment, Communication, Effective Team working, Team Effectiveness Criteria, Common characteristics of Effective Teams, Factors affecting Team Effectiveness, Personal characteristics of members, Team Structure, Team Process, Team Outcomes.

Facing an Interview: Foundation in core subject, Industry Orientation/ Knowledge about the company, Professional Personality, Communication Skills, activities before interview, upon entering interview room, during the interview and at the end. Mock interviews.

Advanced Grammar: Topics like parallel construction, dangling modifiers, active and passive voices, etc.

Syllogisms, Critical reasoning: A course on verbal reasoning. Listening Comprehension advanced: An exercise on improving listening skills.

Reading Comprehension advanced: A course on how to approach advanced level of reading, comprehension passages. Exercises on competitive exam questions.

Specific Training: Solving campus recruitment papers, National level and state level competitive examination papers; Speed mathematics; Tackling aptitude problems asked in interview; Techniques to remember (In Mathematics). Lateral Thinking problems. Quick checking of answers techniques; Techniques on elimination of options, Estimating and predicting correct answer; Time management in aptitude tests; Test taking strategies.

Semester VI

PHYSICS PAPER -VII

21PHY316	**ATOMIC AND MOLECULAR PHYSICS**	**3-1-0**	**4**

Objective: To enable students to apply the basic knowledge of classical and quantum mechanics at the atomic and molecular level.

Course outcomes:

1. To understand the basic idea of X-ray spectrum and its usage in analyzing different types of crystals.

2. To understand the different aspects of studying the structure of an atom and toknow different types of methods to find the charge of an electron.
3. To acquire the knowledge of Zeeman effect and its classical and quantum approach.
4. To understand the basic idea of molecular spectra and to acquire the knowledge about different types of molecular spectra.
5. To understand the basic idea of Electro-Magnetic theory and to set up maxwell's equation

Unit I

X-Rays: Continuous X-ray spectra. Duanne and Hunt limit. Characteristic X ray spectra, Moseley's law and its significance, X-ray energy levels.

Bragg's law and Bragg spectrometer.A brief mention of different types of crystals. Structures of NaCl and KCl crystals.

Compton Effect – Expression for Compton Shift.

Unit II

Atomic Spectra

The Electron*: Determination* of e/m of an electron by Thomson method, Determination of charge of an electron by Millikan's oil drop method.

Atomic Spectra *:* Inadequacy of Bohr atomic model, correction due to finite mass of the nucleus, Rydberg constant in terms of reduced mass, Excitation and Ionization potentials, Franck-Hertz experiment, Bohr-Sommerfeld Model of atom, vector model of an atom, Electron spin, space quantization, magnetic moment of an electron due to its orbital motion. Stern-Gerlach experiment and its theory.

Spin-orbit interaction and Fine structure of spectral lines.Quantum numbers and selection rules.Pauli's exclusion principle.Electronic configuration of atoms.Valence electron and a brief mention of L-S and J-J coupling for trio electron atoms.

Unit III

Zeeman effect: Introduction, experimental study of normal Zeeman effect, theory of normal Zeeman effect, expression for Zeeman effect, quantum theory of normal Zeeman effect, anomalous Zeeman effect, Paschen-Back effect and Stark effect.

Unit IV

Molecular Spectra (10 hrs): Molecular formation, the H molecular ion, H_2 – molecule. Salient features of molecular spectra.
Rotation, vibration and electronic spectra of molecules, associated quantum numbers and selection rules. Theory of pure rotation and rotation- vibration spectra, Raman and IR spectra, simple applications.

Unit V

NMR Spectroscopy: Introduction to NMR spectroscopy, Chemical shifts and J-coupling One-dimensional proton NMR One dimensional NMR of X-nuclei (13C, 15N, 31P and 19F)Homonuclear 2D NMR Heteronuclear 2D NMRStructure determination of molecules Mapping of CO's and PO's

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	1	3	3	3	1	2				3	2	3	
CO2	3	1	3	3	3	1	2				3	2	3	
CO3	3	1	3	3	3	1	2				3	2	3	
CO4	3	1	3	3	3	1	2				3	2	3	
CO5	3	1	3	3	3	1	2				3	2	3	

TEXTBOOKS:

1. Atomic and nuclear physics -Littlefield and T.V. Thorley
2. Molecular spectra – G Herzberg

3. Fundamental university physics, vol. 3 – Aloson and Finn

REFERENCES:

1. Perspectives of Modern Physics Beiser.
2. Electromagnetism, Reitz and Milford.
3. Concepts of modern physics, Fifth Edition- ABeiser
4. Introduction to modern Physics- F.R. Richtmeyer. E.H. Kennard and T. Lauritsen
5. Lasers – A K Gatak
6. Modern Physics - K.S. Krane
7. Introduction to modern Physics – H S Mani and G K Mehta

PHYSICS PAPER-VIII

21PHY387 PRACTICALS 0-0-2 1

Objective: To gain the knowledge of analyzing different types of optical spectrum and spectral response of electronic devices.

Course outcome:

CO1: To examine Hydrogen spectrum and to calculate Rydberg constant.
CO2: To analyze different spectrum of different molecule.
CO3: To examine the spectral response of Photocell and Photodiode.

(A minimum of eight experiments from the following)

1. Determination of Rydberg constant by studying the Fraunhoffer spectrum
2. Analysis of powder X ray photograph
3. Study of the characteristics and spectral response of a photocell (selenium photocell
4. Study of hydrogen spectrum
5. Analysis of band spectrum of PN molecule.
6. Analysis of rotational spectrum of nitrogen.
7. Analysis of rotational vibrational spectrum of a diatomic molecule (HBr).

8. Absorption spectrum of $KMnO_4$
9. Determination of dipole moment of an organic liquid
10. Spectral response of a photodiode and its I –V characteristics.

Mapping of CO's and PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	3	3	2	2			3	2	3	3	
CO2	3	2	3	3	3	2	2			3	2	3	3	
CO3	3	2	3	3	3	2	2			3	2	3	3	

MATHEMATICS PAPER – VII

21MAT316COMPLEX ANALYSIS 2-1-0 3

Objectives: To enable students to obtain knowledge of theory of complex functions of a complex variable and get acquainted with different methods and techniques of series and bilinear transformations.

Course Outcomes:

CO1	To understand the concepts of Analytic function, Cauchy- Riemann equations and Harmonic function.
CO2	Appling the concept of mapping like translation, rotation, magnification and inverse.
CO3	Apply and analyze to solve problem using contour integral.
CO4	Application of Taylor's series, Lourent's series to solve problems.

CO5	Evaluating using the concept of Singularities, poles, residue theorem.

Unit I

Definition – Algebra of complex numbers – polar forms – regions – Limits – continuity – differentiability – CR equations – Analytic Functions – Harmonic Functions.

(Chapters 1 & 2)

Unit II

Conformal mappings – bilinear transformations – Special bilinear transformations – fixed points.

Chapter-9 (Sections: 9.1-9.4)

Unit III

Introduction to complex Integration – Contour integral – Primitives – Cauchy-Goursat theorem – Winding number – Cauchy's integral formula.

Chapter-4 (Sections: 4.1-4.4, 4.6, 4.7)

Unit IV

Sequences – series – power series – uniform convergence of power series – Taylor's series – Laurent's series – Integration and differentiation of Power series.

Chapters- 5 & 6 (Sections: 5.1-5.2, 6.1-6.3,6.5,6.6)

Unit V

Zeros and singularities of analytic functions – types of singularities – poles – residue theorem.

Chapter-7 (Sections: 7.1-7.3)

Classification of Singularities – Residues – Poles and zeroes.

Chapter-7 (Sections: 7.1-7.3)

TEXTBOOKS:

1. H S Kasana, *Complex variables and Theory and Applications*, 2nd edition, Prentice Hall India.

REFERENCES:

1. S. Ponnusamy, *Foundations of Complex Analysis*, 2nd Edition, Narosa Publishing House, 2005.
2. J.W. Brown and R.V. Churchil, *Complex Variable and Applications*, 8th edition, McGraw Hill, 2008.
3. R. Roopkumar, *Complex Analysis*, 1st edition, Pearson Education, Chennai, 2014.

