B.Sc.(PCM): Syllabus Revision in 2016-17.

S. No	Course Code	Session 2015-16	Session 2016-17	Remark Syllabus Change/ new course
	BSC101	English **Unit I: Grammar and Usage** 1. Tense. 2. Modals. 3. Active & Passive voice. 4. Direct & Indirect Speech. **Unit II Elements of Communication** 1. Communication: Meaning, Importance and Process 2. Verbal and Non- Verbal Communication **3.** Barriers to Communication**.** 4. Qualities of good Communication **Unit III: Comprehension(Poetry)** 1. Stopping by Woods on a Snowy Evening: Robert Frost 2. Song of Youth by Dr.A.P.J.Abdul Kalam 3. Where the Mind is Without Fear : Rabindra Nath Tagore 4. Abou Ben Adhem by Leigh Hunt **Unit: IV: Comprehension (Prose)** 1. An Astrologer's Day: R.K.Narayan 2. The Gift of Magi : O.Henry 3. Of Studies: Francis Bacon 4. On the Rule of the Road: A.G. Gardiner **Unit V: Composition** 1. Letter Writing: Formal and Informal 2. C.V. Writing. 3. E-Mails 4. Paragraph Writing	English **Unit I: Grammar and Usage** 1. Tense. 2. Modals. 3. Active & Passive voice. 4. Direct & Indirect Speech. **Unit II Elements of Communication** 1. Communication: Meaning, Importance and Process 2. Verbal and Non- Verbal Communication 3. Barriers to Communication**.** **4.** Qualities of good Communication **Unit III: Comprehension(Poetry)** 1. Stopping by Woods on a Snowy Evening: Robert Frost 2.Song of Youth by Dr.A.P.J.Abdul Kalam 3.Where the Mind is Without Fear : Rabindra Nath Tagore 4.Abou Ben Adhem by Leigh Hunt **Unit: IV: Comprehension (Prose)** 1.An Astrologer's Day: R.K.Narayan 2.The Gift of Magi : O.Henry 3.Of Studies: Francis Bacon 4.On the Rule of the Road: A.G. Gardiner **Unit V: Composition** 1. Letter Writing: Formal and Informal 2. C.V. Writing. 3. E-Mails 4. Paragraph Writing	
	BSC102	Mechanics **Unit 1:** Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with	**Unit 1:** Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with	

		respect to a parameter. Ordinary Differential Equations:1st order homogeneous differential equations. 2nd order homogeneous differential equations with constant coefficients. **Unit 2:** Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets.Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum. **Unit 3:** Gravitation: Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications.Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped Oscillations. **Unit 4:** Elasticity: Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants – Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion – Torsional pendulum-	respect to a parameter. Ordinary Differential Equations:1st order homogeneous differential equations. 2nd order homogeneous differential equations with constant coefficients. **Unit 2:** Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets. Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum. **Unit 3:** Gravitation: Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications.Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped Oscillations. **Unit 4:** Elasticity: Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants – Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion – Torsional pendulum -Determination of	

		Determination of Rigidity modulus and moment of inertia - q, η and □by Searles method. **Unit 5:** Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.	Rigidity modulus and moment of inertia - q, η and □by Searles method. **Unit 5:** Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.	
	BSC103	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic hydrocarbons **UNIT-I** **Atomic Structure:** Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure. **Quantum Mechanics:** What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and $\psi 2$, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wavefunctions (atomic orbitals) and their variations for 1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions	**UNIT-I** **Atomic Structure:** Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure. **Quantum Mechanics:** What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and $\psi 2$, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution	

		and the concept of the most probable distance with special reference to 1*s* and 2*s* atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers *ml* and *ms*. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number (*ms*). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations. **UNIT-II** **Chemical Bonding and Molecular Structure:** *Ionic Bonding:* General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character. *Covalent bonding:* VB Approach: Shapes	functions and the concept of the most probable distance with special reference to 1*s* and 2*s* atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers *ml* and *ms*. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number (*ms*). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations. **UNIT-II** **Chemical Bonding and Molecular Structure:** *Ionic Bonding:* General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage	

		of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds. **UNIT-III** *MO Approach:* Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches. ***Section B: Organic Chemistry-1*** **Stereochemistry:** Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis* - *trans*	ionic character. *Covalent bonding:* VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds. **UNIT-III** *MO Approach:* Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches. ***Section B: Organic Chemistry-1*** **Stereochemistry:** Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms).	

		nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems). **UNIT-IV** **Fundamentals of Organic Chemistry:** Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule. **UNIT-V** **Aliphatic Hydrocarbons:** Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. **Alkanes:** (Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation. **Alkenes:** (Upto 5 Carbons) *Preparation:* Elimination reactions:	Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis* - *trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems). **UNIT-IV** **Fundamentals of Organic Chemistry:** Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule. **UNIT-V** **Aliphatic Hydrocarbons:** Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. **Alkanes:** (Upto 5 Carbons).	

		Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cisaddition (alk. KMnO4) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation. **Alkynes**: (Upto 5 Carbons) *Preparation:* Acetylene from CaC2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alk. KMnO4.	*Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation. **Alkenes:** (Upto 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cisaddition (alk. KMnO4) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation. **Alkynes**: (Upto 5 Carbons) *Preparation:* Acetylene from CaC2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alk. KMnO4.	
	BSC104	Differential Calculus **Unit- I** Limit and Continuity (ε and δ definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem,	**Unit- I** Limit and Continuity (ε and δ definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem,	

		Unit- II Tangents and normals, Curvature, Asymptotes, Singular points, **Unit- III** Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates. **Unit- IV** Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of sin x, cos x, ex, log(l+x), (l+x)m, **Unit- V** Partial differentiation, Euler's theorem on homogeneous functions. Maxima and Minima with several variables, Indeterminate forms.	**Unit- II** Tangents and normals, Curvature, Asymptotes, Singular points, **Unit- III** Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates. **Unit- IV** Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of sin x, cos x, ex, log(l+x), (l+x)m, **Unit- V** Partial differentiation, Euler's theorem on homogeneous functions. Maxima and Minima with several variables, Indeterminate forms.	
	BSC105	Mechanics Lab		
		1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope. 2. To determine the Height of a Building using a Sextant. 3. To determine the Moment of Inertia of a Flywheel. 4. To determine the Young's Modulus of a Wire by Optical Lever Method. 5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle. 6. To determine the Elastic Constants of a Wire by Searle's method. 7. To determine g by Bar Pendulum. 8. To determine g by Kater's Pendulum. 9. To determine **g** and velocity for a freely	1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope. 2. To determine the Height of a Building using a Sextant. 3. To determine the Moment of Inertia of a Flywheel. 4. To determine the Young's Modulus of a Wire by Optical Lever Method. 5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle. 6. To determine the Elastic Constants of a Wire by Searle's method. 7. To determine g by Bar Pendulum.	

		falling body using Digital Timing Technique 10. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g	8. To determine g by Kater's Pendulum. 9. To determine **g** and velocity for a freely falling body using Digital Timing Technique 10. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g	
	BSC106	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic hydrocarbons Lab		
		Section A: Inorganic Chemistry - Volumetric Analysis 1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture. 2. Estimation of oxalic acid by titrating it with KMnO4. 3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO4. 4. Estimation of Fe (II) ions by titrating it with K2Cr2O7 using internal indicator. 5. Estimation of Cu (II) ions iodometrically using Na2S2O3. ***Section B: Organic Chemistry*** 1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements) 2. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given) (a) Identify and separate the components of a given mixture of two amino acids	***Section A: Inorganic Chemistry - Volumetric Analysis*** 1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture. 2. Estimation of oxalic acid by titrating it with KMnO4. 3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO4. 4. Estimation of Fe (II) ions by titrating it with K2Cr2O7 using internal indicator. 5. Estimation of Cu (II) ions iodometrically using Na2S2O3. ***Section B: Organic Chemistry*** 1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements) 2. Separation of mixtures by Chromatography: Measure the R_f value in each case (combination of two compounds to be given) (a) Identify and separate the components of a given mixture of two amino acids	

		(glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography (b) Identify and separate the sugars present in the given mixture by paper chromatography.	(glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography (b) Identify and separate the sugars present in the given mixture by paper chromatography.	
	BSC201	Environmental Science **Unit-1 Ecosystem: concepts and functions** Ecosystem- Definition and Introduction of Ecosystem- Abiotic and Biotic components, types of Ecosystems, Structure and functions of Ecosystem- Food chain, Food web, Ecological pyramids, Energy flow in Ecosystem. Biodiversity- Definition, Type and levels of Biodiversity, Values, Threats of biodiversity Conservation of biodiversity- In-situ and Ex-situ**.** **Unit -2 Natural Resources** Definition and classification of natural resources, Types and uses of renewable and non renewable resources in India, potentials of resources in India. **Unit- 3 Environmental Pollution and Control measures** Causes, Effects and Control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, and Nuclear Hazards. Disaster management: Floods, earthquake, cyclone and landslides. **Unit -4 Solid Waste Management** Introduction, Classification of solid waste, Composition and characteristics of solid waste, collection, conveyance and disposal methods of solid waste, Reuse, Recycle and Recovery of waste.	**Unit-1 Ecosystem: concepts and functions** Ecosystem- Definition and Introduction of Ecosystem- Abiotic and Biotic components, types of Ecosystems, Structure and functions of Ecosystem- Food chain, Food web, Ecological pyramids, Energy flow in Ecosystem. Biodiversity- Definition, Type and levels of Biodiversity, Values, Threats of biodiversity Conservation of biodiversity- In-situ and Ex-situ**.** **Unit -2 Natural Resources** Definition and classification of natural resources, Types and uses of renewable and non renewable resources in India, potentials of resources in India. **Unit- 3 Environmental Pollution and Control measures** Causes, Effects and Control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, and Nuclear Hazards. Disaster management: Floods, earthquake, cyclone and landslides. **Unit -4 Solid Waste Management** Introduction, Classification of solid waste, Composition and characteristics of solid waste, collection, conveyance and disposal methods of solid waste, Reuse, Recycle and Recovery of waste. **Unit-5 Social Issues and Environment** Sustainable development, urban problems	

		Unit-5 Social Issues and Environment Sustainable development, urban problems related to energy, Water conservation, Rain water harvesting water shed management, Resettlement and rehabilitation Public awareness and Environmental Education. Environment Protection Act- 1986, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest conservation Act.	related to energy, Water conservation, Rain water harvesting water shed management, Resettlement and rehabilitation Public awareness and Environmental Education. Environment Protection Act- 1986, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest conservation Act.	
	BSC202	Electricity, Magnetism and EMT **Unit 1:** **Vector Analysis**: Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only). **Unit 2:** **Electrostatics:** Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor	**Unit 1:** **Vector Analysis**: Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only). **Unit 2:** **Electrostatics:** Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.	

		completely filled with dielectric. **Unit 3:** **Magnetism:** Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials. **Unit 4:** **Electromagnetic Induction:** Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field. **Unit 5:** **Maxwell`s equations and Electromagnetic wave propagation:** Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.	**Unit 3:** **Magnetism:** Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials. **Unit 4:** **Electromagnetic Induction:** Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field. **Unit 5:** **Maxwell`s equations and Electromagnetic wave propagation:** Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.	
	BSC203	Chemical energetic, Equilibria & Functional Group Organic Chemistry-I **UNIT-I** **Chemical Energetics:** Review of thermodynamics and the Laws of Thermodynamics. Important principles	**UNIT-I** **Chemical Energetics:** Review of thermodynamics and the Laws of Thermodynamics. Important principles and	

		and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances. **Chemical Equilibrium:** Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔGo, Le Chatelier's principle. Relationships between *Kp, Kc* and *Kx* for reactions involving ideal gases. **UNIT-II** **Ionic Equilibria:** Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.	definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances. **Chemical Equilibrium:** Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔGo, Le Chatelier's principle. Relationships between *Kp, Kc* and *Kx* for reactions involving ideal gases. **UNIT-II** **Ionic Equilibria:** Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.	

		Section B: Organic Chemistry-2 Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. **UNIT-III** **Aromatic hydrocarbons:** *Preparation* (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. *Reactions*: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene). **Alkyl and Aryl Halides:** **Alkyl Halides:** (Upto 5 Carbons) Types of Nucleophilic Substitution (SN_1, SN_2 and SN_i) reactions. *Preparation:* from alkenes *and* alcohols. *Reactions:* hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination v/s substitution. **Aryl Halides:** *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. *Reactions (Chlorobenzene):* Aromatic nucleophilic substitution (replacement by –	***Section B: Organic Chemistry-2*** Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. **UNIT-III** **Aromatic hydrocarbons:** *Preparation* (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. *Reactions*: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene). **Alkyl and Aryl Halides:** **Alkyl Halides:** (Upto 5 Carbons) Types of Nucleophilic Substitution (SN_1, SN_2 and SN_i) reactions. *Preparation:* from alkenes *and* alcohols. *Reactions:* hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination v/s substitution. **Aryl Halides:** *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. *Reactions (Chlorobenzene):* Aromatic nucleophilic substitution (replacement by – OH group) and effect of nitro substituent.	

		OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides. **UNIT-IV** **Alcohols, Phenols and Ethers** (Upto 5 Carbons) **Alcohols:** *Preparation:* Preparation of 1o, 2o and 3o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. *Reactions:* With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO4, acidic dichromate, conc. HNO3). Oppeneauer oxidation *Diols:* (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement. **Phenols:** (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts. *Reactions:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction. **Ethers (aliphatic and aromatic):** Cleavage of ethers with HI. **UNIT-V**	Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides. **UNIT-IV** **Alcohols, Phenols and Ethers** (Upto 5 Carbons) **Alcohols:** *Preparation:* Preparation of 1o, 2o and 3o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. *Reactions:* With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO4, acidic dichromate, conc. HNO3). Oppeneauer oxidation *Diols:* (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement. **Phenols:** (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts. *Reactions:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction. **Ethers (aliphatic and aromatic):** Cleavage of ethers with HI. **UNIT-V** **Aldehydes and ketones (aliphatic and**	

		Aldehydes and ketones (aliphatic and aromatic): (Formaldehye, acetaldehyde, acetone and benzaldehyde) *Preparation:* from acid chlorides and from nitriles. *Reactions* – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction.	**aromatic):** (Formaldehye, acetaldehyde, acetone and benzaldehyde) *Preparation:* from acid chlorides and from nitriles. *Reactions* – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction.	
	BSC204	Differential Equations **Unit- I** First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x, y, p. **Unit- II** Methods for solving, higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order. **Unit- III** Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations. **Unit- IV** Order and degree of partial differential equations, Concept of linear and non-linear	**Unit- I** First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x, y, p. **Unit- II** Methods for solving, higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order. **Unit- III** Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations. **Unit- IV** Order and degree of partial differential equations, Concept of linear and non-linear	

		partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method. **Unit- V** Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.	partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method. **Unit- V** Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.	
	BSC205	Electricity, Magnetism and EMT Lab **Unit- I** First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x, y, p. **Unit- II** Methods for solving, higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order. **Unit- III** Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations. **Unit- IV** Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's	**Unit- I** First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x, y, p. **Unit- II** Methods for solving, higher-order differential equations. Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order. **Unit- III** Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Total differential equations. **Unit- IV** Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's	

		method. **Unit- V** Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.	method. **Unit- V** Classification of second order partial differential equations into elliptic, parabolic and hyperbolic through illustrations only.	
	BSC206	Chemical energetic , Equilibria & Functional Group Organic Chemistry-I Lab ***Section A: Physical Chemistry*** **Thermochemistry** 1. Determination of heat capacity of calorimeter for different volumes. 2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide. 3. Determination of enthalpy of ionization of acetic acid. 4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl). 5. Determination of enthalpy of hydration of copper sulphate. 6. Study of the solubility of benzoic acid in water and determination of ΔH. **Ionic equilibria** pH measurements a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter. b) Preparation of buffer solutions:	***Section A: Physical Chemistry*** **Thermochemistry** 1. Determination of heat capacity of calorimeter for different volumes. 2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide. 3. Determination of enthalpy of ionization of acetic acid. 4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl). 5. Determination of enthalpy of hydration of copper sulphate. 6. Study of the solubility of benzoic acid in water and determination of ΔH. **Ionic equilibria** pH measurements a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter. b) Preparation of buffer solutions: (i) Sodium acetate-acetic acid	

		(i) Sodium acetate-acetic acid (ii) Ammonium chloride-ammonium hydroxide Measurement of the pH of buffer solutions and comparison of the values with theoretical values. ***Section B: Organic Chemistry*** 1. Purification of organic compounds by crystallization (from water and alcohol) and distillation. 2. Criteria of Purity: Determination of melting and boiling points. 3. Preparations: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting point and calculation of quantitative yields to be done. (a) Bromination of Phenol/Aniline (b) Benzoylation of amines/phenols (c) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone	(ii) Ammonium chloride-ammonium hydroxide Measurement of the pH of buffer solutions and comparison of the values with theoretical values. ***Section B: Organic Chemistry*** 1. Purification of organic compounds by crystallization (from water and alcohol) and distillation. 2. Criteria of Purity: Determination of melting and boiling points. 3. Preparations: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting point and calculation of quantitative yields to be done. (a) Bromination of Phenol/Aniline (b) Benzoylation of amines/phenols (c) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone	
	BSC301	Thermal Physics and Statistical Mechanics **Unit 1:** Laws of Thermodynamics:Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between CP & CV, Work Done during Isothermal and Adiabatic Processes, Compressibility & Expansion Coefficient, Reversible & irreversible processes, Second law & Entropy, Carnot's cycle & theorem, Entropy	**Unit 1:** Laws of Thermodynamics:Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between CP & CV, Work Done during Isothermal and Adiabatic Processes, Compressibility & Expansion Coefficient, Reversible & irreversible processes, Second law & Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible	

		changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero. **Unit II:** Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications - Joule-Thompson Effect, Clausius- Clapeyron Equation, Expression for (CP – CV), CP/CV, TdS equations. **Unit III:** Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases. **Unit IV:** Theory of Radiation: Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh- Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law. **Unit V:** **Statistical Mechanics:** Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-	processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero. **Unit II:** Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications - Joule-Thompson Effect, Clausius- Clapeyron Equation, Expression for (CP – CV), CP/CV, TdS equations. **Unit III:** Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases. **Unit IV:** Theory of Radiation: Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh- Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law. **Unit V:** **Statistical Mechanics:** Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas -	

		Einstein distribution law - photon gas - comparison of three statistics.	comparison of three statistics.	
	BSC302	Solutions, Phase equilibria, Conductance, Electrochemistry & Functional Group Organic Chemistry-II ***Section A: Physical Chemistry-2*** **UNIT-I** **Solutions:** Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperaturecomposition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes. Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction. **Phase Equilibrium:** Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver,	***Section A: Physical Chemistry-2*** **UNIT-I** **Solutions:** Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperaturecomposition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes. Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction. **Phase Equilibrium:** Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points	

		$FeCl_3$-H_2O and Na-K only). **UNIT-II** **Conductance:** Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions. Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base). **Electrochemistry:** Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data. Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge. pH determination using hydrogen	(lead-silver, $FeCl_3$-H_2O and Na-K only). **UNIT-II** **Conductance:** Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions. Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base). **Electrochemistry:** Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data. Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge. pH determination using hydrogen electrode and	

		electrode and quinhydrone electrode. Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only). ***Section B: Organic Chemistry-3*** Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. **UNIT-III** **Carboxylic acids and their derivatives** Carboxylic acids (aliphatic and aromatic) *Preparation:* Acidic and Alkaline hydrolysis of esters. *Reactions:* Hell – Vohlard - Zelinsky Reaction. **Carboxylic acid derivatives (aliphatic):** (Upto 5 carbons) *Preparation:* Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion. *Reactions:* Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation. **UNIT-IV** **Amines and Diazonium Salts** Amines (Aliphatic and Aromatic): (Upto 5 carbons) *Preparation*: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann	quinhydrone electrode. Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only). ***Section B: Organic Chemistry-3*** Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. **UNIT-III** **Carboxylic acids and their derivatives** Carboxylic acids (aliphatic and aromatic) *Preparation:* Acidic and Alkaline hydrolysis of esters. *Reactions:* Hell – Vohlard - Zelinsky Reaction. **Carboxylic acid derivatives (aliphatic):** (Upto 5 carbons) *Preparation:* Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion. *Reactions:* Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation. **UNIT-IV** **Amines and Diazonium Salts** Amines (Aliphatic and Aromatic): (Upto 5 carbons) *Preparation*: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. *Reactions:* Hofmann vs. Saytzeff	

		Bromamide reaction. *Reactions:* Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation. **Diazonium salts**: *Preparation:* from aromatic amines. *Reactions:* conversion to benzene, phenol, dyes. **UNIT-V** **Amino Acids, Peptides and Proteins:** *Preparation of Amino Acids:* Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis. *Reactions of Amino acids*: ester of –COOH group, acetylation of $–NH_2$ group, complexation with Cu2+ ions, ninhydrin test. Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins. Determination of Primary structure of Peptides by degradation Edmann degradation (N-terminal) and C–terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid-	elimination, Carbylamine test, Hinsberg test, with HNO_2, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation. **Diazonium salts**: *Preparation:* from aromatic amines.*Reactions:* conversion to benzene, phenol, dyes. **UNIT-V** **Amino Acids, Peptides and Proteins:** *Preparation of Amino Acids:* Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis. *Reactions of Amino acids*: ester of –COOH group, acetylation of $–NH_2$ group, complexation with Cu2+ ions, ninhydrin test.Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins. Determination of Primary structure of Peptides by degradation Edmann degradation (N-terminal) and C–terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid-phase synthesis. **Carbohydrates**: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure),	

		phase synthesis. **Carbohydrates**: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.	Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.	
	BSC303	Real Analysis **Unit- I** Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem. **Unit- II** Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof). **Unit- III** *Integration.* The Riemann Integral and its properties. Integrability of continuous and monotonic functions. Functions of bounded variation, their relation with monotonic functions, and integrability.	**Unit- I** Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem. **Unit- II** Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof). **Unit- III** *Integration.* The Riemann Integral and its properties. Integrability of continuous and monotonic functions. Functions of bounded variation, their relation with monotonic functions, and integrability. The	

		The fundamental theorem of calculus. Mean value theorems of integral calculus. Convergence of improper integrals. Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, **Unit- IV** comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test (Tests of Convergence without proof). Definition and examples of absolute and conditional convergence. **Unit- V** Sequences and series of functions, Pointwise and uniform convergence. Mn-test, M test, Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence.	fundamental theorem of calculus. Mean value theorems of integral calculus. Convergence of improper integrals. Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, **Unit- IV** comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test (Tests of Convergence without proof). Definition and examples of absolute and conditional convergence. **Unit- V** Sequences and series of functions, Pointwise and uniform convergence. Mn-test, M test, Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence.	
	BSC304	**SEC-1 (Choose any one)**		
	BSC304 A	Analytical Geometry **Unit I** Analytical geometry of three dimensions. Direction cosines. **Unit II** Straight line. Plane. **Unit III** Sphere. Cone. Cylinder. **Unit IV** Techniques for sketching parabola, ellipse and hyperbola. **Unit V** Classification of quadratic equations representing lines, parabola, ellipse and hyperbola. Spheres, Cylindrical surfaces.	**Unit I** Analytical geometry of three dimensions. Direction cosines. **Unit II** Straight line. Plane. **Unit III** Sphere. Cone. Cylinder. **Unit IV** Techniques for sketching parabola, ellipse and hyperbola. Reflection properties of parabola, ellipse and hyperbola. **Unit V** Classification of quadratic equations representing lines, parabola, ellipse and	**Syllabus Change**

			hyperbola. Spheres, Cylindrical surfaces. Illustrations of graphing standard quadric surfaces like cone, ellipsoid.	
	BSC304 B	Integral Calculus **Unit I** Integration by Partial fractions, integration of rational and irrational functions. Properties of definite integrals. **Unit II** Reduction formulae for integrals of rational, trigonometric. **Unit III** Areas and lengths of curves in the plane, **Unit IV** volumes and surfaces of solids of revolution. **Unit V** Double and Triple integrals.	**Unit I** Integration by Partial fractions, integration of rational and irrational functions. Properties of definite integrals. **Unit II** Reduction formulae for integrals of rational, trigonometric, exponential and logarithmic functions and of their combinations. **Unit III** Areas and lengths of curves in the plane, **Unit IV** volumes and surfaces of solids of revolution. **Unit V** Double and Triple integrals.	**Syllabus Change**
	BSC304 C	Physics workshop skills **Unit 1: Introduction:** Measuring units. conversion to SI and CGS. Familiarization with meter scale, Vernier calliper, Screw gauge and their utility. Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc. **Unit 2: Mechanical Skill**: Concept of workshop practice. Overview of manufacturing methods: casting, foundry, machining, forming and welding. Types of welding joints and welding defects. Common materials used for manufacturing like steel, copper, iron, metal sheets, composites and alloy, wood. Concept of machine processing. **Unit 3:** Cutting tools, lubricating oils. Cutting of a metal sheet using blade. Smoothening of cutting edge of sheet	**Unit 1: Introduction:** Measuring units. conversion to SI and CGS. Familiarization with meter scale, Vernier calliper, Screw gauge and their utility. Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, mountains, etc. **Unit 2: Mechanical Skill**: Concept of workshop practice. Overview of manufacturing methods: casting, foundry, machining, forming and welding. Types of welding joints and welding defects. Common materials used for manufacturing like steel, copper, iron, metal sheets, composites and alloy, wood. Concept of machine processing, introduction to common machine tools like lathe, shaper,	**Syllabus Change**

		using file. Drilling of holes of different diameter in metal sheet and wooden block. **Unit 4: Electrical and Electronic Skill**: Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB. **Unit 5: Introduction to prime movers**: Mechanism, gear system, wheel, Fixing of gears with motor axel. Lever mechanism.	drilling, milling and surface machines. **Unit 3:** Cutting tools, lubricating oils. Cutting of a metal sheet using blade. Smoothening of cutting edge of sheet using file. Drilling of holes of different diameter in metal sheet and wooden block. Use of bench vice and tools for fitting. Make funnel using metal sheet. **Unit 4: Electrical and Electronic Skill**: Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB. Operation of oscilloscope. Making regulated power supply. Timer circuit, Electronic switch using transistor and relay. **Unit 5: Introduction to prime movers**: Mechanism, gear system, wheel, Fixing of gears with motor axel. Lever mechanism, Lifting of heavy weight using lever. braking systems, pulleys, working principle of power generation systems. Demonstration of pulley experiment.	
	BSC304D	Computational physics skills **Unit I: Introduction:** Importance of computers in Physics, paradigm for solving physics problems for solution**.** Usage of linux as an Editor. **Algorithms and Flowcharts:** Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin (x) as a series. **Unit II: Scientific Programming**: Some fundamental Linux Commands (Internal and External commands). Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and	**Unit I: Introduction:** Importance of computers in Physics, paradigm for solving physics problems for solution**.** Usage of linux as an Editor. **Algorithms and Flowcharts:** Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin (x) as a series, algorithm for plotting (1) lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal. **Unit II: Scientific Programming**: Some fundamental Linux Commands (Internal	**Syllabus Change**

		their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted). **Unit III: Control Statements:** Types of Logic (Sequential, Selection, Repetition), Branching Statements (Logical **IF**, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO-CONTINUE, DO-ENDDO, DOWHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems. **Unit IV: Scientific word processing:** **Introduction to LaTeX:** TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages. **Equation representation:** Formulae and equations.	and External commands). Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems. **Unit III: Control Statements:** Types of Logic (Sequential, Selection, Repetition), Branching Statements (Logical **IF**, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO-CONTINUE, DO-ENDDO, DOWHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems. **Programming:** 1. Exercises on syntax on usage of FORTRAN 2. Usage of GUI Windows, Linux	