MATHEMATICS PAPER - VIII

21MAT317 PROBABILITY AND STATISTICS 3-1 0 4

Objectives: To enable students to understand the properties of probability and probability distributions and apply wide variety of specific statistical methods.

Course Outcomes:

CO1	Understand the basic concepts of probability and probability modelling.
CO2	Gain in depth knowledge about statistical distributions, properties and real time applications.
CO3	Find measures of central tendency for distribution of sample statistics
CO4	To understand the concept of theory of estimation
CO5	Ability to make decisions under uncertainties using statistical testing of hypothesis

Unit I

Probability Concepts: Sample Space and Events: Random Experiments – Sample Space – Events – Interpretations of Probability: Introduction – Axioms of probability – Addition Rules – Conditional Probability – Multiplication and Total Probability Rules – Independence – Bayes Theorem.

(Sections: 2.1 – 2.7)

Unit II

Discrete Random Variables and Distributions: Discrete Random Variables – Probability Distributions – Probability Mass Function – Cumulative Distribution Functions – Mean – Variance – Discrete Uniform Distribution – Binomial Distribution – Geometric and Negative Binomial Distribution – Poisson Distributions.

(Sections: 3.1-3.7, 3.9)

Unit III

Continuous Random Variables and Distributions: Continuous Random Variables – Probability Distributions and Probability Density Functions – Cumulative Distribution Functions – Mean – Variance – Continuous Uniform Distribution – Exponential Distribution – Normal Distribution – Chebyshevs Inequality – Moment-Generating Functions.

(Sections: 4.1-4.6,4.9)

Unit IV

Two Dimensional Discrete and Continuous Random Variables: Joint Probability Distributions – Marginal Probability Distributions – Conditional Probability Distributions –
Independence – Covariance and Correlation.

(Sections:5.1, 5.3, 5.5)

Unit V

Point Estimation of Parameters: GeneralConcept of Point Estimation – Methods of Point Estimation – Sampling distributions – Chi-square, t and F distributions (only definitions and use) – Central Limit Theorem.

Simple Linear Regression: Empirical Models – Simple Linear Regression.

(Sections:7.1-7.5, 4.10.2, 8.3.1, 10.5.1, 11.1, 11.2)

TEXTBOOKS:

1. Douglas C. Montgomery and George C. Runger, *Applied Statistics and Probability for Engineers*, 3rd edition, John Wiley and Sons Inc., 2005

REFERENCES:

1. Ravichandran J., *Probability and Statistics for engineers*, 1st Reprint Edition, Wiley India, 2012.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, *Probability and Statistics for Engineers and Scientists*, 9th Edition, Pearson Education Asia, 2007.
3. Sheldon M. Ross, *Introduction to Probability and Statistical Inference*, 6th edition, Pearson.
4. A. Papoulis and Unnikrishna Pillai, *Probability, Random Variable and Stochastic Processes*, 4th edition, McGraw Hill, 2002.

Chemistry Paper - VIII

21CHY316 FUNCTIONAL GROUPS, HETEROCYCLIC COMPOUNDS AND NATURAL PRODUCTS 3-1-0 4

OBJECTIVES: To develop an understanding of Natural Products,Alcohols and Phenols, Carbonyl Compounds, Organic Compounds of Nitrogen and Heterocyclic Compounds.

Course Outcome:

CO1	To explain the formation, structure, bonding and chemical properties of alcohols and phenols.
CO2	To explain the synthesis and properties of carbonyl compounds.
CO3	To describe the formation and properties of organic compounds containing nitrogen.
CO4	To explain the formation, structure and chemical properties of heterocyclic compounds.

CO5	To describe the basic characteristics, classification, nomenclature and structure of natural products.

Unit I

Alcohols and Phenols: Monohydric alcohols: Nomenclature, methods of formation (reduction of aldehydes, ketones, carboxylic acids and esters). Hydrogen bonding, Acidic nature. Reactions of alcohols (oxidation, esterification, dehydration). Dihydric alcohols: Nomenclature, methods of formation (from alkenes and alkyl dihalides), chemical reactions of vicinal glycols - oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-pinacolone rearrangement. Trihydric alcohols: Nomenclature and methods of formation (from alkenes and alkenals), chemical reactions of glycerol (with nitric acid, oxalic acid and HI). Phenols: Nomenclature, structure and bonding, Preparation of phenol, resorcinol and 1 and 2- naphthols (one method each). Physical properties and acidic character of phenol. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols: Electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Houben-Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.

Unit II

Carbonyl Compounds: Aldehydes and Ketones: Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties. Benzoin, aldol, Perkin and Knoevenagel condensations. Use of acetals as protecting group. Baeyer-Villager oxidation of ketones, Cannizzaro reaction. MPV, Clemmensen, Wolff-Kishner, LiAlH4 and NaBH4 reductions. Halogenation of enolizableketones. An introduction to α,β-unsaturated aldehydes and ketones. Carboxylic Acids and their Derivatives: Reactions of carboxylic acids: HVZ reaction, synthesis of acid chlorides, esters and amides. Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of formation and chemical reactions hydroxy acids – malic, tartaric and citric acids. Unsaturated monocarboxylic acids: Methods of formation and chemical reactions Dicarboxylic acids: Methods of formation and effect of heat and dehydrating agents. Carboxylic acid derivatives: Structure and nomenclature of

acid chlorides, esters, amides and acid anhydrides. Preparation of carboxylic acid derivatives, chemical reactions. Mechanism of esterification and hydrolysis (acid, base conditions).

Unit III

Organic Compounds of Nitrogen: Nitro Compounds: Introduction, Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanism of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media. Picric acid. Aliphatic and Aromatic amines: Structure and nomenclature of amines, Preparation of alkyl and aryl amines (reduction of nitro compounds, nitrites), reductive amination of aldehydic and ketonic compounds. Gabriel-phthalimide reaction, Hofmann bromamide reaction. Reactivity, physical properties, stereochemistry of amines. Separation of a mixture of primary, secondary and tertiary amines (Hinsberg's method). Structural features effecting basicity of amines. Amine salts as phase – transfer catalysts. Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Synthetic transformations by aryl diazonium salts, azo coupling.

Unit IV

Heterocyclic Compounds: Introduction, methods of formation of five membered heterocycles – furan, thiophene and pyrrole. Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and their chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Six membered heterocycles: methods of formation of pyridine, mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.

Introduction to condensed five and six-membered heterocycles, preparation and reactions of Indole, quinoline and isoquinoline with special reference to Fischer indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

Unit V

Natural Products: Carbohydrates: Introduction, classification and nomenclature. Configuration of monosaccharides. Erythro and threodiastereomers. Interconversions in

carbohydrates – glucose to fructose, fructose to glucose, aldopentose to aldohexose and aldohexose to aldopentose. Epimerisation, mechanism of osazone formation, Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Structural elucidation of D(+) glucose. Mechanism of Mutarotation. Constitution of disaccharides - maltose, sucrose and lactose. Introduction to polysaccharides (starch and cellulose) without involving structure determination. Alkaloids: Introduction, general methods of structural determination, structural elucidation of Conine, Nicotine and piperineTerpinoids: Introduction, isoprene rule, structural elucidation of Citral and Menthol. Amino acids, Peptides, Proteins and Nucleic acids Classification, structure and stereochemistry of amino acids. Acid-base behaviour, isoelectric point and electrophoresis. Preparation and reactions of α- amino acids. Classification of proteins. Peptide structure determination - end group analysis, selective hydrolysis of peptides. Solid-phase peptide synthesis. Primary and secondary structures of proteins. Protein denaturation. Nucleic acids: Introduction, constituents of nucleic acids. Ribonucleosides and Ribonucleotides. The double helical structure of DNA.

TEXTBOOKS:

1. R. T. Morrison and R.N. Boyd, 'Organic Chemistry', 6th Edition - Prentice Hall of India.

REFERENCES:

1.. M. K. Jain and S. C. Sharma 'Modern Organic Chemistry', 3 rd Edition, Visal Publishing Company Co.
2. K. S. Tewari and N. K. Vishnoi, 'Organic Chemistry', 3 rd Edition, Vikas Publishing House
3. I.L. Finar, Organic Chemistry - Volume I & II - Pearson Education

---

Chemistry Paper IX

21CHY387 **PRACTICALS** **0-0-2 1**

Course Outcome:

CO1	Demonstrate the experimental procedure for important organic preparations and determination of melting point of organic compounds.
CO2	Apply experimental techniques for the quantitative estimation of the properties of organic compounds.
CO3	Apply various chromatographic approaches for separation and identification of components of a mixture.

1. Organic preparations:

Recrystallisation and determination of melting point and its importance may be mentioned

(a) Acetylation: Preparation of acetanilide from aniline

(b) Oxidation: Preparation of benzoin acid from benzaldehyde

(c) Nitration: Preparation of m-dinitrobenzene from benzene

(d) Hydrolysis: preparation of benzoic acid from ethyl benzoate

2. Quantitative organic analysis (Any four)

(a) Estimation of aniline by bromate-bromide method

(b) Estimation of glucose by Fehlings method

(c) Determination of iodine value of an oil by Vij's method

(d) Determination of saponification value of an ester / oil

(e) Estimation of amino acid by formal titration method

(f) Estimation of ascorbic acid in Vitamin C tablets by Volumetry

(g) Estimation of Paracetamol by titrimetric and photo spectrometric methods.

(h) Gravimetric Analysis of Lead, Iron and Nickel

i) **Chromatographic Techniques** (Any two)

(i) Thin Layer Chromatography

Determination of Rf values and identification of organic compounds:

(a) Separation of green leaf pigments (spinach leaves may be used)

(b) Separation of mixture of dyes

(ii) Paper Chromatography Determination of Rf values and identification of organic compounds:

(iii) Column Chromatography: Separation of ortho and para nitroanilines

21SCI399 **PROJECT** **Credit – 6**

To allow students to gain research experience in experimental and theoretical areas of basic sciences and to enhance their skills in scientific and technical writing and communication. Through the project, student will gain exposure to current and recent literature in physics, chemistry and interdisciplinary areas and will be trained to propose novel research problems and develop methodologies to solve them.

Students with an inclination towards physics will be encouraged to work on problems in both fundamental and applied branches of physics employing experimental as well as theoretical/computational techniques.
Students opting for chemistry will apply experimental and theoretical techniques to solve problems in inorganic, organic and physical chemistry and their application in the areas of industry, biology, medicine, energy and environment.

Besides topics on pure physics and chemistry, students will also be encouraged to work in interdisciplinary areas such as nanosciences, medicinal chemistry, material science, modeling and simulationetc.

ELECTIVES – MATHEMATICS

21MAT431 **OPERATIONS RESEARCH** **3-0-0 3**

OBJECTIVES:
To enable students to

- Understand the concept of linear programming and its problems
- Apply the knowledge of networks

Unit I

Linear Programming Problems: Introduction to Operations Research, necessity of Operations Research in modern management- models in Operations Research, Introduction to Linear Programming Problems, Formulation of Linear Programming Problems, solutions to Linear Programming Problems based on graphical method, solutions based on simplex algorithm.

Unit II

Transportation Models: Introduction to transportation - mathematical formulation of transportation problem, methods for initial basic feasible solution methods, MODI method for optimal.

Unit III

Assignment Models: Introduction to assignment problem, mathematical formulation of assignment problem.

Unit IV

Queuing Theory: Introduction to queuing theory, characteristics of queuing theory, single channel queuing models with finite and infinite size, solution to single channel queuing models.

Unit V

CPM and PERT: Network logic, concepts and definition, network scheduling by critical path method, program evaluation and review technique.

TEXTBOOKS AND REFERENCES:

1) Hamadi A. Taha, "Operations Research - An Introduction", Seventh Edition, Pearson Education, 2014.
2) KantiSwarup, P.K. Gupta and Man Mohan, "Operations Research", NinthEdition,Sultan Chand and Sons, 2001.

21MAT432 **NUMERICAL METHODS** **3-0-0 3**

OBJECTIVES: To enable students to

- Understand the concept of interpolation and approximation
- Apply various techniques of solving transcendental and polynomial equations

Unit I

Roots of Transcendental and Polynomial Equations: Bisection method, Iteration methods based on first degree equation, Rate of convergence, system of nonlinear equations.
Solution of System of Linear Algebraic Equations: Iteration methods
Eigenvalues and Eigenvectros: Jacobi Method for symmetric matrices, Power method for arbitrary matrices.
Sections : 2.2, 2.3, 2.5, 2.7, 3.4, 3.5, 3.6

Unit II

Interpolation and Approximation: Lagrange and Newton interpolation for unequal intervals, Finite difference operators, Interpolating polynomials using finite differences.
Sections: 4.2, 4.3,4.4.

Unit III

Differentiation and Integration: Numerical differentiation, Methods based on interpolation, Numerical integration, Methods based on undetermined coefficients.
Sections: 5.2, 5.6, 5.7, 5.8

Unit IV

Solutions of Ordinary Differential Equations: Initial Value problems, single step methods, Taylor series method, Second, Third and Fourth order Runge-Kutta methods.
Sections: 6.1,6.3, 6.4

Unit V

Solutions of Partial Differential equations: Elliptic partial Differential equations, Parabolic partial differential equations, Hyperbolic partial differential equations.
Sections: 12.1, 12.2, 12.3

TEXTBOOKS:

1) M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical methods for scientific and Engineering computation, New Age International Publishers, 2007, 5th edition.
2) R.L. Burden, J. D. Faires, Numerical Analysis, Richard Stratton, 2011, 9th edition.

REFERENCES:

1. S.D. Conte and Carl de Boor, 'Elementary Numerical Analysis; An Algorithmic Approach'. International series in Pune and Applied Mathematics, McGraw Hill Book Co., 1980.
2. Kandasamy P, Thilagavathi.K and Gunavathi. K. 'Numerical Methods'- S. Chand and Company Ltd., New Delhi- Revised Edition 2007.

21MAT433 INTEGRAL TRANSFORMS AND FOURIER SERIES 3-0-0 3

OBJECTIVES: To enable students to

- Acquaint with the knowledge of fourier analysis and Laplace transforms
- Solve the linear ordinary differential equations

Unit I

Fourier Analysis: Fourier series, Complex Form of Fourier Series, Parseval's Identity,

Unit II

Fourier Integrals, Fourier integral theorem.

Unit III

Infinite Complex Fourier Transforms, Sine and Cosine Transforms, Properties, Convolution theorem and Parseval's theorem**.**

Unit IV

Laplace Transforms: Laplace Transforms, Inverse Transforms, Properties, Transforms of Derivatives and Integrals, Second Shifting Theorem, Unit Step Function and Dirac-Delta Function, Differentiation and Integration of Transforms.

Unit V

Convolution, Initial and Final Value Theorems, Periodic Functions, Solving Linear Ordinary Differential Equations with Constant Coefficients, System of Differential Equations and Integral Equations.

TEXTBOOKS:

E Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 2002, Eighth Edition.

REFERENCES:

1) Larry C. Andrews and Bhimson. K. Shivamoggi, The Integral Transforms for Engineers, Spie Press, Washington, 1999.
2) J. L. Schiff, The Laplace Transform, Springer, 1999.
3) Stanley J Farlow,' Partial Differential Equations for Scientists and Engineers' Dover Book on Mathematics, 1993

21MAT434 **APPLIED STATISTICS** **3-0-0 3**

OBJECTIVES: To enable students to

- Understand the concept of statistical inference of two samples
- Apply statistical techniques in quality control

Unit I

Tests of Hypothesis for a Single Sample: Hypothesis Testing, Tests on a Population Proportion- Tests on the Mean of a Normal Distribution with Variance known and unknown, Tests on the variance –Test for Goodness of fit, Contingency table tests.
Sections: 9.1-9.9

Unit II

Statistical Inference for Two Samples: Inference on the Difference in Means of Two Normal Distributions, Variance Known and Unknown, A nonparametric tests for difference in Two means, Paired t test, Inference on the variances of the Two Normal Distributions.
Sections: 10.1-10.6

Unit III

Design of Experiments of Single Factor: Introduction, Completely Randomized Single Factor Experiment, computation of sum of squares, Random effect models, Randomized complete block design, computation of sum of squares.
Sections: 13.1-13.4

Unit IV

Design of Experiment with several factors: Introduction – Latin Square Design – statistical model for LSD, computation of sum of squares – two factor factorial experiment – main and interaction effects, data and statistical model- computation of sum of squares.