		Unit V: Visualization: Introduction to graphical analysis and its limitations. Introduction to Gnuplot. importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot	Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN. 3. To print out all natural even/ odd numbers between given limits. 4. To find maximum, minimum and range of a given set of numbers. **5.** Calculating Euler number using exp(x) series evaluated at x=1 **.** **Unit IV: Scientific word processing:** **Introduction to LaTeX:** TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages. **Equation representation:** Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, Generating table of contents, bibliography and citation, Making an index and glossary, List making environments, Fonts, Picture environment and colors, errors. **Unit V: Visualization:** Introduction to graphical analysis and its limitations. Introduction to Gnuplot. importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot **Hands on exercises:** 1. To compile a frequency distribution and evaluate mean, standard deviation etc. 2. To evaluate sum of finite series and the	

			area under a curve. 3. To find the product of two matrices 4. To find a set of prime numbers and Fibonacci series. 5. To write program to open a file and generate data for plotting using Gnuplot. 6. Plotting trajectory of a projectile projected horizontally. 7. Plotting trajectory of a projectile projected making an angle with the horizontally. 8. Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen. Saving it as an eps file and as a pdf file. 9. To find the roots of a quadratic equation. 10. Motion of a projectile using simulation and plot the output for visualization. 11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization. 12. Motion of particle in a central force field and plot the output for visualization.	
	BSC304 E	Pharmaceutical Chemistry **Unit-I** **Drugs & Pharmaceuticals:** Drug discovery, design and development; Basic Retrosynthetic approach. **UNIT-II** Synthesis of the representative drugs of the following classes: antibiotics (Chloramphenicol); antibacterial and antifungal agents **UNIT-III** Synthesis of the representative drugs of the following classes: Central Nervous System	**Unit-I** **Drugs & Pharmaceuticals:** Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, lbuprofen). **UNIT-II** Synthesis of the representative drugs of the following classes: antibiotics (Chloramphenicol); antibacterial and	**Syllabus Change**

		agents (Phenobarbital, Diazepam), **UNIT-IV** **Fermentation** Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, **UNIT-V** Aerobic and anaerobic fermentation. Production of Lysine, Glutamic acid, Vitamin B_2, Vitamin B12 and Vitamin C.	antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), **UNIT-III** Synthesis of the representative drugs of the following classes: Central Nervous System agents (Phenobarbital, Diazepam),Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine). **UNIT-IV** **Fermentation** Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, **UNIT-V** Aerobic and anaerobic fermentation. Production of Lysine, Glutamic acid, Vitamin B_2, Vitamin B12 and Vitamin C. **Practicals** 1. Preparation of Aspirin and its analysis. 2. Preparation of magnesium bisilicate (Antacid).		
	BSC304F	Basic Analytical Chemistry) **UNIT-I** **Introduction:** Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in	**UNIT-I** **Introduction:** Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in	**Syllabus Change**	

		analytical measurements. **UNIT-II** **Analysis of soil**: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators a. Determination of pH of soil samples. b. **UNIT-III** **Analysis of water:** Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods. a. Determination of pH, acidity and alkalinity of a water sample. b. Determination of dissolved oxygen (DO) of a water sample. **UNIT-IV** **Chromatography:** Definition, general introduction on principles of chromatography, paper chromatography, TLC etc. a. Paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+}). b. To compare paint samples by TLC method. **UNIT-V** **Analysis of cosmetics:** Major and minor constituents and their function a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.	analytical measurements. Presentation of experimental data and results, from the point of view of significant figures. **UNIT-II** **Analysis of soil**: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators a. Determination of pH of soil samples. b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration. **UNIT-III** **Analysis of water:** Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods. a. Determination of pH, acidity and alkalinity of a water sample. b. Determination of dissolved oxygen (DO) of a water sample. **Analysis of food products:** Nutritional value of foods, idea about food processing and food preservations and adulteration. a. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc. b. Analysis of preservatives and colouring matter. **UNIT-IV**		

		b. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration.	**Chromatography:** Definition, general introduction on principles of chromatography, paper chromatography, TLC etc. a. Paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+}). b. To compare paint samples by TLC method. **Ion-exchange:** Column, ion-exchange chromatography etc. Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible). **UNIT-V** **Analysis of cosmetics:** Major and minor constituents and their function a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate. b. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration. **Practicals:** **Suggested Applications (Any one)**: a. To study the use of phenolphthalein in trap cases. b. To analyze arson accelerants. c. To carry out analysis of gasoline. **Suggested Instrumental demonstrations:** a. Estimation of macro nutrients: Potassium,		

			Calcium, Magnesium in soil samples by flame photometry. b. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets. c. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drink.		
	BSC305	Thermal Physics and Statistical Mechanics Lab 1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method. 2. Measurement of Planck's constant using black body radiation. 3. To determine Stefan's Constant. 4. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus. 5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method. 6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method. 7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer. 8. To study the variation of thermo emf across two junctions of a thermocouple with temperature. 9. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system 10. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge	1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method. 2. Measurement of Planck's constant using black body radiation. 3. To determine Stefan's Constant. 4. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus. 5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method. 6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method. 7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer. 8. To study the variation of thermo emf across two junctions of a thermocouple with temperature. 9. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system 10. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge		
	BSC306	Solutions, Phase equilibria, Conductance, Electrochemistry & Functional Group Organic Chemistry-II Lab			

		Section A: Physical Chemistry **Distribution** Study of the equilibrium of one of the following reactions by the distribution method: $I_2(aq) + I^-(aq) \rightleftharpoons I^{3-}(aq)$ $Cu^{2+}(aq) + xNH_2(aq) \rightleftharpoons [Cu(NH_3)_x]^{2+}$ **Phase equilibria** a) Construction of the phase diagram of a binary system (simple eutectic) using cooling curves. b) Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it. c) Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature. **Conductance** I. Determination of cell constant II. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid. III. Perform the following conductometric titrations: i. Strong acid vs. strong base ii. Weak acid vs. strong base **Potentiometry** Perform the following potentiometric	***Section A: Physical Chemistry*** **Distribution** Study of the equilibrium of one of the following reactions by the distribution method: $I_2(aq) + I^-(aq) \rightleftharpoons I^{3-}(aq)$ $Cu^{2+}(aq) + xNH_2(aq) \rightleftharpoons [Cu(NH_3)_x]^{2+}$ **Phase equilibria** a) Construction of the phase diagram of a binary system (simple eutectic) using cooling curves. b) Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it. c) Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature. **Conductance** I. Determination of cell constant II. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid. III. Perform the following conductometric titrations: i. Strong acid vs. strong base ii. Weak acid vs. strong base **Potentiometry** Perform the following potentiometric	

		titrations: i. Strong acid vs. strong base ii. Weak acid vs. strong base iii. Potassium dichromate vs. Mohr's salt ***Section B: Organic Chemistry*** **I** Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative. **II** 1. Separation of amino acids by paper chromatography 2. Determination of the concentration of glycine solution by formylation method. 3. Titration curve of glycine 4. Action of salivary amylase on starch 5. Effect of temperature on the action of salivary amylase on starch. 6. Differentiation between a reducing and a nonreducing sugar.	titrations: i. Strong acid vs. strong base ii. Weak acid vs. strong base iii. Potassium dichromate vs. Mohr's salt ***Section B: Organic Chemistry*** **I** Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative. **II** 1. Separation of amino acids by paper chromatography 2. Determination of the concentration of glycine solution by formylation method. 3. Titration curve of glycine 4. Action of salivary amylase on starch 5. Effect of temperature on the action of salivary amylase on starch. 6. Differentiation between a reducing and a nonreducing sugar.	
	BSC401	Waves and optics **Unit 1:** **Superposition of Two Collinear Harmonic oscillations**: Linearity and Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats). **Superposition of Two Perpendicular Harmonic Oscillations**: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses. **Waves Motion- General**: Transverse	**Unit 1:** **Superposition of Two Collinear Harmonic oscillations**: Linearity and Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats). **Superposition of Two Perpendicular Harmonic Oscillations**: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses. **Waves Motion- General**: Transverse	

		waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity. **Unit II:** **Fluids:** Surface Tension: Synclastic and anticlastic surface - Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature - Jaegar's method. Viscosity: Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of a liquid with temperature lubrication. Physics of low pressure - production and measurement of low pressure - Rotary pump - Diffusion pump - Molecular pump - Knudsen absolute gauge - penning and pirani gauge – Detection of leakage. **UNIT III:** **Sound:** Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem - Application to saw tooth wave and square wave - Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditoria. **UNIT IV:** **Wave Optics:** Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle. **Interference:**	waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity. **Unit II:** **Fluids:** Surface Tension: Synclastic and anticlastic surface - Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature - Jaegar's method. Viscosity: Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of a liquid with temperature lubrication. Physics of low pressure - production and measurement of low pressure - Rotary pump - Diffusion pump - Molecular pump - Knudsen absolute gauge - penning and pirani gauge – Detection of leakage. **UNIT III:** **Sound:** Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem - Application to saw tooth wave and square wave - Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditoria. **UNIT IV:** **Wave Optics:** Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle. **Interference:** Interference: Division of amplitude and	

		Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index. **UNIT V:** **Michelson's Interferometer:** Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index and Visibility of fringes. **Diffraction:** Fraunhofer diffraction: Single slit; Double Slit. Multiple slits & Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis. **Polarization:** Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.	division of wavefront. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index. **UNIT V:** **Michelson's Interferometer:** Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index and Visibility of fringes. **Diffraction:** Fraunhofer diffraction: Single slit; Double Slit. Multiple slits & Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis. **Polarization:** Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.	
	BSC402	Transition Metal & Coordination Chemistry, states and matter Chemical kinetics **UNIT-I** **Transition Elements (3d series):** General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu.Lanthanoids	**UNIT-I** **Transition Elements (3d series):** General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu.Lanthanoids and	

		and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only). **UNIT-II** **Coordination Chemistry:** Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Drawbacks of VBT. IUPAC system of nomenclature. **Crystal Field Theory:** Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for *Oh* and *Td* complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination. ***Section B: Physical Chemistry-3*** **UNIT-III** **Kinetic Theory of Gases:** Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real	actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only). **UNIT-II** **Coordination Chemistry:** Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Drawbacks of VBT. IUPAC system of nomenclature. **Crystal Field Theory:** Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for *Oh* and *Td* complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination. ***Section B: Physical Chemistry-3*** **UNIT-III** **Kinetic Theory of Gases:** Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle	

		gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO_2. Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only). **UNIT-IV** **Liquids:** Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only). **Solids:** Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–	temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO_2. Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only). **UNIT-IV** **Liquids:** Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only). **Solids:** Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray	

		Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals. **UNIT-V** **Chemical Kinetics:** The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).	diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals. **UNIT-V** **Chemical Kinetics:** The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).	
	BSC403	Algebra **Unit- I** Definition and examples of groups, examples of abelian and non-abelian groups, the group Zn of integers under addition modulo n and the group U(n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, circle group, the general linear group GLn (n,R), groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, the permutation group Sym (n), Group of quaternions. **Unit- II** Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. **Unit- III**	**Unit- I** Definition and examples of groups, examples of abelian and non-abelian groups, the group Zn of integers under addition modulo n and the group U(n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, circle group, the general linear group GLn (n,R), groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, the permutation group Sym (n), Group of quaternions. **Unit- II** Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. **Unit- III** Cosets, Index of subgroup, Lagrange's	

		Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups. **Unit- IV** Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems, Zn the ring of integers modulo n, ring of real quaternions, **Unit- V** Rings of matrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains and fields, examples of fields: Zp, Q, R, and C. Field of rational functions.	theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups. **Unit- IV** Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems, Zn the ring of integers modulo n, ring of real quaternions, **Unit- V** Rings of matrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains and fields, examples of fields: Zp, Q, R, and C. Field of rational functions.	
	BSC404	**SEC-2 (Choose any one)**		
	BSC404 A	Vector Calculus **Unit I** Vector Algebra. Operations with vectors. Scalar and vector product of three vectors. **Unit II** Vector Calculus. Scalar-valued functions over the plane and the space. Vector function of a scalar variable: **Unit III** Differentiation and partial differentiation of a vector function. Derivative of sum, dot product and cross product of two vectors **Unit IV**	**Unit I** Vector Algebra. Operations with vectors. Scalar and vector product of three vectors. Product of four vectors. Reciprocal vectors. **Unit II** Vector Calculus. Scalar-valued functions over the plane and the space. Vector function of a scalar variable: Curves and Paths. Vector fields. **Unit III** Differentiation and partial differentiation of a vector function. Derivative of sum, dot product and cross product of two vectors.	**Syllabus Change**

		Gradient, divergence and curl. Vector integration: Path, line, surface, and volume integrals. Line integrals of linear differential forms, integration of total differentials, conservative fields, conditions for line integrals to depend only on the endpoints. **Unit V** Theorems of Green, Gauss problems based on these.	the tangent plane, total differential **Unit IV** Gradient, divergence and curl. Vector integration: Path, line, surface, and volume integrals. Line integrals of linear differential forms, integration of total differentials, conservative fields, conditions for line integrals to depend only on the endpoints, the fundamental theorem on exact differentials. Serret-Frenet Formulas. **Unit V** Theorems of Green, Gauss, Stokes, and problems based on these.	
	BSC404 B	Theory of Equations **Unit I** General properties of polynomials, maximum and minimum values of a polynomials, **Unit II** General properties of equations, Descarte's rule of signs positive and negative rule, **Unit III** Symmetric functions, Applications symmetric function of the roots, **Unit IV** Transformation of equations. **Unit V** Algebraic solutions of the cubic and biquadratic.	**Unit I** General properties of polynomials, Graphical representation of a polynomials, maximum and minimum values of a polynomials, **Unit II** General properties of equations, Descarte's rule of signs positive and negative rule, Relation between the roots and the coefficients of equations. **Unit III** Symmetric functions, Applications symmetric function of the roots, **Unit IV** Transformation of equations. Solutions of reciprocal and binomial equations. **Unit V** Algebraic solutions of the cubic and biquadratic. Properties of the derived functions.	**Syllabus Change**

	BSC404C	Electrical circuit & net work skills **Unit I:** **Basic Electricity Principles**: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. **Unit II:** **Understanding Electrical Circuits**: Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements **Unit III:** **Electrical Drawing and Symbols**: Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop. **Generators and Transformers**: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers. **Unit IV:** **Solid-State Devices**: Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources **Unit V:** **Electrical Wiring**: Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits.	**Unit I:** **Basic Electricity Principles**: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. Familiarization with multimeter, voltmeter and ammeter. **Unit II:** **Understanding Electrical Circuits**: Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money. **Unit III:** **Electrical Drawing and Symbols**: Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop. **Generators and Transformers**: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers. **Electric Motors**: Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor. **Unit IV:** **Solid-State Devices**: Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources	**Syllabus Change**

			Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection Device **Unit V:** **Electrical Wiring**: Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wirenuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board	
	BSC404D	Technical drawing **Unit 1:** **Introduction**: Drafting Instruments and their uses. lettering: construction and uses of various scales: dimensioning as per I.S.I. 696-1972. Engineering Curves: Parabola:hyperbola: ellipse: cycloids, involute: spiral: helix and loci of points of simple moving mechanism.2D geometrical construction. **Unit II:** **Projections**: Straight lines, planes and solids. Development of surfaces of right and oblique solids. Section of solids **Unit III:** **Object Projections**: Orthographic projection. Interpenetration and intersection of solids. **Unit IV:** **CAD Drawing**: Introduction to CAD and Auto CAD, precision drawing and drawing aids, Geometric shapes, Demonstrating CAD- specific skills (graphical user	**Unit 1:** **Introduction**: Drafting Instruments and their uses. lettering: construction and uses of various scales: dimensioning as per I.S.I. 696-1972. Engineering Curves: Parabola:hyperbola: ellipse: cycloids, involute: spiral: helix and loci of points of simple moving mechanism.2D geometrical construction. Representation of 3D objects. Principles of projections. **Unit II:** **Projections**: Straight lines, planes and solids. Development of surfaces of right and oblique solids. Section of solids **Unit III:** **Object Projections**: Orthographic projection. Interpenetration and intersection of solids. Isometric and oblique parallel projection of solids. **Unit IV:** **CAD Drawing**: Introduction to CAD and Auto CAD, precision drawing and drawing	**Syllabus Change**

		interface.Create, retrieve, edit, and use symbol libraries. **Unit V:** Demonstrating basic skills to produce 2- D and 3-Ddrawings. 3D modeling with Auto CAD (surfaces and solids),.	aids, Geometric shapes, Demonstrating CAD- specific skills (graphical user interface.Create, retrieve, edit, and use symbol libraries. Use inquiry commands to extract drawing data). Control entity properties. **Unit V:** Demonstrating basic skills to produce 2- D and 3-Ddrawings. 3D modeling with Auto CAD (surfaces and solids), 3D modeling with sketch up, annotating in Auto CAD with text and hatching, layers, templates & design center, advanced plotting (layouts, viewports), office standards, dimensioning, internet and collaboration, Blocks, Drafting symbols, attributes, extracting data. basic printing, editing tools, Plot/Print drawing to appropriate scale.	
	BSC404 E	Analytical Clinical Biochemistry **UNIT-I** **Carbohydrates:** Biological importance of carbohydrates, Metabolism, Cellular currency of energy (ATP), Glycolysis, Alcoholic and Lactic acid fermentations, Krebs cycle. **UNIT-II** **Proteins:** Classification, biological importance; Primary and secondary and tertiary structures of proteins: α-helix and β- pleated sheets. **UNIT-III** **Enzymes:** Nomenclature, Characteristics (mention of Ribozymes), Classification; Active site, Mechanism of enzyme action, Stereospecificity of enzymes, Coenzymes	**UNIT-I** **Carbohydrates:** Biological importance of carbohydrates, Metabolism, Cellular currency of energy (ATP), Glycolysis, Alcoholic and Lactic acid fermentations, Krebs cycle. Isolation and characterization of polysachharides. **UNIT-II** **Proteins:** Classification, biological importance; Primary and secondary and tertiary structures of proteins: α-helix and β-pleated sheets, Isolation, characterization, denaturation of proteins. **UNIT-III** **Enzymes:** Nomenclature, Characteristics (mention of Ribozymes), Classification;	**Syllabus Change**

		and cofactors, Enzyme inhibitors, Introduction to Biocatalysis: Importance in "Green Chemistry" and Chemical Industry. **UNIT-IV** **Lipids:** Classification. Biological importance of triglycerides and phosphoglycerides and cholesterol; Lipid membrane, Liposomes and their biological functions and underlying applications. **Lipoproteins:** Properties, functions and biochemical functions of steroid hormones. Biochemistry of peptide hormones. **UNIT-V** **Biochemistry of disease: A diagnostic approach by blood/ urine analysis.** *Blood:* Composition and functions of blood, blood coagulation. Blood collection and preservation of samples. Anaemia, Regulation, estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin. *Urine:* Collection and preservation of samples. 6. Formation of urine. Composition and estimation of constituents of normal and pathological urine.	Active site, Mechanism of enzyme action, Stereospecificity of enzymes, Coenzymes and cofactors, Enzyme inhibitors, Introduction to Biocatalysis: Importance in "Green Chemistry" and Chemical Industry. Nomenclature, classification, effect of pH, temperature on enzyme activity, enzyme inhibition. **UNIT-IV** **Lipids:** Classification. Biological importance of triglycerides and phosphoglycerides and cholesterol; Lipid membrane, Liposomes and their biological functions and underlying applications. **Lipoproteins:** Properties, functions and biochemical functions of steroid hormones. Biochemistry of peptide hormones. *Structure of DNA* (Watson-Crick model) and RNA, Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation, Introduction to Gene therapy. **UNIT-V** **Biochemistry of disease: A diagnostic approach by blood/ urine analysis.** *Blood:* Composition and functions of blood, blood coagulation. Blood collection and preservation of samples. Anaemia, Regulation, estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin.	

			Urine: Collection and preservation of samples. 6. Formation of urine. Composition and estimation of constituents of normal and pathological urine. **Practicals** Identification and estimation of the following: 1. Carbohydrates – qualitative and quantitative. 2. Lipids – qualitative. 3. Determination of the iodine number of oil. 4. Determination of the saponification number of oil. 5. Determination of cholesterol using Liebermann- Burchard reaction. 6. Proteins – qualitative. 7. Isolation of protein. 8. Determination of protein by the Biuret reaction. 9. Determination of nucleic acids	
	BSC404F	Green Methods in Chemistry **UNIT-I** Introduction: Definitions of Green Chemistry. Brief introduction of twelve principles of Green Chemistry, with examples. **UNIT-II** Green solvents, Green Chemistry and catalysis and alternative sources of energy. **UNIT-III** Real world Cases in Green Chemistry:	**UNIT-I** Introduction: Definitions of Green Chemistry. Brief introduction of twelve principles of Green Chemistry, with examples, special emphasis on atom economy, reducing toxicity. **UNIT-II** Green solvents, Green Chemistry and catalysis and alternative sources of energy, Green energy and sustainability.	**Syllabus Change**

		Surfactants for carbon dioxide – Replacing smog producing . **UNIT-IV** Real world Cases in Green Chemistry: Designing of environmentally safe marine antifoulant. **UNIT-V** An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.	**UNIT-III** Real world Cases in Green Chemistry: Surfactants for carbon dioxide – Replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments. **UNIT-IV** Real world Cases in Green Chemistry: Designing of environmentally safe marine antifoulant. Right fit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments. **UNIT-V** An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn. **Practicals** 1. Preparation and characterization of biodiesel from vegetable oil. 2. Extraction of D-limonene from orange peel using liquid CO2 prepared from dry ice. 3. Mechano chemical solvent free synthesis of azomethine. Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper(II).	
	BSC405	Waves and optics Lab 1. To investigate the motion of coupled oscillators 2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify λ2 – T Law.	1. To investigate the motion of coupled oscillators 2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify λ2 – T Law.	

		3. To study Lissajous Figures 4. Familiarization with Schuster`s focussing; determination of angle of prism. 5. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method). _ 6. To determine the Refractive Index of the Material of a given Prism using Sodium Light. 7. To determine Dispersive Power of the Material of a given Prism using Mercury Light 8. To determine the value of Cauchy Constants of a material of a prism. 9. To determine the Resolving Power of a Prism. 10. To determine wavelength of sodium light using Fresnel Biprism. 11. To determine wavelength of sodium light using Newton's Rings. 12. To determine the wavelength of Laser light using Diffraction of Single Slit. 13. To determine wavelength of (1) Sodium & (2) spectrum of Mercury light using plane diffraction Grating 14. To determine the Resolving Power of a Plane Diffraction Grating. 15. To measure the intensity using photosensor and laser in diffraction patterns of single and double slits.	3. To study Lissajous Figures 4. Familiarization with Schuster`s focussing; determination of angle of prism. 5. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method). _ 6. To determine the Refractive Index of the Material of a given Prism using Sodium Light. 7. To determine Dispersive Power of the Material of a given Prism using Mercury Light 8. To determine the value of Cauchy Constants of a material of a prism. 9. To determine the Resolving Power of a Prism. 10. To determine wavelength of sodium light using Fresnel Biprism. 11. To determine wavelength of sodium light using Newton's Rings. 12. To determine the wavelength of Laser light using Diffraction of Single Slit. 13. To determine wavelength of (1) Sodium & (2) spectrum of Mercury light using plane diffraction Grating 14. To determine the Resolving Power of a Plane Diffraction Grating. 15. To measure the intensity using photosensor and laser in diffraction patterns of single and double slits.	
	BSC406	Transition Metal & Coordination Chemistry Lab ***Section A: Inorganic Chemistry*** Semi-micro qualitative analysis (using H2S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding insoluble salts) out of the following:	***Section A: Inorganic Chemistry*** Semi-micro qualitative analysis (using H2S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding insoluble salts) out of the following:	

		Cations : NH^{4+}, Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^{+} Anions : CO_3^{2-} , S^{2-}, SO^{2-}, $S_2O_3^{2-}$, NO_3^{-}, CH_3COO^{-}, Cl^{-}, Br^{-}, I^{-}, NO_3^{-}, SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, $C_2O_4^{2-}$, F^{-} *(Spot tests should be carried out wherever feasible)* 1. Estimate the amount of nickel present in a given solution as *bis*(dimethylglyoximato)nickel(II) or aluminium as oximate in a given solution gravimetrically. 2. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA. 3. Estimation of total hardness of a given sample of water by complexometric titration. ***Section B: Physical Chemistry*** (I) Surface tension measurement (use of organic solvents excluded). a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer. b) Study of the variation of surface tension of a detergent solution with concentration. (II) Viscosity measurement (use of organic solvents excluded). a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.	Cations : NH^{4+}, Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^{+} Anions : CO_3^{2-} , S^{2-}, SO^{2-}, $S_2O_3^{2-}$, NO_3^{-}, CH_3COO^{-}, Cl^{-}, Br^{-}, I^{-}, NO_3^{-}, SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, $C_2O_4^{2-}$, F^{-} *(Spot tests should be carried out wherever feasible)* 1. Estimate the amount of nickel present in a given solution as *bis*(dimethylglyoximato)nickel(II) or aluminium as oximate in a given solution gravimetrically. 2. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA. 3. Estimation of total hardness of a given sample of water by complexometric titration. ***Section B: Physical Chemistry*** (I) Surface tension measurement (use of organic solvents excluded). a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer. b) Study of the variation of surface tension of a detergent solution with concentration. (II) Viscosity measurement (use of organic solvents excluded). a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.	

		b) Study of the variation of viscosity of an aqueous solution with concentration of solute. (III) Chemical Kinetics Study the kinetics of the following reactions. 1. Initial rate method: Iodide-persulphate reaction 2. Integrated rate method: a. Acid hydrolysis of methyl acetate with hydrochloric acid. b. Saponification of ethyl acetate. c. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate	b) Study of the variation of viscosity of an aqueous solution with concentration of solute. (III) Chemical Kinetics Study the kinetics of the following reactions. 1. Initial rate method: Iodide-persulphate reaction 2. Integrated rate method: a. Acid hydrolysis of methyl acetate with hydrochloric acid. b. Saponification of ethyl acetate. c. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate	
	BSC501	**SEC-3 (Choose any one)**		
	BSC501 A	Probability and Statistics **Unit I** Sample space, probability axioms, real random variables (discrete and continuous), probability mass/density functions, **Unit II** Mathematical expectation, moments, moment generating function. **Unit III** Discrete distributions: uniform, binomial. **Unit IV** continuous distributions: uniform, normal. **Unit V** Joint cumulative distribution function and its properties, joint probability density functions.	**Unit I** Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, **Unit II** Mathematical expectation, moments, moment generating function, characteristic function. **Unit III** Discrete distributions: uniform, binomial, Poisson. **Unit IV** continuous distributions: uniform, normal, exponential. **Unit V** Joint cumulative distribution function and	**Syllabus Change**

			its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables.	
	BSC501 B	Mathematical Modelling **Unit I** Introduction, basic steps of Mathematical Modeling, its needs. **Unit II** Elementary ideas of dynamical systems, autonomous dynamical systems in the plane-linear theory. **Unit III** Applications of differential equations: the vibrations of a mass on a spring, mixture problem. **Unit IV** Mechanics of simultaneous differential equations. Applications to Traffic Flow. **Unit V** conduction of heat in solids, gravitational potential.	**Unit I** Introduction, basic steps of Mathematical Modeling, its needs, types of models, limitations. **Unit II** Elementary ideas of dynamical systems, autonomous dynamical systems in the plane-linear theory. Equilibrium point, node, saddle point, focus, centre and limit-cycle ideas with simple illustrations and figures. **Unit III** Applications of differential equations: the vibrations of a mass on a spring, mixture problem, free damped motion, forced motion, resonance phenomena, electric circuit problem, **Unit IV** Mechanics of simultaneous differential equations. Applications to Traffic Flow. Vibrating string, vibrating membrane, **Unit V** conduction of heat in solids, gravitational potential, conservation laws.	**Syllabus Change**
	BSC501 C	Radiology & safety **Unit 1:** **Basics of Atomic and Nuclear Physics:** Basic concept of atomic structure; X rays characteristic and production; concept of bremsstrahlung and auger electron, The composition of nucleus and its properties, mass number, isotopes of element, spin, binding energy, stable and unstable isotopes, law of radioactive decay, Mean	**Unit 1:** **Basics of Atomic and Nuclear Physics:** Basic concept of atomic structure; X rays characteristic and production; concept of bremsstrahlung and auger electron, The composition of nucleus and its properties, mass number, isotopes of element, spin, binding energy, stable and unstable isotopes, law of radioactive decay, Mean	**Syllabus Change**