Sections : 14.1-14.5

Unit V

Statistical Quality Control: Quality improvement and statistics, Introduction to control limits - control charts for variables – X-bar chart, R-chart, S chart for individual observations- attribute control charts – Control charts for Proportions and for defects per unit.
Sections: 15.1-15.6

TEXTBOOKS:

1) Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley and Sons Inc., 2005

REFERENCES:

1) Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability and Statistics for Engineers and Scientists, 8th Edition, Pearson Education Asia, 2007

2) Ravichandran, J. Probability and Statistics for engineers, First Reprint Edition, Wiley India, 2012.

21MAT435 NUMBER THEORY 3-0-0 3

OBJECTIVES: To enable students to

- Understand the concept of divisibility, congruencies and arithmetical funcitons
- Understand the concept of primitive roots and Diophantine equations

Unit I

Divisibility: Definition, properties, division algorithm, greatest integer function (Sec 1.1)
Primes: Definition, Euclid's Theorem, Prime Number Theorem (statement only), Goldbach and Twin Primes conjectures, Fermat primes, Mersenne primes. The greatest

common divisor: Definition, properties, Euclid's algorithm, linear combinations and the GCD - The least common multiple: Definition and properties. The Fundamental Theorem of Arithmetic: Euclid's Lemma, canonical prime factorization, divisibility, gcd, and lcm in terms of prime factorizations. Primes in arithmetic progressions: Dirichlet's Theorem on primes in arithmetic progressions (statement only) (Sec 1.2 to 1.5)

Unit II

Congruences: Definitions and basic properties, residue classes, complete residue systems, reduced residue systems - Linear congruences in one variable, Euclid's algorithm - Simultaneous linear congruences, Chinese Remainder Theorem - Wilson's Theorem - Fermat's Theorem, pseudoprimes and Carmichael numbers - Euler's Theorem (Sec 2.1 to 2.6).

Unit III

Arithmetic functions: Arithmetic function, multiplicative functions: definitions and basic examples - The Moebius function, Moebius inversion formula - The Euler phi function, Carmichael conjecture - The number-of-divisors and sum-of-divisors functions - Perfect numbers, characterization of even perfect numbers (Sec 3.1 to 3.6).

Unit IV

Quadratic residues: Quadratic residues and nonresidues - The Legendre symbol: Definition and basic properties, Euler's Criterion, Gauss' Lemma - The law of quadratic reciprocity (Sec 4.1 to 4.3).

Unit V

Primitive roots:
The order of an integer - Primitive roots: Definition and properties - The Primitive Root Theorem: Characterization of integers for which a primitive root exists (Sec 5.1 to 5.3).
Diophantine Equations
Linear Diophantine Equations - Pythagorean triples – Representation of an integer as a Sum of squares (Sec 6.1, 6.3, 6.5).

TEXTBOOK:

James Strayer, 'Elementary Number Theory', Waveland Press, 1994/2002, ISBN 1-57766-224-5

REFERENCES:

1) Tom M. Apostol,' Introduction to Analytic Number Theory', Springer, Under Graduate Studies in Mathematics, 1976.
2) Kenneth Rosen, Elementary Number Theory and its Applications, 5th Edition, McGraw Hill.
3) I. Niven, H. Zuckerman, H. Montgomery, An Introduction to the Theory of Numbers, 5th Edition, Wiley.
4) Burton, David M. Elementary Number Theory. Allyn and Bacon, 1976.

21MAT436 SPECIAL FUNCTIONS 3-0-0 3

OBJECTIVES: To enable students to

- Understand gamma and beta functions
- Solve the Legendre equations using various techniques

Unit I

Gamma and Beta Functions and Elliptic Functions
Part II: 4.1 – 4.11

Unit II

Special functions , power series solution of differential equations, ordinary point ; Solution about singular points , Frobenius method. Bessel's equation, solution of Bessel's equation, Bessel's functions $J_n(x)$.
Part II: 8.5-8.6, 8.8- 8.10, 11.1, 11.2.

Unit III

Recurrence Formulae, Equations reducible to Bessel's equation, orthogonalityofBessel'sFunctions, A generating function for $J_n(x)$.
Part II: 11.8, 11.10, 11.11.

Unit IV

Legendre's equation, Legendre's polynomial $P_n(x)$, Legendre's function of the second kind [Qn(x)], General solution of Legendre's equation, Rodrigue's formula, Legendre polynomials, A generating function of Legendre's polynomial.
Part II: 9.1-9.4.

Unit V

Orthogonality of Legendre polynomials, Recurrence formulae for $P_n(x)$ Green's function – Green's Identities – Generalized functions
Part II: 9.8-9.9, 9.22-9.25.

TEXTBOOKS:

1) M.D. Raisinghania, Ordinary and Partial Differential Equations, S.Chand, 18th edition, 2016

REFERENCES:

1) I. N. Sneddon - Special Functions of mathematical Physics & Chemistry, 3 Oliver & Boyd, London.
2) N. N. Lebedev - Special Functions and Their Applications, PHI.
3) Special Functions, R. Askey and R. Roy, Cambridge.

ELECTIVES – PHYSICS

21PHY331MEDICAL PHYSICS 3-0-0 3

OBJECTIVE: To enable students to provide Medical Physics support with the goal of improving the effectiveness and safety in the use of Physics and technologies in medicine.

Course outcomes:

1. Ability to describe the mechanism of the body.
2. To explain the acoustics of the body.
3. Ability to explain the application of X-rays in medical field.
4. Ability to explain the application of radiation in medical field.
5. Ability to explain the protection given to patient, staff and public from radiation.

UNIT I:

Mechanics of the body: Skeleton, forces, and body stability. Muscles and dynamics of body movement. Physics of Loco-motors Systems: joints and movements, Stability and Equilibrium. Energy household of the body: Energy balance in the body, Energy consumption of the body, Heat losses of the body, Thermal Regulation. Pressure system of body: Physics of breathing, Physics of cardiovascular system.

UNIT II:

Acoustics of the body: Nature and characteristics of sound, Production of speech, Physics of the ear, Diagnostics with sound and ultrasound. Optical system of the body: Physics of the eye. Electrical system of the body: Physics of the nervous system, Electrical signals and information transfer.

UNIT III:

X-RAYS: Electromagnetic spectrum, production of x-rays, x-ray spectra, Bremsstrahlung, Characteristic x-ray. X-ray tubes & types: Coolidge tube, x-ray tube design, tube cooling stationary mode, Rotating anode x-ray tube, Tube rating, quality and intensity of x-ray.

X-ray generator circuits, half wave and full wave rectification, filament circuit, kilo voltage circuit, types of X-Ray Generator, high frequency generator, exposure timers and switches, HT cables, HT generation.

UNIT IV:

Radiation Physics: Radiation units exposure, absorbed dose, units: rad, grey, relative biological effectiveness, effective dose, inverse square law. Interaction of radiation with matter Compton & photoelectric effect, Rem & Sievert, linear attenuation coefficient. Radiation Detectors: Thimble chamber, condenser chambers, Geiger Muller counter, Scintillation counters and Solid State detectors, ionisation chamber, Dosimeters, survey methods, area monitors, TLD, Semiconductor detectors.

UNIT V:

Radiation And Radiation Protection: Principles of radiation protection,protective materials-radiation effects, somatic, genetic stochastic and deterministic effect. Personal monitoring devices: TLD film badge, pocket dosimeter, OSL dosimeter. Radiation dosimeter. Natural radioactivity, Biological effects of radiation, Radiation monitors. Steps to reduce radiation to Patient, Staff and Public. Dose Limits for Occupational workers and Public. AERB: Existence and Purpose.

Mapping of CO's and PO's

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	1	3	2	2	2				1	2	2	
CO2	3	2	1	3	2	2	2				1	2	2	
CO3	3	2	1	3	2	2	2				1	2	2	
CO4	3	2	1	3	2	2	2				1	2	2	
CO5	3	2	1	3	2	2	2				1	2	2	

TEXT BOOKS:

1)Basic Radiological Physics Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003)

2) Physics of Radiation Therapy: F M Khan - Williams and Wilkins, Third edition (2003)

3) Advanced Practical Physics for students, B.L. Flint & H.T. Worship, 1971, Asia Publishing House.