		life and half life, basic concept of alpha, beta and gamma decay. **Unit II:** **Interaction of Radiation with matter: Types of Radiation:** Alpha, Beta, Gamma and Neutron and their sources, sealed and unsealed sources, **Interaction of Photons** – Photoelectric effect, Compton Scattering, Pair Production, Linear and Mass Attenuation Coefficients. **Unit III:** **Radiation detection and monitoring devices: Radiation Quantities and Units:** Basic idea of different units of activity, KERMA, exposure, absorbed dose, equivalent dose, effective dose, collective equivalent dose, Annual Limit of Intake (ALI) and derived Air Concentration (DAC). **Unit IV:** **Radiation safety management:** *Biological effects of ionizing radiation*, Operational limits and basics of radiation hazards evaluation and control: radiation protection standards, International Commission on Radiological Protection (ICRP) principles, justification, optimization, limitation. **Unit V:** **Application of nuclear techniques:** Application in medical science (e.g., MRI, PET, Projection Imaging Gamma Camera, radiation therapy), Archaeology, Art, Crime detection, Mining and oil. *Industrial Uses:* Tracing, Gauging, Material Modification, Sterization, Food preservation.	life and half life, basic concept of alpha, beta and gamma decay, concept of cross section and kinematics of nuclear reactions, types of nuclear reaction, Fusion, fission **Unit II:** **Interaction of Radiation with matter: Types of Radiation:** Alpha, Beta, Gamma and Neutron and their sources, sealed and unsealed sources, **Interaction of Photons** – Photoelectric effect, Compton Scattering, Pair Production, Linear and Mass Attenuation Coefficients, **Interaction of Charged Particles:** Heavy charged particles - Beth-Bloch Formula, Scaling laws, Mass Stopping Power, Range, Straggling, Channeling and Cherenkov radiation. Beta Particles- Collision and Radiation loss (Bremsstrahlung), **Interaction of Neutrons**- Collision, slowing down and Moderation. **Unit III:** **Radiation detection and monitoring devices: Radiation Quantities and Units:** Basic idea of different units of activity, KERMA, exposure, absorbed dose, equivalent dose, effective dose, collective equivalent dose, Annual Limit of Intake (ALI) and derived Air Concentration (DAC). **Radiation detection:** Basic concept and working principle of *gas detectors* (Ionization Chambers, Proportional Counter, Multi-Wire Proportional Counters (MWPC) and Gieger Muller Counter), *Scintillation Detectors* **(**Inorganic and Organic Scintillators), *Solid States Detectors* and *Neutron Detectors, Thermo luminescent Dosimetry.* **Unit IV:** **Radiation safety management:** *Biological effects of ionizing radiation*, Operational limits and basics of radiation hazards	

			evaluation and control: radiation protection standards, International Commission on Radiological Protection (ICRP) principles, justification, optimization, limitation, introduction of safety and risk management of radiation. Nuclear waste and disposal management. Brief idea about Accelerator driven Sub-critical system (ADS) for waste management. **Unit V:** **Application of nuclear techniques:** Application in medical science (e.g., MRI, PET, Projection Imaging Gamma Camera, radiation therapy), Archaeology, Art, Crime detection, Mining and oil. *Industrial Uses:* Tracing, Gauging, Material Modification, Sterization, Food preservation. **Experiments:** 1. Study the background radiation levels using Radiation meter **Characteristics of Geiger Muller (GM) Counter:** 2) Study of characteristics of GM tube and determination of operating voltage and plateau length using background radiation as source (without commercial source). 3) Study of counting statistics using background radiation using GM counter. 4) Study of radiation in various materials (e.g. KSO4 etc.). Investigation of possible radiation in different routine materials by operating GM at operating voltage. 5) Study of absorption of beta particles in Aluminum using GM counter. 6) Detection of α particles using reference source & determining its half life using spark counter 7) Gamma spectrum of Gas Light mantle (Source of Thorium)	

	BSC501 D	Weather forecasting **Unit I:** **Introduction to atmosphere:** Elementary idea of atmosphere: physical structure and composition; compositional layering of the atmosphere; variation of pressure and temperature with height; air temperature; requirements to measure air temperature. **Unit II:** **Measuring the weather:** Wind; forces acting to produce wind; wind speed direction: units, its direction; measuring wind speed and direction; humidity, clouds and rainfall. **Unit III:** **Weather systems:** Global wind systems; air masses and fronts: classifications; jet streams; local thunderstorms. **Unit IV:** **Climate and Climate Change:** Climate: its classification; causes of climate change; global warming and its outcomes. **Unit V:** **Basics of weather forecasting:** Weather forecasting: analysis and its historical background; need of measuring weather; types of weather forecasting; weather forecasting methods; criteria of choosing weather station; basics of choosing site and exposure; satellites observations in weather forecasting; weather maps; uncertainty and predictability; probability forecasts.	**Unit I:** **Introduction to atmosphere:** Elementary idea of atmosphere: physical structure and composition; compositional layering of the atmosphere; variation of pressure and temperature with height; air temperature; requirements to measure air temperature; temperature sensors: types; atmospheric pressure: its measurement; cyclones and anticyclones: its characteristics. **Unit II:** **Measuring the weather:** Wind; forces acting to produce wind; wind speed direction: units, its direction; measuring wind speed and direction; humidity, clouds and rainfall, radiation: absorption, emission and scattering in atmosphere; radiation laws. **Unit III:** **Weather systems:** Global wind systems; air masses and fronts: classifications; jet streams; local thunderstorms; tropical cyclones: classification; tornadoes; hurricanes. **Unit IV:** **Climate and Climate Change:** Climate: its classification; causes of climate change; global warming and its outcomes; air pollution; aerosols, ozone depletion, acid rain, environmental issues related to climate. **Unit V:** **Basics of weather forecasting:** Weather forecasting: analysis and its historical	**Syllabus Change**

			background; need of measuring weather; types of weather forecasting; weather forecasting methods; criteria of choosing weather station; basics of choosing site and exposure; satellites observations in weather forecasting; weather maps; uncertainty and predictability; probability forecasts. **Demonstrations and Experiments:** 1. Study of synoptic charts & weather reports, working principle of weather station. 2. Processing and analysis of weather data: (a) To calculate the sunniest time of the year. (b) To study the variation of rainfall amount and intensity by wind direction. (c) To observe the sunniest/driest day of the week. (d) To examine the maximum and minimum temperature throughout the year. (e) To evaluate the relative humidity of the day. (f) To examine the rainfall amount month wise. 3. Exercises in chart reading: Plotting of constant pressure charts, surfaces charts, upper wind charts and its analysis. 4. Formats and elements in different types of weather forecasts/ warning (both aviation and non aviation)	
	BSC501E	Chemistry of Cosmetics & Perfumes **UNIT-I** A general study including preparation and uses of the following, shampoo, suntan lotions. **UNIT-II**	**UNIT-I** A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions. **UNIT-II**	**Syllabus Change**

		A general study including preparation and uses of the following: face powder, lipsticks. **UNIT-III** A general study including preparation and uses of the following: creams (cold, vanishing and shaving creams). **UNIT-IV** Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol. **UNIT-V** Essential oils and their importance in cosmetic industries with reference to eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.	A general study including preparation and uses of the following: face powder, lipsticks, talcum powder, nail enamel. **UNIT-III** A general study including preparation and uses of the following: creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. **UNIT-IV** Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, **UNIT-V** Essential oils and their importance in cosmetic industries with reference to eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone. **Practicals** 1. Preparation of talcum powder. 2. Preparation of shampoo. 3. Preparation of enamels. 4. Preparation of hair remover. 5. Preparation of face cream. 6. Preparation of nail polish and nail polish remover.	
	BSC501 F	Pesticide Chemistry **UNIT-I** General introduction to pesticides (natural and synthetic). **UNIT-II**	**UNIT-I** General introduction to pesticides (natural and synthetic), benefits and adverse effects. **UNIT-II**	**Syllabus Change**

		Changing concepts of pesticides, structure activity relationship, synthesis **UNIT-III** Technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,). **UNIT-IV** Technical manufacture and uses of representative pesticides in the following classes: Carbamates (Carbofuran); **UNIT-V** Technical manufacture and uses of representative pesticides in the following classes: Quinones (Chloranil). **Practicals** To calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications.	Changing concepts of pesticides, structure activity relationship, synthesis **UNIT-III** Technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion). **UNIT-IV** Technical manufacture and uses of representative pesticides in the following classes: Carbamates (Carbofuran and carbaryl); **UNIT-V** Technical manufacture and uses of representative pesticides in the following classes: Quinones (Chloranil), Anilides (Alachlor and Butachlor). **Practicals** 1 To calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications. 2 Preparation of simple organophosphates, phosphonates and thiophosphates	
	BSC502	**DSE-1A (Choose any one)**		
	BSC502 A	Matrices **Unit- I** R, R2, R3 as vector spaces over R. Standard basis for each of them. Concept of Linear Independence and examples of different bases.	**Unit- I** R, R2, R3 as vector spaces over R. Standard basis for each of them. Concept of Linear Independence and examples of different bases. Subspaces of R2, R3.	**Syllabus Change**

		Unit- II Translation, Dilation, Rotation, Reflection in a point, line and plane. Matrix form of basic geometric transformations. **Unit- III** Types of matrices. Rank of a matrix. Invariance of rank under elementary transformations. Reduction to normal form. **Unit- IV** Matrices in diagonal form. Reduction to diagonal form upto matrices of order 3. **Unit- V** Rank of matrix. Solutions of a system of linear equations using matrices.	**Unit- II** Translation, Dilation, Rotation, Reflection in a point, line and plane. Matrix form of basic geometric transformations. Interpretation of eigen values and eigen vectors for such transformations and eigen spaces as invariant subspaces. **Unit- III** Types of matrices. Rank of a matrix. Invariance of rank under elementary transformations. Reduction to normal form, Solutions of linear homogeneous and non-homogeneous equations with number of equations and unknowns upto four. **Unit- IV** Matrices in diagonal form. Reduction to diagonal form upto matrices of order 3. Computation of matrix inverses using elementary row operations. **Unit- V** Rank of matrix. Solutions of a system of linear equations using matrices. Illustrative examples of above concepts from Geometry, Physics, Chemistry, Combinatorics and Statistics.	
	BSC502 B	Mechanics **Unit- I** Conditions of equilibrium of a particle and of coplanar forces acting on a rigid Body, Laws of friction, Problems of equilibrium under forces including friction. **Unit- II** Velocity and acceleration of a particle along a curve: radial and transverse components (plane curve). **Unit- III** Motion of a particle in three dimensions. Motion on a smooth sphere, cone. **Unit- IV**	**Unit- I** Conditions of equilibrium of a particle and of coplanar forces acting on a rigid Body, Laws of friction, Problems of equilibrium under forces including friction, Centre of gravity, Work and potential energy. **Unit- II** Velocity and acceleration of a particle along a curve: radial and transverse components (plane curve),tangential and normal components (space curve). **Unit- III**	**Syllabus Change**

		Newton's Laws of motion, Simple harmonic motion, Simple Pendulum, **Unit- V** Projectile Motion. Motion of a projectile in a resisting medium.	Motion of a particle in three dimensions. Motion on a smooth sphere, cone, and on any surface of revolution. **Unit- IV** Newton's Laws of motion, Simple harmonic motion, Simple Pendulum, **Unit- V** Projectile Motion. Motion of a projectile in a resisting medium. Motion of a particle in a plane under different laws of resistance.	
	BSC502 C	Linear Algebra **Unit I** Vector spaces, subspaces, algebra of subspaces, linear combination of vectors, linear independence, **Unit II** basis and dimension, dimension of subspaces. **Unit III** Linear transformations, null space, range, rank and nullity of a linear transformation. **Unit IV** Eigen values and Eigen vectors, Characteristic Polynomial. **Unit V** change of coordinate matrix.	**Unit I** Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, **Unit II** basis and dimension, dimension of subspaces. **Unit III** Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. **Unit IV** Dual Space, Dual Basis, Double Dual, Eigen values and Eigen vectors, Characteristic Polynomial. **Unit V** Isomorphisms, Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.	**Syllabus Change**
	BSC503	**DSE-2A (Choose any one)**		
	BSC503 A	Analytical Methods in Chemistry **UNIT-I** **Qualitative and quantitative aspects of**	**UNIT-I** **Qualitative and quantitative aspects of**	**Syllabus Change**

		analysis: Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals. **Optical methods of analysis I:** Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law. *UV-Visible Spectrometry:* Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument. **UNIT-II** **Optical methods of analysis II:** *Flame Atomic Absorption and Emission Spectrometry:* Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction. **UNIT-III** **Thermal methods of analysis:** Theory of thermogravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture.	**analysis:** Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals. **Optical methods of analysis I:** Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law. *UV-Visible Spectrometry:* Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; *Basic principles of quantitative analysis:* estimation of metal ions from aqueous solution, geometrical isomers, *keto-enol* tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method. *Infrared Spectrometry:* Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data, Effect and importance of isotope substitution. **UNIT-II** **Optical methods of analysis II:**	

		UNIT-IV **Separation techniques I:** Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media. **UNIT-V** **Separation techniques II:** Stereoisomeric separation and analysis: Measurement of optical rotation, calculation of Enantiomeric excess (ee)/ diastereomeric excess (de) ratios and determination of enantiomeric composition using NMR, Chiral solvents and chiral shift reagents. Chiral chromatographic techniques using chiral columns (GC and HPLC).	*Flame Atomic Absorption and Emission Spectrometry:* Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples. **UNIT-III** **Thermal methods of analysis:** Theory of thermogravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture. **Electroanalytical methods:** Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values. **UNIT-IV** **Separation techniques I:** Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions.	

			Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media. Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC. **UNIT-V** **Separation techniques II:** Stereoisomeric separation and analysis: Measurement of optical rotation, calculation of Enantiomeric excess (ee)/ diastereomeric excess (de) ratios and determination of enantiomeric composition using NMR, Chiral solvents and chiral shift reagents. Chiral chromatographic techniques using chiral columns (GC and HPLC). Role of computers in instrumental methods of analysis.	
	BSC503 B	Novel Inorganic Solids **UNIT-I** **Synthesis and modification of inorganic solids:** Conventional heat and beat methods, Co-precipitation method, Sol-gel methods, Hydrothermal method, Ion-exchange and Intercalation methods. **UNIT-II** **Nanomaterials:**	**UNIT-I** **Synthesis and modification of inorganic solids:** Conventional heat and beat methods, Co-precipitation method, Sol-gel methods, Hydrothermal method, Ion-exchange and Intercalation methods. **Inorganic solids of technological importance:** Solid electrolytes – Cationic, anionic, mixed	**Syllabus Change**

		Overview of nanostructures and nanomaterials: classification. Preparation of gold and silver metallic nanoparticles, self-assembled nanostructurescontrol of nanoarchitecture-one dimensional control. Carbon nanotubes and inorganic nanowires. Bio-inorganic nanomaterials. **UNIT-III** **Introduction to engineering materials for mechanical construction:** Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels, copper, aluminium and their alloys like duralumin, brasses and bronzes cutting tool materials, super alloys thermoplastics, thermosets and composite materials. **UNIT-IV** **Composite materials:** Introduction, limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials, reinforcements, metal-matrix composites, polymer-matrix composites. **UNIT-V** **Speciality polymers:** Conducting polymers - Introduction, conduction mechanism, polyacetylene, polyparaphenylene and polypyrrole, applications of conducting polymers, Ionexchange resins and their applications.	Inorganic pigments – coloured solids, white and black pigments. Molecular material and fullerides, molecular materials & chemistry – onedimensional metals, molecular magnets, inorganic liquid crystals. **UNIT-II** **Nanomaterials:** Overview of nanostructures and nanomaterials: classification. Preparation of gold and silver metallic nanoparticles, self-assembled nanostructurescontrol of nanoarchitecture-one dimensional control. Carbon nanotubes and inorganic nanowires. Bio-inorganic nanomaterials, DNA and nanomaterials, natural and antisical nanomaterials, bionano composites. **UNIT-III** **Introduction to engineering materials for mechanical construction:** Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels, copper, aluminium and their alloys like duralumin, brasses and bronzes cutting tool materials, super alloys thermoplastics, thermosets and composite materials. **UNIT-IV** **Composite materials:** Introduction, limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials,	

			reinforcements, metal-matrix composites, polymer-matrix composites, fibre-reinforced composites, environmental effects on composites, applications of composites. **UNIT-V** **Speciality polymers:** Conducting polymers - Introduction, conduction mechanism, polyacetylene, polyparaphenylene and polypyrrole, applications of conducting polymers, Ionexchange resins and their applications. Ceramic & Refractory: Introduction, classification, properties, raw materials, manufacturing and applications.	
	BSC503 C	Organometallics, Bioinorganic chemistry , Polynuclear hydrocarbons and UV ,IR Spectroscopy **UNIT-I** **Chemistry of 3d metals:** Oxidation states displayed by Cr, Fe, Co, Ni and Co. A study of the following compounds (including preparation and important properties); Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$. **UNIT-II** **Bio-Inorganic Chemistry:** A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. **UNIT-III**	**UNIT-I** **Chemistry of 3d metals:** Oxidation states displayed by Cr, Fe, Co, Ni and Co. A study of the following compounds (including preparation and important properties); Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$. **Organometallic Compounds:** Definition and Classification with appropriate examples based on nature of metalcarbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of	**Syllabus Change**

		Polynuclear and heteronuclear aromatic compounds: Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene. **UNIT-IV** **Active methylene compounds:** *Preparation:* Claisen ester condensation. Keto-enol tautomerism. **UNIT-V** **Application of Spectroscopy to Simple Organic Molecules** Application of visible, ultraviolet and Infrared spectroscopy in organic molecules. Electromagnetic radiations, electronic transitions, λmax & εmax, chromophore, auxochrome, bathochromic and hypsochromic shifts.	3d metals. p-acceptor behaviour of carbon monoxide. Synergic effects (VB approach)-(MO diagram of CO can be referred to for synergic effect to IR frequencies). **UNIT-II** **Bio-Inorganic Chemistry:** A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, stabilization of protein structures and structural role (bones). **UNIT-III** **Polynuclear and heteronuclear aromatic compounds:** Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene , Furan, Pyrrole, Thiophene, and Pyridine. **UNIT-IV** **Active methylene compounds:** *Preparation:* Claisen ester condensation. Keto-enol tautomerism. *Reactions:* Synthetic uses of ethylacetoacetate (preparation of non-heteromolecules having upto 6 carbon). **UNIT-V** **Application of Spectroscopy to Simple Organic Molecules**	

			Application of visible, ultraviolet and Infrared spectroscopy in organic molecules. Electromagnetic radiations, electronic transitions, λmax & εmax, chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating l max of conjugated dienes and α,β – unsaturated compounds. Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions).	
	BSC503 D	Chemistry of Main Group Elements, Theories of Acids and Bases **Acids and Bases:** Brönsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. **UNIT-II** **General Principles of Metallurgy:** Chief modes of occurrence of metals based on standard electrode potentials, Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agents. Hydrometallurgy with reference to cyanide process for gold and silver. **UNIT-III** ***s*- and *p*-Block Elements:** Periodicity in *s*- and *p*-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electron gain enthalpy, electronegativity (Pauling scale). General characteristics of	**Acids and Bases:** Brönsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), applications of HSAB process. **UNIT-II** **General Principles of Metallurgy:** Chief modes of occurrence of metals based on standard electrode potentials, Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agents. Hydrometallurgy with reference to cyanide process for gold and silver. Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn, Au): electrolytic refining, zone refining, van Arkel-de Boer	**Syllabus Change**

		s-block metals like density, melting and boiling points, flame colour and reducing nature. **UNIT-IV** **Structure, bonding and properties (acidic/ basic nature, oxidizing/ reducing nature and hydrolysis of the following compounds and their applications in industrial and environmental chemistry wherever applicable:** Diborane and concept of multicentre bonding, hydrides of Groups 13 (EH_3), 14, 15, 16 and 17. **UNIT-V** **Noble gases:** Rationalization of inertness of noble gases, clathrates, preparation and properties of XeF_2, XeF_4 and XeF_6 ,bonding in these compounds using VBT and shapes of noble gas compounds using VSEPR Theory . **Inorganic Polymers:** Types of inorganic polymers and comparison with organic polymers, structural features, classification and important applications of silicates.	process, Parting Process, Mond's process and Kroll Process. **UNIT-III** ***s*- and *p*-Block Elements:** Periodicity in *s*- and *p*-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electron gain enthalpy, electronegativity (Pauling scale). General characteristics of *s*-block metals like density, melting and boiling points, flame colour and reducing nature. Oxidation states of *s*- and *p*-block elements, inert-pair effect, diagonal relationships and anomalous behaviour of first member of each group. Allotropy in C, P and S. Complex forming tendency of *s* block elements and a preliminary idea of crown ethers and cryptates, structures of basic beryllium acetate, salicylaldehyde/ acetylacetonato complexes of Group 1 metals. Solutions of alkali metals in liquid ammonia and their properties. Common features, such as ease of formation, solubility and stability of oxides, peroxides, superoxides, sulphates and carbonates of *s*-block metals. **UNIT-IV** **Structure, bonding and properties (acidic/ basic nature, oxidizing/ reducing nature and hydrolysis of the following**	

			compounds and their applications in industrial and environmental chemistry wherever applicable: Diborane and concept of multicentre bonding, hydrides of Groups 13 (EH_3), 14, 15, 16 and 17. Oxides of N and P, Oxoacids of P, S and Cl. Halides and oxohalides of P and S (PCl_3, PCl_5, $SOCl_2$ and SO_2Cl_2) Interhalogen compounds. A brief idea of pseudohalides. **UNIT-V** **Noble gases:** Rationalization of inertness of noble gases, clathrates, preparation and properties of XeF_2, XeF_4 and XeF_6 ,bonding in these compounds using VBT and shapes of noble gas compounds using VSEPR Theory . **Inorganic Polymers:** Types of inorganic polymers and comparison with organic polymers, structural features, classification and important applications of silicates. Synthesis, structural features and applications of silicones. Borazines and cyclophosphazenes – preparation, properties and reactions. Bonding in $(NPCl_2)_3$.	
	BSC504	**DSE-3A (Choose any one)**		
	BSC504 A	Digital, Analog and Instrumentation **UNIT-I:** **Digital Circuits** Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates. De Morgan's Theorems.	**UNIT-I:** **Digital Circuits** Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and	**Syllabus Change**

		Boolean Laws. **UNIT-II:** **Semiconductor Devices and Amplifiers:** Semiconductor Diodes: p and n type semiconductors. Barrier Formation in PN Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode. PN junction and its characteristics. Static and Dynamic Resistance. Principle and structure of (1) LEDs (2) Photodiode (3) Solar Cell. Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Active, Cutoff, and Saturation Regions. **UNIT-III:** **Operational Amplifiers (Black Box approach):** Characteristics of an Ideal and Practical Op-Amp (IC 741), Open-loop& Closed-loop Gain. CMRR, concept of Virtual ground. Applications of Op-Amps: (1) Inverting and Non-inverting Amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Zero Crossing Detector. **UNIT-IV:** **Instrumentations:** Introduction to CRO: Block Diagram of CRO. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference. **UNIT-V:** **Power Supply**: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor filter, Zener Diode and Voltage	XNOR Gates. De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Minterms and Maxterms. Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map. Binary Addition. Binary Subtraction using 2's Complement Method).Half Adders and Full Adders and Subtractors, 4-bit binary Adder-Subtractor. **UNIT-II:** **Semiconductor Devices and Amplifiers:** Semiconductor Diodes: p and n type semiconductors. Barrier Formation in PN Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode. PN junction and its characteristics. Static and Dynamic Resistance. Principle and structure of (1) LEDs (2) Photodiode (3) Solar Cell. Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Active, Cutoff, and Saturation Regions. Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line and Qpoint. Voltage Divider Bias Circuit for CE Amplifier. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Class A, B, and C Amplifiers. **UNIT-III:** **Operational Amplifiers (Black Box approach):** Characteristics of an Ideal and Practical Op-Amp (IC 741), Open-loop& Closed-loop	

		Regulation.	Gain. CMRR, concept of Virtual ground. Applications of Op-Amps: (1) Inverting and Non-inverting Amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Zero Crossing Detector. **Sinusoidal Oscillators:** Barkhausen's Criterion for Self-sustained Oscillations. Determination of Frequency of RC Oscillator **UNIT-IV:** **Instrumentations:** Introduction to CRO: Block Diagram of CRO. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference. **UNIT-V:** **Power Supply**: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor filter, Zener Diode and Voltage Regulation Timer IC: IC 555 Pin diagram and its application as Astable & Monostable, Multivibrator	
	BSC504 B	Elements of Modern Physics **UNIT I:** Planck's quantum, Planck's constant and light as a collection of photons; Photo-electric effect and Compton scattering. **UNIT II:** Problems with Rutherford model-instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; calculation of energy levels for hydrogen like atoms and their spectra. **UNIT III:** Two slit interference experiment with photons, atoms and particles; linear	**UNIT I:** Planck's quantum, Planck's constant and light as a collection of photons; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. **UNIT II:** Problems with Rutherford model- instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; calculation of energy levels for hydrogen like atoms and their spectra. Position measurement- gamma ray microscope thought experiment; Wave-	**Syllabus Change**

		superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators. **UNIT IV:** One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier. Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. **UNIT V:** Fission and fusion - mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons.	particle duality, Heisenberg uncertainty principle- impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle. **UNIT III:** Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of wave function, probabilities and normalization; Probability and probability current densities in one dimension. **UNIT IV:** One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier. Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, semi-empirical mass formula and binding energy. Radioactivity: stability of nucleus; Law of radioactive decay; Mean life & half-life; □ decay; □□decay - energy released, spectrum and Pauli's prediction of neutrino; □-ray emission. **UNIT V:** Fission and fusion - mass deficit, relativity	

			and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions.	
	BSC504C	Mathematical Physics **UNIT I:** **Calculus of functions of more than one variable**: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. **UNIT II:** **Fourier Series**: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. **UNIT III:** **Frobenius Method and Special Functions**: Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. **UNIT IV:** **Some Special Integrals:** Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral). **UNIT V:** **Complex Analysis**: Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions.	**UNIT I:** **Calculus of functions of more than one variable**: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers. **UNIT II:** **Fourier Series**: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. **UNIT III:** **Frobenius Method and Special Functions**: Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Orthogonality. Simple recurrence relations. **UNIT IV:** **Some Special Integrals:** Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).	**Syllabus Change**

			Partial Differential Equations: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. **UNIT V:** **Complex Analysis**: Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula.	
	BSC504D	Solid State Physics **UNIT I:** **Crystal Structure:** Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. **UNIT II:** **Elementary Lattice Dynamics:** Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. **UNIT III :** **Magnetic Properties of Matter:** Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law. **UNIT IV:**	**UNIT I:** **Crystal Structure:** Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Atomic and Geometrical Factor. **UNIT II:** **Elementary Lattice Dynamics:** Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T3 law **UNIT III :** **Magnetic Properties of Matter:** Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia – and	**Syllabus Change**

		Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. **UNIT V:** **Elementary band theory:** Kronig Penny model. Band Gaps. Conductors, Semiconductors and insulators. P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient.	Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss. **UNIT IV:** **Dielectric Properties of Materials:** Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena. Application: Plasma Oscillations, Plasma Frequency, Plasmons. **UNIT V:** **Elementary band theory:** Kronig Penny model. Band Gaps. Conductors, Semiconductors and insulators. P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient. **Superconductivity:** Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect.	
	BSC505	**DSE-2A (Choose any one)**		
	BSC505 A	Analytical Methods in Chemistry Lab **I. Separation Techniques** 1. Chromatography: (a) Separation of mixtures	**I. Separation Techniques** 1. Chromatography: (a) Separation of mixtures	