REFERENCES:

1) Christensen's Physics of Diagnostic Radiology: Curry, Dowdey and Murry - Lippincot Williams and Wilkins (1990)

2) The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and 36 Boone Lippincot Williams and Wilkins, Second Edition (2002)

3) The Physics of Radiology-H E Johns and Cunningham.

4) Handbook of Physics in Diagnostic Imaging: Roshan S. Livingstone: B. I. Publications Pvt Ltd.

5) A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi.

21PHY332RENEWABLE ENERGY AND ENERGY HARVESTING 3-0-0 3

OBJECTIVE: To enable students to understand the use of different sources of energy.

Course outcomes:

1. Understand the need of energy conversion and the various methods of energy storage.
2. Explain the field applications of solar energy.

3. Identify Winds energy and Tidal energy as alternate form of energy and to know how it can be tapped.
4. Ability to explain the Geothermal and Hydro energy, its mechanism of production and its applications.
5. Ability to explain the electro-magnetic energy harvesting and its application.

UNIT I :

Fossil fuels and Alternate Sources of energy: Fossil fuels and Nuclear Energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.

UNIT II:

Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.

UNIT III:

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices.

Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass.

UNIT IV:

Geothermal Energy: Geothermal Resources, Geothermal Technologies.

Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources.

Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power

UNIT V:

Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications.

Carbon captured technologies, cell, batteries, power consumption

Environmental issues and Renewable sources of energy, sustainability.

Mapping of CO's and PO's

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	1	3	2	2	2				1	2	2	
CO2	3	2	1	3	2	2	2				1	2	2	
CO3	3	2	1	3	2	2	2				1	2	2	
CO4	3	2	1	3	2	2	2				1	2	2	
CO5	3	2	1	3	2	2	2				1	2	2	

REFERENCES:

1)Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2) Solar energy - M P Agarwal - S Chand and Co. Ltd.
3) Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4) Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
5) Dr. P Jayakumar, Solar Energy: Resource Assessment Handbook, 2009
6) J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
7) http://en.wikipedia.org/wiki/Renewable_energy

21PHY333 INTRODUCTION TO NANOPHYSICS AND APPLICATIONS 3-0-0 3

Objective: To enable students to provide knowledge about nanotechnology and its applications in Physics by focusing on different areas.

Course outcomes:

1. To acquire the knowledge of nano-size and its aspects different fields of sciences
2. To explain the properties of nanomaterials and size-effect.
3. To explain different approaches in fabricating nanomaterials and to understand the basics knowledge of quantum confinement in fabricating nanomaterials.
4. To explain how nanomaterials are characterized using different instruments and their principle of working.
5. To apply the applications of nanomaterials in different fields of physics.

UNIT I:

Introduction: relation of nano to other sciences - chemistry, biology, astronomy, geology, nano in nature.

UNIT II:

Properties of nano-materials: size effect, particle's size, shape, and density, melting point, surface tension, gettability, surface area and pore, composite structure, crystal structure, surface characteristics; mechanical, electrical, properties, and optical properties.

UNIT III:

Synthesis of nanoparticles: Classification of fabrication methods – top-to-bottom and bottom-to-top approaches, physical and chemical methods of preparation: CVD, controlled precipitation, sol-gel method, PLD etc; Confinement of particles – low dimensional structures - quantum wells, wires and dots.

UNIT IV:

Characterization of nanoparticles: X-Ray diffraction, examples of XRD, Debye-Scherzer formula; FTIR: principle, methodologies and accessories; SEM: basics and primary mode of operation, applications; TEM: basic principles; STM: basic principles and instrumentation; AFM: basics, modes of operation and applications; Photoluminescence: basic principles.

UNIT V:

Application of nanophysics: Carbon nanostructures: Fullerenes, CNTs and their applications; MEMS and NEMS devices; Quantum Cascade Lasers, Smart materials, GMR and Spintronic, multifarious.

Mapping of CO's and PO's

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	3	3	3	2	3				3	3	3	
CO2	3	2	3	3	3	2	3				3	3	3	
CO3	3	2	3	3	3	2	3				3	3	3	
CO4	3	2	3	3	3	2	3				3	3	3	

CO5	3	2	3	3	3	2	3				3	3	3	

REFERENCES:

1. Charles P Poole Jr. & Frank J Owens, Introduction to Nanotechnology, 1E, Wiley, 2007
2. W.R Fawner (Ed.), Nanotechnology and Nano electronics, Springer, 2006
3. M Hosokawa, et al, Nanoparticle Technology Handbook, Elsevier Publishers, 2007
4. S.V. Gaponenko, P.L Knight & A. Miller, Optical Properties of Semiconductor Nanocrystals, CUP, 1E, 2005
5. T Pradeep, Nano: The Essentials, TMH, 1E, 2007

21PHY334 PHYSICS OF THE ATMOSPHERE 3-0-0 3

OBJECTIVE: To enable students to understand the atmosphere of Earth and the climate change.

Course outcomes:

1. Be able to describe the basic structure of an atmosphere and the climate system.
2. Be able to use fundamental thermodynamics to derive expressions for the variation of temperature, pressure, and air density with height.
3. Be able to explain fundamental fluid dynamics involved in atmosphere.
4. Be able to explain stratospheric chemistry approach involved in atmosphere.
5. Be able to describe the detailed explanation of climate change.

UNIT I:

Earth - Atmosphere system – Introduction, Composition and structure, Radiative equilibrium, Energy budget, General circulation, Historical perspectives, Weather & Climate

UNIT II:

Atmospheric thermodynamics – Ideal gas law, First law of thermodynamics, Atmospheric composition, Hydrostatic balance, Entropy & potential temperature, Parcel concepts, Available potential energy, Moisture in the atmosphere, Saturated adiabatic lapse rate, Tephigram, Cloud formation
Atmospheric radiation – Basic physical concepts, Radiative transfer equation, basic spectroscopy of molecules, Transmittance, Absorption by atmospheric gases, Heating rates, Greenhouse effect revisited, Simple scattering model.

UNIT III:

Basic fluid dynamics – Mass conservation, material derivative, alternative form of continuity equation, equation of state for the atmosphere, Navier-Stokes equation, Rotating frames of reference, equations of motion in coordinate form, geostrophic and hydrostatic approximation, Pressure coordinates and geopotential, Thermodynamic energy equation; Atmospheric fluid dynamics – vorticity and potential vorticity, Boussinesq approximation, Quasi-geostrophic motion, Gravity waves, Rossby waves, Boundary layers, Instability

UNIT IV:

Stratospheric chemistry – Thermodynamics and chemical reactions, Chemical kinetics, Bimolecular reactions, Photo-dissociation, Stratospheric ozone, Transport of chemicals, Antarctic ozone hole.
Atmospheric remote sounding – Observations, remote sounding from space and ground; Atmospheric modeling – Hierarchy of models, Numerical methods, Uses of complex numerical models, Lab models

UNIT V:

Climate change – Introduction, energy balance model, some solutions of the linearised energy balance model, Climatic feedbacks, Radiative forcing due to increase in Carbon dioxide.

Projects based on Modules 4 and 5 (Reading a journal paper & reproducing calculations, Numerical modeling and / or data analyses)

TEXTBOOKS/REFERENCES

1. Andrews DG: An introduction to atmospheric physics, 2E, CUP, 2010
2. Salby ML: Physics of the Atmosphere and Climate, CUP, 2012
3. Holton JR: An introduction to Dynamic Meteorology, 4E, AP, 2004
4. Wallace JM & Hobbs PV: Atmospheric Science-An introductory Survey, 2E, AP, 2006
5.Chandrasekar A: Basics of Atmospheric Science, PHI, 2010

Mapping of CO's and PO's

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	1	3	3	1	2				3	3	3	
CO2	3	3	1	3	3	1	2				3	3	3	
CO3	3	3	1	3	3	1	2				3	3	3	
CO4	3	3	1	3	3	1	2				3	3	3	
CO5	3	3	1	3	3	1	2				3	3	3	

21PHY335 **BIOPHYSICS** **3-0-0 3**

OBJECTIVE: To enable students to study the selected biological phenomena using physical principles.