		(i) Paper chromatographic separation of Fe^{3+}, Al^{3+}, and Cr^{3+}. (ii) Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the R_f values. (b) Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their R_f values. (c) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC **II. Solvent Extractions:** (i) To separate a mixture of Ni^{2+} & Fe^{2+} by complexation with DMG and extracting the Ni^{2+}-DMG complex in chloroform, and determine its concentration by spectrophotometry. (ii) Solvent extraction of zisconium with amberliti LA-1, separation from a mixture of irons and gallium. 3. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps. 4. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques. 5. Analysis of soil: (i) Determination of pH of soil. (ii) Total soluble salt (iii) Estimation of calcium, magnesium,	(i) Paper chromatographic separation of Fe^{3+}, Al^{3+}, and Cr^{3+}. (ii) Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the R_f values. (b) Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their R_f values. (c) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC **II. Solvent Extractions:** (i) To separate a mixture of Ni^{2+} & Fe^{2+} by complexation with DMG and extracting the Ni^{2+}-DMG complex in chloroform, and determine its concentration by spectrophotometry. (ii) Solvent extraction of zisconium with amberliti LA-1, separation from a mixture of irons and gallium. 3. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps. 4. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques. 5. Analysis of soil: (i) Determination of pH of soil. (ii) Total soluble salt (iii) Estimation of calcium, magnesium, phosphate, nitrate	

		phosphate, nitrate 6. Ion exchange: (i) Determination of exchange capacity of cation exchange resins and anion exchange resins. (ii) Separation of metal ions from their binary mixture. (iii) Separation of amino acids from organic acids by ion exchange chromatography. **III Spectrophotometr**y 1. Determination of pKa values of indicator using spectrophotometry. 2 Structural characterization of compounds by infrared spectroscopy. 3 Determination of dissolved oxygen in water. 4 Determination of chemical oxygen demand (COD). 5 Determination of Biological oxygen demand (BOD). 6 Determine the composition of the ferric-salicylate/ ferric-thiocyanate complex by Job's method.	6. Ion exchange: (i) Determination of exchange capacity of cation exchange resins and anion exchange resins. (ii) Separation of metal ions from their binary mixture. (iii) Separation of amino acids from organic acids by ion exchange chromatography. **III Spectrophotometr**y 1. Determination of pKa values of indicator using spectrophotometry. 2 Structural characterization of compounds by infrared spectroscopy. 3 Determination of dissolved oxygen in water. 4 Determination of chemical oxygen demand (COD). 5 Determination of Biological oxygen demand (BOD). 6 Determine the composition of the ferric-salicylate/ ferric-thiocyanate complex by Job's method.	
	BSC505 B	Novel Inorganic Solids Lab 1. Determination of cation exchange method 2. Determination of total difference of solids. 3. Synthesis of hydrogel by co-precipitation method.	1. Determination of cation exchange method 2. Determination of total difference of solids. 3. Synthesis of hydrogel by co-precipitation method.	

		4. Synthesis of silver and gold metal nanoparticles.	4. Synthesis of silver and gold metal nanoparticles.	
	BSC505 C	Organometallics, Bioinorganic chemistry ,Polynuclear hydrocarbons and UV ,IR Spectroscopy Lab ***Section A: Inorganic Chemistry*** 1. Separation of mixtures by chromatography: Measure the R_f value in each case. (Combination of two ions to be given) Paper chromatographic separation of Fe^{3+}, $A1^{3+}$ and Cr^{3+} or Paper chromatographic separation of Ni^{2+}, Co^{2+}, Mn^{2+} and Zn^{2+} 2. Preparation of any two of the following complexes and measurement of their conductivity: (i) tetraamminecarbonatocobalt (III) nitrate (ii) tetraamminecopper (II) sulphate (iii) potassium trioxalatoferrate (III) trihydrate Compare the conductance of the complexes with that of M/1000 solution of NaCl, $MgCl_2$ and $LiCl_3$. ***Section B: Organic Chemistry*** Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.	***Section A: Inorganic Chemistry*** 1. Separation of mixtures by chromatography: Measure the R_f value in each case. (Combination of two ions to be given) Paper chromatographic separation of Fe^{3+}, $A1^{3+}$ and Cr^{3+} or Paper chromatographic separation of Ni^{2+}, Co^{2+}, Mn^{2+} and Zn^{2+} 2. Preparation of any two of the following complexes and measurement of their conductivity: (i) tetraamminecarbonatocobalt (III) nitrate (ii) tetraamminecopper (II) sulphate (iii) potassium trioxalatoferrate (III) trihydrate Compare the conductance of the complexes with that of M/1000 solution of NaCl, $MgCl_2$ and $LiCl_3$. ***Section B: Organic Chemistry*** Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.	
	BSC505 D	Chemistry of Main Group Elements, Theories of Acids and Bases Lab 1. Iodometric estimation of potassium	1. Iodometric estimation of potassium	

		dichromate and copper sulphate 2. Iodimetric estimation of antimony in tartaremetic 3. Estimation of amount of available chlorine in bleaching powder and household bleaches 4. Estimation of iodine in iodized salts. 5. Iodimetric estimation of ascorbic acid in fruit juices. 6. Estimation of dissolved oxygen in water samples. 7. Gravimetric estimation of sulphate as barium sulphate. 8. Gravimetric estimation of aluminium as oximato complex 9. Preparation of the following: potash alum, chrome alum, tetraamminecopper(II) sulphate monohydrate, potassium trioxalatoferrate(III) (any two, including one double salt and one complex).	dichromate and copper sulphate 2. Iodimetric estimation of antimony in tartaremetic 3. Estimation of amount of available chlorine in bleaching powder and household bleaches 4. Estimation of iodine in iodized salts. 5. Iodimetric estimation of ascorbic acid in fruit juices. 6. Estimation of dissolved oxygen in water samples. 7. Gravimetric estimation of sulphate as barium sulphate. 8. Gravimetric estimation of aluminium as oximato complex 9. Preparation of the following: potash alum, chrome alum, tetraamminecopper(II) sulphate monohydrate, potassium trioxalatoferrate(III) (any two, including one double salt and one complex).	
	BSC506	**DSE-3A (Choose any one)**		
	BSC506 A	Digital, Analog and Instrumentation Lab 1. To measure (a) Voltage, and (b) Frequency of a periodic waveform using a CRO 2. To verify and design AND, OR, NOT and XOR gates using NAND gates. 3. To minimize a given logic circuit. 4. Half adder, Full adder and 4-bit Binary Adder. 19 5. Adder-Subtractor using Full Adder I.C. 6. To design an astable multivibrator of	1. To measure (a) Voltage, and (b) Frequency of a periodic waveform using a CRO 2. To verify and design AND, OR, NOT and XOR gates using NAND gates. 3. To minimize a given logic circuit. 4. Half adder, Full adder and 4-bit Binary Adder. 19 5. Adder-Subtractor using Full Adder I.C. 6. To design an astable multivibrator of	

		given specifications using 555 Timer. 7. To design a monostable multivibrator of given specifications using 555 Timer. 8. To study IV characteristics of PN diode, Zener and Light emitting diode 9. To study the characteristics of a Transistor in CE configuration. 10. To design a CE amplifier of a given gain (mid-gain) using voltage divider bias. 11. To design an inverting amplifier of given gain using Op-amp 741 and study its frequency response. 12. To design a non-inverting amplifier of given gain using Op-amp 741 and study its Frequency Response. 13. To study a precision Differential Amplifier of given I/O specification using Opamp. 14. To investigate the use of an op-amp as a Differentiator 15. To design a Wien Bridge Oscillator using an op-amp.	given specifications using 555 Timer. 7. To design a monostable multivibrator of given specifications using 555 Timer. 8. To study IV characteristics of PN diode, Zener and Light emitting diode 9. To study the characteristics of a Transistor in CE configuration. 10. To design a CE amplifier of a given gain (mid-gain) using voltage divider bias. 11. To design an inverting amplifier of given gain using Op-amp 741 and study its frequency response. 12. To design a non-inverting amplifier of given gain using Op-amp 741 and study its Frequency Response. 13. To study a precision Differential Amplifier of given I/O specification using Opamp. 14. To investigate the use of an op-amp as a Differentiator 15. To design a Wien Bridge Oscillator using an op-amp.	
	BSC506 B	Elements of Modern Physics Lab 1. To determine value of Boltzmann constant using V-I characteristic of PN diode. 2. To determine work function of material of filament of directly heated vacuum diode. 3. To determine value of Planck's constant using LEDs of at least 4 different colours. 4. To determine the ionization potential of mercury. 5. To determine the wavelength of H-alpha emission line of Hydrogen atom. 6. To determine the absorption lines in the rotational spectrum of Iodine vapour. 7. To study the diffraction patterns of single and double slits using laser source and measure its intensity	1. To determine value of Boltzmann constant using V-I characteristic of PN diode. 2. To determine work function of material of filament of directly heated vacuum diode. 3. To determine value of Planck's constant using LEDs of at least 4 different colours. 4. To determine the ionization potential of mercury. 5. To determine the wavelength of H-alpha emission line of Hydrogen atom. 6. To determine the absorption lines in the rotational spectrum of Iodine vapour. 7. To study the diffraction patterns of single and double slits using laser source and measure its intensity variation using Photosensor and compare with	

		variation using Photosensor and compare with incoherent source – Na light. 8. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light 9. To determine the value of e/m by magnetic focusing. 10. To setup the Millikan oil drop apparatus and determine the charge of an electron.	incoherent source – Na light. 8. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light 9. To determine the value of e/m by magnetic focusing. 10. To setup the Millikan oil drop apparatus and determine the charge of an electron.	
	BSC506C	Mathematical Physics Lab 1. Introduction and Overview: Computer architecture and organization, memory and Input/output devices. 2. Basics of scientific computing: Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow & over flow emphasize the importance of making equations in terms of dimensionless variables, Iterative methods 3. Errors and error Analysis: Truncation and round off errors, Absolute and relative errors, Floating point computations. 4. Review of C & C++ Programming fundamentals: Introduction to Programming, constant variables and data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements	11. Introduction and Overview: Computer architecture and organization, memory and Input/output devices. 12. Basics of scientific computing: Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow & over flow emphasize the importance of making equations in terms of dimensionless variables, Iterative methods 13. Errors and error Analysis: Truncation and round off errors, Absolute and relative errors, Floating point computations. 14. Review of C & C++ Programming fundamentals: Introduction to Programming, constant variables and data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision	

		(decision making and looping statements) (*If-statement. If-else Statement. Nested if Structure. Else-if Statement. Ternary Operator. Goto Statement. Switch Statement. Unconditional and Conditional Looping. While-Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops*), Arrays (*1D&2D*) and strings, user defined functions, Structures and Unions, Idea of classes and objects. 5. Programs: using C/C++ language: Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending-descending order, Binary search 6. Random number generation: Area of circle, area of square, volume of sphere, value of pi (**π**) 7. Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods: Solution of linear and quadratic equation, solving $\alpha = tan\alpha; I = I_0\left(\frac{sin\alpha}{\alpha}\right)^2$ in optics. *8.* Interpolation by Newton Gregory Forward and Backward difference formula, Error, estimation of linear interpolation: Evaluation of trigonometric functions e.g. *sin θ, cos θ, tanθ, etc.* 9. Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal an d Simpson rules), Monte Carlo method: Given Position with equidistant time data to calculate	making and looping statements) (*If-statement. If-else Statement. Nested if Structure. Else-if Statement. Ternary Operator. Goto Statement. Switch Statement. Unconditional and Conditional Looping. While-Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops*), Arrays (*1D&2D*) and strings, user defined functions, Structures and Unions, Idea of classes and objects. 15. Programs: using C/C++ language: Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending-descending order, Binary search 16. Random number generation: Area of circle, area of square, volume of sphere, value of pi (**π**) 17. Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods: Solution of linear and quadratic equation, solving $\alpha = tan\alpha; I = I_0\left(\frac{sin\alpha}{\alpha}\right)^2$ in optics. *18.* Interpolation by Newton Gregory Forward and Backward difference formula, Error, estimation of linear interpolation: Evaluation of trigonometric functions e.g. *sin θ, cos θ, tanθ, etc.* 19. Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal an d Simpson rules), Monte Carlo method: Given Position with equidistant time data to calculate velocity and acceleration and vice-versa. Find the area of B-H Hysteresis loop	

		velocity and acceleration and vice-versa. Find the area of B-H Hysteresis loop 10. Solution of Ordinary Differential Equations (ODE), First order Differential equation Euler, modified Euler and Runge-Kutta (RK), second and fourth order methods: First order differential equation • Radioactive decay • Current in RC, LC circuits with DC source • Newton's law of cooling • Classical equations of motion Attempt following problems using RK 4 order method: • Solve the coupled differential equations $\frac{dx}{dt} = y + x - \frac{x^3}{3}$; $\frac{dy}{dx} = -x$ for four initial conditions $x(0) = 0;\ y(0) = -1, -2, -3, -4$ plot x vs y for each of the four initial conditions on the same screen for 0≤ t ≤ 15. The differential equation describing the motion of a pendulum is $\frac{d^2\theta}{dt^2} = -sin(\theta)$. The pendulum is released from rest at an angular displacement α, i.e.$\theta(0) = \alpha$ and$\theta'(0) = 0$. Solve the equation for $\alpha = 0.1, 0.5$ and 1.0 and plot θas a function of time in the range $0 \leq t \leq 8\pi$. Also plot the analytic solution valid for small $\theta, \sin(\theta) = \theta$.	20. Solution of Ordinary Differential Equations (ODE), First order Differential equation Euler, modified Euler and Runge-Kutta (RK), second and fourth order methods: First order differential equation • Radioactive decay • Current in RC, LC circuits with DC source • Newton's law of cooling • Classical equations of motion Attempt following problems using RK 4 order method: • Solve the coupled differential equations $\frac{dx}{dt} = y + x - \frac{x^3}{3}$; $\frac{dy}{dx} = -x$ for four initial conditions $x(0) = 0;\ y(0) = -1, -2, -3, -4$ plot x vs y for each of the four initial conditions on the same screen for 0≤ t ≤ 15. The differential equation describing the motion of a pendulum is $\frac{d^2\theta}{dt^2} = -sin(\theta)$. The pendulum is released from rest at an angular displacement α, i.e.$\theta(0) = \alpha$ and$\theta'(0) = 0$. Solve the equation for $\alpha = 0.1, 0.5$ and 1.0 and plot θas a function of time in the range $0 \leq t \leq 8\pi$. Also plot the analytic solution valid for small $\theta, \sin(\theta) = \theta$.	
	BSC506 D	Solid State Physics Lab 1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method) 2. To measure the Magnetic susceptibility of Solids. 3. To determine the Coupling Coefficient of a Piezoelectric crystal. 4. To measure the Dielectric Constant of a dielectric Materials with frequency 5. To determine the complex dielectric constant and plasma frequency of metal	1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method) 2. To measure the Magnetic susceptibility of Solids. 3. To determine the Coupling Coefficient of a Piezoelectric crystal. 4. To measure the Dielectric Constant of a dielectric Materials with frequency 5. To determine the complex dielectric constant and plasma frequency of metal	

		using Surface Plasmon resonance (SPR) 6. To determine the refractive index of a dielectric layer using SPR 7. To study the PE Hysteresis loop of a Ferroelectric Crystal. 8. To draw the BH curve of iron using a Solenoid and determine the energy loss from Hysteresis. 9. To measure the resistivity of a semiconductor (Ge) crystal with temperature by fourprobe method (from room temperature to 150 oC) and to determine its band gap.	using Surface Plasmon resonance (SPR) 6. To determine the refractive index of a dielectric layer using SPR 7. To study the PE Hysteresis loop of a Ferroelectric Crystal. 8. To draw the BH curve of iron using a Solenoid and determine the energy loss from Hysteresis. 9. To measure the resistivity of a semiconductor (Ge) crystal with temperature by fourprobe method (from room temperature to 150 oC) and to determine its band gap.	
	BSC601 A	Transportation and Game Theory **Unit I** Transportation problem and its mathematical formulation, northwest-corner method, least cost method . **Unit II** algorithm for solving transportation problem, assignment problem and its mathematical formulation. **Unit III** Job Sequencing Problems **Unit IV** Game theory: formulation of two person zero sum games. **Unit V** Games with mixed strategies, graphical solution procedure.	**Unit I** Transportation problem and its mathematical formulation, northwest-corner method, least cost method and Vogel approximation method for determination of starting basic solution, **Unit II** algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem. **Unit III** Job Sequencing Problems **Unit IV** Game theory: formulation of two person zero sum games, solving two person zero sum games. **Unit V** Games with mixed strategies, graphical solution procedure. Solution by Simplex Method.	**Syllabus Change**