Course outcomes:

1. Ability to explain the basics laws in physics and chemistry, various techniques to study biomolecules.
2. Be able to apply various spectroscopic methods to study biomolecules.
3. Ability to explain fundamentals of molecular modelling and macromolecular structure.
4. Be able to apply the neuro science as application in biophysics.

UNIT I:

Introduction: Laws of Physics and Chemistry, introduction to crystallography, Introduction to chromatography, electrophoresis Physico-Chemical Techniques to studyBiomolecules: hydration of macromolecules, diffusion of osmosis, sedimentation, ultracentrifuge, rotational dissuasion, light scattering, small angle X-ray scattering, Mass spectrometry.

UNIT II:

Spectroscopy: UV spectroscopy, circular dichroism, Fluorescence spectroscopy, IR, Raman and Electron spin spectroscopy, NMR spectroscopy.

UNIT III:

Molecular Modeling & Macromolecular Structure: building the structure of H_2O_2, , nucleic-acid structure, monomers, polymers, double helical structure of DNA, Polymorphism and nanostructure of DNA, structure of RNA, protein structure: amino acids, virus structure

UNIT IV:

Energy Pathways in Biology: free energy, couple reactions, group transfer potential, Pyridinenucleotides, photosynthesis, energy conversion pathways, membrane transport. Biomechanics: strained muscles, mechanical properties of muscles, cardiovascular-system.

UNIT V:

Neurobiophysics: nervous system, physics of membrane potentials, sensory mechanisms. Origin and evolution of life: prebiotic earth, theories of origin and evolution of life, laboratory experiments on formation of small molecules.

TEXTBOOKS:

1. "Cell and Molecular Biology-Concepts and Experiments" by G.Karp, 2nd ed. John Wiley & Sons, Inc. Singapore, 1999.
2. "Principles of Physical Biochemistry" by K.vanHolde, W.C. Johnson, and P.S.Ho. *Prentice Hall, 1998.*

Mapping of CO's and PO's

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	1	3	3	3	1	1				3	2	3	
CO2	3	1	3	3	3	1	1				3	2	3	
CO3	3	1	3	3	3	1	1				3	2	3	
CO4	3	1	3	3	3	1	1				3	2	3	

21PHY336 **SPACE PHYSICS** **3-0-0 3**

OBJECTIVE: To enable students to study in detail about physics and kinematics of the planetary bodies.

Course outcomes:

1. Be able to brief about the history of solar-terrestrial physics.
2. Be able to explain about space plasma physics.
3. Be able to explain solar winds and Interplanetary Magnetic Field.
4. Be able to explain the interaction of solar winds with magnetized planets.
5. Be able to brief about magnetosphere.

UNIT I:

Brief history of solar-terrestrial physics – The variables Sun and the heliosphere. Earth's space environment and upper atmosphere.

UNIT II:

Space plasma physics – single particle motion, plasma state, Fluid description, MHD & Kinetic theory, Applications.

UNIT III:

Solar wind & Interplanetary Magnetic Field(IMF), Shocks and Instabilities in space.

UNIT IV:

Solar wind interactions with magnetized planets – Introduction, planetary magnetic fields, spherical harmonic expansions, geomagnetic field and its measurements, variations in Earth's field.

UNIT V:

Magnetosphere – Dynamics, Sw-Magnetosphere interactions; Ionosphere, Currents in space and Ionosphere; Neutral – Dynamics.

REFERENCES:

1) Hannu E.J. Koskinen, Physics-of Space Storms, Springer, 2011.
2) Molwin, M., An Introduction to Space Weather, CUP, 2008.
3) Kivelson& Russell, Introduction to Space Physics, CUP, 1995.

Mapping of CO's and PO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	2	2	2	3				2	3	1	
CO2	3	1	1	2	2	2	3				2	3	1	
CO3	3	1	1	2	2	2	3				2	3	1	
CO4	3	1	1	2	2	2	3				2	3	1	
CO5	3	1	1	2	2	2	3				2	3	1	

ELECTIVES – CHEMISTRY

21CHY531 ENVIRONMENTAL CHEMISTRY 3-0-0 3

OBJECTIVES:To study environmental management and impact assessment and the toxic effects of pollutants.

Unit I

Chemical toxicology : Toxicity -effects, toxic chemicals in the environment, impact of toxic chemicals on enzymes, biochemical effects of As, Cd, Pb, Hg, Co, NOx, SO_2 , O_3, PAN, CN, pesticides, carcinogenic substances.

Unit II

Air pollution: Primary pollutants, hydrocarbons-photochemical smog, particulates, radioactivity, effects of atmospheric pollution -acid rain, ozone layer depletion. Indoor air pollution. Effect of electric and magnetic fields in the environment Air pollution accidents – Bhopal and Chernobyl.

Air quality standards. Sampling and analysis of pollutants – CO, SO_2, H_2S, hydrocarbons, SPM. Noise pollution –Measurement, Classification, Hazards.

Unit III

Water pollution: Pollution of fresh water, ground water and ocean. Thermal pollution. Sampling and measurement of water quality – odour, colour, EC, turbidity, TDS, salinity, COD, BOD, DO, coliform, pH, acidity, CO_2, alkalinity, hardness, NO^{3-}, NO^{2-}, NH_3, phosphate, fluoride, chloride, cyanide, sulphide, sulphate and metals- As, Cd, Fe, Pb, Hg, SAR, WQI. Water quality parameters and standards. Waste water treatment techniques.

Unit IV

Effluent and waste management: Effluent – definition and characteristics. Methods for water and waste water treatment and systems (physical, chemical, and biological). Air pollution emission control devises – principle methods. Plants, animals and microorganisms for controlling pollution and treatment of effluents. Waste management – definition, characterisation, sources and classification. Waste treatment and disposing methods, - recycling and reuse. Methods for management for hazardous and toxic wastes. Principle and strategies of green chemistry –Illustrate with examples.

Unit V

Lithosphere: Composition, reactions in soil. Wastes and pollutants in soil. Sampling procedures and analysis of soil- cation exchange capacity, lime status, lime requirement, gypsum requirement, pH, N, P, K, S, Ca, Mg. Management of solid waste

TEXTBOOKS:

1. A. K. De, Environmental Chemistry, New age International Ltd.
2. S. S. Dara, A Textbook of Environmental chemistry and pollution control, S.Chand& Company Ltd.

REFERENCES:

1. G. T. Tyler, Living in the Environment, Tomson Brooke/Cole.
2. V K Ahluwalia, Environmental Chemistry, Ane Books Pvt Ltd, New Delhi
3. Tisdale, S.L., Nelson, W.L. and Beaton, J. D. Soil Fertility and Fertilisers, Macmillan Publishing Company, New York, 1990.

21CHY532 CHEMISTRY OF TOXICOLOGY 3-0-0 3

OBJECTIVES:

To understand about the pros and cons of using processed food stuff.
To understand the difference between the various types of soaps, synthetic detergents and cosmetics.
To understand the about the environmental hazards of plastics.
To understand about different bio pesticides.

Unit I

Food additives and Flavours: Functional food additives, adulteration, food laws. Food colours - permitted and non – permitted- Toxicology. Flavours – natural and synthetic- Toxicology .Other functional additives- Soft drinks- formulation Health drinks. Sugars - manufacture of sugar from cane sugar and beet root, artificial sugars.

Unit II

Soaps, Synthetic Detergents and Cosmetics: Soaps – Introduction, detergent action of soap. Toilet soap, bathing bars, washing soaps, liquid soap manufacture- additives, fillers and flavours. Significance of acidity and alkalinity.

Detergents- Introduction, detergent action, types of detergents-cationic, anionic, amphiphilic detergents. Common detergent chemicals. Additives, excipients colours and flavours. Enzymes used in commercial detergents. Environmental hazards.

Cosmetics- Introduction, classification – bathing oils, face creams, toilet powder, skin products, dental cosmetics, hair dyes, shaving cream, shampoo, general formulation of each type. Toxicology of cosmetics.

Unit III

Green Chemistry: Purpose, principles to be followed for green chemistry, synthesis of Adipic acid, Catechol, Methyl methacrylate, Ibuprofen, Paracetamol and furfural.Greenreagents.Oxidation technology for waste water treatment - green chemistry using biocatalytic reactions. Green chemistry in future.

Unit IV

Chemistry and Agriculture: Factors affecting soil pH - Soil pH and nutrient availability - Soil degradation causes. Fertilisers - classification of NPK fertilisers - sources - natural and synthetic. Excessive use of fertilisers and its impact on the environment. Bio fertilisers. Plant growth hormones.

Pesticides- Classification-insecticides, herbicides, fungicides. Excessive use of pesticides –environmental hazards. Acts and Laws concerning the pesticides. Bio pesticides, biofertilizers - rhizobium, azospirillum, acetobacter - Blue green algae and azolla - production and quality control of biofertilizers. Bio-conversion of agricultural wastes.

Unit V

Drugs : Chemotherapy- types of drugs- analgesics, antipyretics, antihistamines, antacids tranquillisers, sedatives, antibiotics.

TEXT BOOKS:

1) A. K. De, Environmental Chemistry, New age International Ltd.
2) S. S. Dara, A Textbook of Environmental chemistry and pollution control, S.Chand& Company Ltd.

REFERENCES:

1. T.P. Cutlet, Food- The Chemistry of its components. Royal Society of Chemistry, London(Paper back)

2. M. M. Srivastava, RashmiSanghi, 'Green Chemistry - Environment Friendly Alternatives', 2nd edition, Narosa Publishing House, 2005.
3. B.K. Sharma. Industrial Chemistry
4. CNR Rao- Understanding chemistry, Universities Press.
5. Puri and Sharma. Advanced Organic Chemistry.
6. V. K.Ahluwallia, 'Green Chemistry - Environmentally Benign Reactions', 1st edition, Ane books Pvt Ltd, 2009.
7. Tisdale, S.L., Nelson, W.L. and Beaton, J. D. Soil Fertility and Fertilisers, Macmillan Publishing Company, New York, 1990.
8. Buchel, K.H. Chemistry of Pesticides, John Wiley & Sons, New York, 1983
9. P.C Pall, K. Goel, R.K Gupta, Insecticides,pesticides and agrobased industries.
10. Singh, V.K Kapoor, Organic Pharmaceutical Chemistry

21CHY533 FORENSIC SCIENCE 3-0-0 3

OBJECTIVES:

To learn Crime investigation through diagnosis of poisoning and post mortem.
To acquire knowledge about explosions, the causes (gelatin sticks, RDX etc) and the security measures.
To understand the methods of detecting forgery in bank and educational records.
To understand the chemical methods used in crime investigation. (Medical aspects).

Unit I

Poisons: Poisons-types and classification-diagnosis of poisons in the living and the dead – clinical symptoms - postmortem appearances. Heavy metal contamination (Hg, Pb, Cd) of sea foods-use of neutron activation analysis in detecting Arsenic in human hair. Treatment in cases of poisoning - use of antidotes for common poisons.

Unit II

Crime Detection: Accidental explosion during manufacture of matches and fire works. Human bombs -possible explosives (gelatin sticks and RDX) - metal detector devices -

composition of bullets and detecting powder burn. Analysis of incendiary and timed bombs - spill of toxic and corrosive chemicals from tankers.

Unit III

Forgery and Counterfeiting Documents: Different types of forged signatures-simulated and traced forgeries - inherent signs of forgery methods - writing deliberately modified uses of ultraviolet rays - comparison of type written letters - checking silver line water mark in currency notes - alloy analysis using AAS to detect counterfeit coins - detection of gold purity in 22 carat ornaments - detecting gold plated jewels - authenticity of diamond.

Unit IV

Tracks and Traces: Tracks and traces - small tracks and police dogs-foot prints - casting of foot prints residue prints, walking pattern or tyre marks - miscellaneous traces and tracks - glass fracture - tool markpaints – fibres. Analysis of biological substances - blood, saliva, urine and hair- Cranial analysis (head and teeth) DNA. Finger printing for tissue identification in dismembered bodies -Detecting steroid consumption in athletes and race horses.

Unit V

Medical Aspects: Aids - causes and prevention - misuse of scheduled drugs - burns and their treatment by plastic surgery. Metabolite analysis using mass spectrum – gas chromatography. Arson-natural fires and arson - burning characteristics and chemistry of combustible materials - nature of combustion. Ballistics - classification - internal and terminal ballistics - small arms - laboratory examination of barrel washing and detection of powder residue by chemical tests.

TEXTBOOK:

1. T.H.James, Forensic Sciences, Stanley Thornes Ltd.

REFERENCE:

1. Richard, Criminalistics - An Introduction to Forensic Science (College Version), 8th Edition, Sofestein, Printice Hall

---

21CHY534 NANOCHEMISTRY AND NANOTECHNOLOGY 3-0-0 3

OBJECTIVES: To study History, terminology and scales of nano systems, Synthesis and characterisation of nano systems Electrical and optical properties of nano systems and Applications of nanomaterials.

Unit I

History: Terminology- scales of nano-systems- nanoparticles: introduction-atoms to molecules-quantum dots-shrinking of bulk materials to quantum dots. Different types of nanoparticles: metal nanoparticles and monolayer substituted nanoparticles- fullerenes

Unit II

Synthesis: Synthesis and characterisation- carbon nanotubes: synthesis and characterisation- various approaches in nanoparticle synthesis: self-assembled monolayers, monolayer protected metal nanoparticles.

Unit III

Characterisation of nanomaterials: Important methods for the characterisation of nanomaterials – electron microscopy (SEM), transmission electron microscopy (TEM), scanning tunneling electron microscopy (STEM), environmental transmission electron microscopy (ETEM), scanning probe electron microscopy (SPL), secondary ion mass spectrometry (SIMS)-photoelectron spectroscopy (UPES and XPES).

Unit IV

Electrical and optical properties of nanomaterials

Electrical and optical properties of nanoparticles- electrical and optical properties of carbon nanotubes- nanocatalysis nanolithography- nanochemical devices- optoelectronic devices- photodetectors- LEDs and lasers.

Unit V

Applications of nanomaterials : Nanocrystals- immunology labelling- applications in medical diagnosis- nanobased drug delivery- applications in biotechnology- nanosensor based on quantum size effects- nano biosensors nano medicines- destructive applications of nanomaterials- nanomaterials in war.

TEXTBOOKS:

C. N. R. Rao and A.Govindraj, Nanotubes and Nanowires, Royal Society of Chemistry (2005).

REFERENCES:

1. T. Pradeep, Nano: The Essentials, McGraw Hill Publishing Company, New Delhi (2007).
2. V. S. Muraleedharan and A. Subramania, Nanosciece and nanotechnology, Ane Books Pvt. Ltd. New Delhi, 2009
3. J. M. M. Duart, R. J. M. Palma and F.A. Rueda, Nanotechnology and microelectronics and optoelectronics, Elsevier (2002).
4. R. Booker and , E. Boysen, Nanotechnology, Wiley India Pvt Ltd, 2008
5. K. J. Klabunde, Nanoscale materials in chemistry, John Wiley and Sons.
6. C. P. Poole Jr and F J Owens, Introduction to nanotechnology, Wiley IndiaPvt Ltd 2009.
7. G.L Hornyak, J.Dutta, H.F Timbals, A.K Rao, Introduction to Nanoscience, CRC Press.

21CHY535 PHARMACEUTICAL CHEMISTRY 3-0-0 3

OBJECTIVES:

To understand the common diseases and the cure
To know the terms of pharmacology
To understand the mechanism of drug action
To acquire knowledge about chemotherapy and the antibiotics
To understand the drugs used for diabetes, hypertension, cholesterolemia

To acquire knowledge about various health promoting drugs

Unit I

Introduction: Common diseases - Infective diseases - insect-borne, air-borne and water-borne – hereditary diseases. Terminology - drug, pharmacology, anti-metabolites. Absorption of drugs - routes of administration of drugs, factors affecting absorption. Assay of drugs - chemical, biological, immunological assays, LD_{50} and ED_{50} therapeutic index, drug dosage.

Unit II

Designation of drugs: Designation of drugs based on physiological action; Definition and two examples with structure each of: Anesthetics-General and local. Analgesics - Narcotic and synthetic. Antipyretics and anti-inflammatory agents. Antibiotics - penicillin, streptomycin, chloramphenicol, tetracyclins. Antivirals. AIDS - symptoms, prevention, treatment. Cancer and neoplastic agents.

Unit III

Common body ailments: Diabetes - Causes, hyper and hypoglycemic drugs - Psychedelic drugs, hypnotics, sedatives (barbiturates, LSD) - Blood pressure - Systolic & Diastolic Hypertensive drugs - Cardiovascular drugs – anti arrhythmic, antianginals, vasodilators – CNS depressants and stimulants – Lipid profile - HDL, LDL cholesterol, lipid lowering drugs.

Unit IV

Health promoting medicines: Nutraceuticals-Vitamins A B C D E and K (structure) micronutrients such as Na, K, Ca, Cu, Zn, I -Medicinally important inorganic compounds of Al, P, As, Hg, Fe

Unit V

Organic Pharmaceutical acids and bases: Organic Pharmaceutical acids; Agents for kidney function (Aminohippuric acid); Agents for liver function (Sulfobromophthalein);

Agents for pituitary function (metyrapone) - Organic pharmaceutical bases - antioxidants, treatment of ulcer and skin diseases.

TEXTBOOKS:

1. Jayashree Ghosh, Pharmaceutical chemistry, S.Chand and Company Ltd., 2006, New Delhi.
2. Lakshmi S., Pharmaceutical chemistry, S.Chand& Sons, 1995, New Delhi. AshutoshKar, Medicinal chemistry, Wiley Eastern Ltd., 1993, New Delhi.
3. David William & Thomas Lemke, Foyes principles of medicinal chemistry, 5th edition 2005, BI publishers.

REFERENCES:

1.RomasNogrady, Medicinal chemistry, II Edition 2004, Oxford University.

21CHY536 SUPRAMOLECULAR CHEMISTRY 3-0-0 3

OBJECTIVES: To understand the molecular to supramolecular chemistry

Unit I

Introduction to Supramolecular Chemistry : From molecular to supramolecular chemistry: Factors leading to strong binding, hydrogen bonding and stacking interactions, Bottom-up approach, Top-Down Approach, Energy and Signals, photo switching devices, electro switching devices, mechanical switching processes,

Unit II

Processing of Energy and Signals by Molecular and Supramolecular system: Fundamental principles of photo induced electron and energy transfer, Molecular electronics, Molecular photonics, Molecular Chemionics, Molecular electro photonics, Molecular Photochemionics.

Unit III

Molecular Recognition: Molecular receptors: crown ethers, siderophores, cyclophanes, cyclodextrin and their application in specific recognition processes. Metal guided self assembly reactions, Self-assembly of polynuclear metal complexes.

Unit IV

Electrochemistry of Supramolecular Systems: Electroluminescent systems as sensors and devices, Redox controlled molecular switches, Biohybrid electrochemical devices, Dendrimers as multielectron storage devices.

Unit V

Molecular Scale Mechanical Devices: Introduction to mechanical devices, Spontaneous mechanical like motions, Allosteric movements, Tweezers and Harpoons, A natural proton pump, Twisters, Molecular valves, Molecular Muscles.

TEXTBOOKS:

1. Vincenzo Balzani, 'Supermolecular Chemistry', Kluwer Academic, 1992
2. Vincenzo Blazon, Alberto Credi and MargheritaVenturi, 'Molecular Devices and Machines: A Journey Into the Nanoworld', Wiley, 2006.
3. Paola Ceroni, Alberto Credi and MargheritaVenturi, 'Electrochemistry of Functional Supramolecular Systems', Wiley, 2010.

REFERENCES:

1. Jonathan W. Steed Atwood, Jerry L.Chich, 'Supramolecular Chemistry', 2nd edition, Wiley, 2009.
2. Fritz Vegetal and F.Alfter 'Supramolecular Chemistry: An Introduction', John Wiley & Sons, 1999.
3. Jean-Marie Lehn, 'Supramolecular Chemistry', RCS publications, 2005.
4. Jonathan Steed, David Turner and Carl Wallace, 'Core concepts in SupramolecularChemistry and nanochemistry', John Wiley & Sons, 2007.
5. Katsuhiko Ariga and ToyokiKunitake, 'Supramolecular chemistry – Fundamentals and applications advanced textbook', Springer-Verlag, 2000.

21CHY537GREEN CHEMISTRY 3-0-0 3

OBJECTIVES: To understand the Green chemical approach of preparation of chemical and nanomaterials.

Unit-I

Green Chemistry: Introduction-Definition of green Chemistry, need of green chemistry, basic principles of green chemistry.Green synthesis-Evaluation of the type of the reaction (i) Rearrangements (100% atom economic), (ii) Addition reaction (100% atom economic).Organic reactions by Sonication method: apparatus required examples of sonochemical reactions (Heck, Hundsdiecker and Wittig reactions).

Unit-II

Selection of solvent:i) Aqueous phase reactions ii) Reactions in ionic liquids, Heckreaction,Suzuki reactions, epoxidation. iii) Solid supported synthesis

Super critical CO2: Preparation, properties and applications, (decaffeination, dry cleaning)

Unit-III

Microwave and Ultrasound assisted green synthesis: Apparatus required, examples of MAOS (synthesis of fused anthroquinones, Leukart reductive amination of ketones) - Advantages and disadvantages of MAOS.Aldol condensation-Cannizzaro reaction-Diels-Alder reactions-Strecker's synthesis.

Unit-IV

Green catalysis: Heterogeneous catalysis, use of zeolites, silica, alumina, supported catalysis-biocatalysis: Enzymes, microbes Phase transfer catalysis (micellar/surfactant)

Unit-V

Examples of green synthesis / reactions and some real world cases:1. Green synthesis of the following compounds: adipic acid, catechol, disodium imino di acetate (alternative Strecker's synthesis). 2. Microwave assisted reaction in water –Hoffmann elimination –

methyl benzoate to benzoic acid –oxidation of toluene and alcohols –microwave assisted reactions in organic solvents. Diels-Alder reactions and decarboxylation reaction.3. Ultrasound assisted reactions–sonochemical Simmons –Smith reaction(ultrasonic alternative to iodine).

TEXTBOOKS:

1. Green Chemistry Theory and Practice. P.T.Anatas and J.C. Warner.
2. Green Chemistry V.K. Ahluwalia Narosa, New Delhi.
3. Real world cases in Green Chemistry M.C. Cann and M.E. Connelly.
4. Green Chemistry: Introductory Text M.Lancaster: Royal Society of Chemistry(London).
5. Green Chemistry: Introductory Text, M.Lancaster.

REFERENCE:

1. Principles and practice of heterogeneous catalysis, Thomas J.M., Thomas M.J., John Wiley.
2. Green Chemistry: Environmental friendly alternatives R S Sanghli and M.M Srivastava, Narosa Publications.

21CHY538MODELLING AND SIMULATION OF CHEMICAL PROCESSES2-1-0 3

Course Objectives:

Understand the basic concepts of classical statistical mechanics, ensembles, partition functions and ensemble averages.

Unit I

Classical statistical mechanics, elementary concepts of temperature, ensembles and fluctuations, partition function, ensemble averaging, ergodicity.

Unit II

Molecular Dynamics Methodology - Force Field, Integrating Algorithms, Periodic Box and Minimum Image Convention, Long Range Forces, Non Bonded Interaction.

Unit III

Molecular Dynamics Simulations in different Ensembles, Temperature Control, Pressure Control, Estimation of Pure Component Properties, Radial Distribution Function, Molecular Dynamics Packages.

Unit IV

Enhanced Sampling, Molecular Dynamics Simulation of Rare Events in Chemistry - Umbrella Sampling, Metadynamics, Applications of enhanced sampling techniques.

Unit V

Simple application of modelling and simulations: Study of assembly of atoms or molecules, Study of nucleation and crystal growth, application in the study of processes such as protein folding, ion channels (Discuss case study from recent literature for each application.)

TEXTBOOKS:

1) A. R. Leach, MolecularModelling: Principles & Applications, Second Edition, 2001, Pearson Education Limited.

2) Michael P. Allen and Dominic J. Tildesley, Computer Simulation of Liquids, Second edition, 2017, Oxford University Press.

REFERENCES:

1) Donald A McQuarrie, Statistical Mechanics, Viva Books Private Limited, 2000.

2) Donald A McQuarrie, John D. Simon, Physical Chemistry: A Molecular Approach, 1997, University Science Books.