	BSC601 B	Graph Theory **Unit I** Definition, examples and basic properties of graphs, pseudographs, complete graphs. **Unit II** isomorphism of graphs, paths and circuits. **Unit III** the adjacency matrix, weighted graph, **Unit IV** travelling salesman's problem, shortest path. **Unit V** Trees. Spanning trees.	**Unit I** Definition, examples and basic properties of graphs, pseudographs, complete graphs, bi-partite graphs. **Unit II** isomorphism of graphs, paths and circuits, Eulerian circuits, Hamiltonian cycles, **Unit III** the adjacency matrix, weighted graph, **Unit IV** travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm. **Unit V** Trees. Spanning trees.	**Syllabus Change**
	BSC601 C	Applied optics **Unit I:** **Sources and Detectors** Lasers, Spontaneous and stimulated emissions, Theory of laser action, Einstein's coefficients, Light amplification, Characterization of laser beam, He-Ne laser, Semiconductor lasers. **Experiments on Lasers:** a. Determination of the grating radial spacing of the Compact Disc (CD) by reflection using He-Ne or solid state laser. b. To find the width of the wire or width of the slit using diffraction pattern obtained by a He-Ne or solid state laser. c. To find the polarization angle of laser	**Unit I:** **Sources and Detectors** Lasers, Spontaneous and stimulated emissions, Theory of laser action, Einstein's coefficients, Light amplification, Characterization of laser beam, He-Ne laser, Semiconductor lasers. **Experiments on Lasers:** a. Determination of the grating radial spacing of the Compact Disc (CD) by reflection using He-Ne or solid state laser. b. To find the width of the wire or width of the slit using diffraction pattern obtained by a He-Ne or solid state laser. c. To find the polarization angle of laser	**Syllabus Change**

		light using polarizer and analyzer d. Thermal expansion of quartz using laser **Unit II:** **Fourier Optics** Concept of Spatial frequency filtering, Fourier transforming property of a thin lens **Unit III:.** **Fourier Transform Spectroscopy** Fourier Transform Spectroscopy (FTS) is a powerful method for measuring emission and absorption spectra, with wide application in atmospheric remote sensing, NMR spectrometry and forensic science. **Unit IV:** **Holography** Basic principle and theory: coherence, resolution, Types of holograms, white light reflection hologram, application of holography in microscopy, interferometry, and character recognition **Unit V:** **Photonics: Fibre Optics** Optical fibres and their properties, Principal of light propagation through a fibre, The numerical aperture, Attenuation in optical fibre and attenuation limit, Single mode and multimode fibres, Fibre optic sensors: Fibre Bragg Grating.	light using polarizer and analyzer d. Thermal expansion of quartz using laser **Experiments on Semiconductor Sources and Detectors:** a. V-I characteristics of LED b. Study the characteristics of solid state laser c. Study the characteristics of LDR d. Photovoltaic Cell e. Characteristics of IR sensor **Unit II:** **Fourier Optics** Concept of Spatial frequency filtering, Fourier transforming property of a thin lens **Experiments on Fourier Optics:** **a. Fourier optic and image processing** 1. Optical image addition/subtraction 2. Optical image differentiation 3. Fourier optical filtering 4. Construction of an optical 4f system **Unit III:.** **Fourier Transform Spectroscopy** Fourier Transform Spectroscopy (FTS) is a powerful method for measuring emission and absorption spectra, with wide application in atmospheric remote sensing, NMR spectrometry and forensic science. **Experiment:** To study the interference pattern from a Michelson interferometer as a function of mirror separation in the interferometer. The resulting interferogram is the Fourier transform of the power spectrum of the source. Analysis of experimental interferograms allows one to determine the transmission characteristics of several interference filters. Computer simulation can also be done. **Unit IV:** **Holography** Basic principle and theory: coherence,	

			resolution, Types of holograms, white light reflection hologram, application of holography in microscopy, interferometry, and character recognition **Experiments on Holography and interferometry:** 1. Recording and reconstructing holograms 2. Constructing a Michelson interferometer or a Fabry Perot interferometer 3. Measuring the refractive index of air 4. Constructing a Sagnac interferometer 5. Constructing a Mach-Zehnder interferometer 6. White light Hologram **Unit V:** **Photonics: Fibre Optics** Optical fibres and their properties, Principal of light propagation through a fibre, The numerical aperture, Attenuation in optical fibre and attenuation limit, Single mode and multimode fibres, Fibre optic sensors: Fibre Bragg Grating **Experiments on Photonics: Fibre Optics** a. To measure the numerical aperture of an optical fibre b. To study the variation of the bending loss in a multimode fibre c. To determine the mode field diameter (MFD) of fundamental mode in a single-mode fibre by measurements of its far field Gaussian pattern d. To measure the near field intensity profile of a fibre and study its refractive index profile e. To determine the power loss at a splice between two multimode fibre	
	BSC601 D	Basic instrumentation skills **Unit I:** **Basic of Measurement:** Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and	**Unit I:** **Basic of Measurement:** Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and	**Syllabus Change**

		loading effects. **Unit II:** **Electronic Voltmeter:** Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance **Unit III:** **Cathode** Ray **Oscilloscope:** Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. **Unit IV:** **Signal Generators and Analysis Instruments:** Block diagram, explanation and specifications of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis. **Unit V:** **Digital Instruments:** Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter. **Digital Multimeter:** Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution.	loading effects. **Multimeter:** Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance. **Unit II:** **Electronic Voltmeter:** Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. **AC millivoltmeter:** Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter**,** specifications and their significance **Unit III:** **Cathode** Ray **Oscilloscope:** Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance. Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working. **Unit IV:** **Signal Generators and Analysis Instruments:** Block diagram, explanation and specifications of low frequency signal generators. pulse generator, and function generator. Brief idea for testing,	

			specifications. Distortion factor meter, wave analysis. **Impedance Bridges & Q-Meters:** Block diagram of bridge. working principles of basic (balancing type) RLC bridge. Specifications of RLC bridge. Block diagram & working principles of a Q- Meter. Digital LCR bridges. **Unit V:** **Digital Instruments:** Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter. **Digital Multimeter:** Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution. **The test of lab skills will be of the following test items:** 1. Use of an oscilloscope. 2. CRO as a versatile measuring device. 3. Circuit tracing of Laboratory electronic equipment, 4. Use of Digital multimeter/VTVM for measuring voltages 5. Circuit tracing of Laboratory electronic equipment, 6. Winding a coil / transformer. 7. Study the layout of receiver circuit. 8. Trouble shooting a circuit 9. Balancing of bridges **Laboratory Exercises:** 1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance. 2. To observe the limitations of a	

			multimeter for measuring high frequency voltage and currents. 3. To measure Q of a coil and its dependence on frequency, using a Q- meter. 4. Measurement of voltage, frequency, time period and phase angle using CRO. 5. Measurement of time period, frequency, average period using universal counter/ frequency counter. 6. Measurement of rise, fall and delay times using a CRO. 7. Measurement of distortion of a RF signal generator using distortion factor meter. 8. Measurement of R, L and C using a LCR bridge/ universal bridge. **Open Ended Experiments:** 1. Using a Dual Trace Oscilloscope 2. Converting the range of a given measuring instrument (voltmeter, ammeter)	
	BSC601 E	Chemical Technology & Society **UNIT-I** **Chemical Technology:** Basic principles of distillation, solvent extraction, solid-liquid leaching and liquidliquid Extraction. **UNIT-II** An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. **UNIT-III** **Society:** Exploration of societal and technological	**UNIT-I** **Chemical Technology:** Basic principles of distillation, solvent extraction, solid-liquid leaching and liquidliquid extraction, separation by absorption and adsorption. **UNIT-II** An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Scaling up operations in chemical industry. Introduction to clean technology.	**Syllabus Change**

		issues from a chemical perspective. Chemical and scientific literacy as a means to better understand topics like air and water **UNIT-IV** Energy from natural sources (i.e. solar and renewable forms), from fossil fuels and from nuclear fission. **UNIT-V** Proteins and nucleic acids, and molecular reactivity and interconversions from simple examples like combustion to complex instances.	**UNIT-III** **Society:** Exploration of societal and technological issues from a chemical perspective. Chemical and scientific literacy as a means to better understand topics like air and water (and the trace materials found in them that are referred to as pollutants). **UNIT-IV** Energy from natural sources (i.e. solar and renewable forms), from fossil fuels and from nuclear fission; materials like plastics and polymers and their natural analogues. **UNIT-V** Proteins and nucleic acids, and molecular reactivity and interconversions from simple examples like combustion to complex instances like genetic engineering and the manufacture of drugs.	
	BSC601 F	Fuel Chemistry **UNIT-I** Review of energy sources (renewable and non-renewable). **UNIT-II** *Coal:* Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic	**UNIT-I** Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value. **UNIT-II** *Coal:* Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal.Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good	**Syllabus Change**

		gasification), Coal liquefaction and Solvent Refining. **UNIT-III** *Petroleum and Petrochemical Industry:* Composition of crude petroleum, Refining and different types of petroleum products and their applications. **UNIT-IV** Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. **UNIT-V** *Lubricants:* Classification of lubricants, lubricating oils (conducting and nonconducting) Solid and semisolid lubricants.	metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining. **UNIT-III** *Petroleum and Petrochemical Industry:* Composition of crude petroleum, Refining and different types of petroleum products and their applications. Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking). **UNIT-IV** Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene. **UNIT-V** *Lubricants:* Classification of lubricants, lubricating oils (conducting and nonconducting) Solid and semisolid lubricants, synthetic lubricants.	
	BSC602 A	Numerical Methods **Unit I** Algorithms, Convergence, Bisection method, False position method, Fixed point iteration method, Newton's method, Secant method, **Unit II** LU decomposition, Gauss- Jacobi, Gauss-	**Unit I** Algorithms, Convergence, Bisection method, False position method, Fixed point iteration method, Newton's method, Secant method, **Unit II**	

		Siedel and SOR iterative methods. **Unit III** Lagrange and Newton interpolation: linear and higher order, finite difference operators. **Unit IV** Numerical differentiation: forward difference, backward difference and central Difference. **Unit V** Integration: trapezoidal rule, Simpson's rule, Euler's method.	LU decomposition, Gauss- Jacobi, Gauss-Siedel and SOR iterative methods. **Unit III** Lagrange and Newton interpolation: linear and higher order, finite difference operators. **Unit IV** Numerical differentiation: forward difference, backward difference and central Difference. **Unit V** Integration: trapezoidal rule, Simpson's rule, Euler's method.	
	BSC602 B	Complex Analysis **Unit I** Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, **Unit II** mappings.Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. **Unit III** Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, **Unit IV** Definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy-Goursat theorem, Cauchy integral formula. **Unit V** Liouville's theorem and the fundamental	 **Unit I** Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, **Unit II** mappings.Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. **Unit III** Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions, **Unit IV** Definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy-Goursat theorem, Cauchy integral formula. **Unit V** Liouville's theorem and the fundamental	

		theorem of algebra. Convergence of sequences and series, Taylor series and its examples. Laurent series and its examples, absolute and uniform convergence of power series.	theorem of algebra. Convergence of sequences and series, Taylor series and its examples. Laurent series and its examples, absolute and uniform convergence of power series.	
	BSC602C	Linear Programming) **Unit I** Linear Programming Problems, Graphical Approach for Solving some Linear Programs. **Unit II** Convex Sets, Supporting and Separating Hyperplanes. Theory of simplex method, optimality and unboundedness, the simplex algorithm, **Unit III** simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison. **Unit IV** Duality, formulation of the dual problem, primal- dual relationships, economic interpretation of the dual, sensitivity analysis. **Unit V** Assignment and Transportation problems	**Unit I** Linear Programming Problems, Graphical Approach for Solving some Linear Programs. **Unit II** Convex Sets, Supporting and Separating Hyperplanes. Theory of simplex method, optimality and unboundedness, the simplex algorithm, **Unit III** simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison. **Unit IV** Duality, formulation of the dual problem, primal- dual relationships, economic interpretation of the dual, sensitivity analysis. **Unit V** Assignment and Transportation problems	
	BSC603A	Polymer Chemistry **UNIT-I** **Introduction and history of polymeric materials:** Different schemes of classification of	**UNIT-I** **Introduction and history of polymeric materials:** Different schemes of classification of	

		polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of polymers. **Functionality and its importance:** Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bi-functional systems, Poly-functional systems. **UNIT-II** **Kinetics of Polymerization:** Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques. **UNIT-III** **Crystallization and crystallinity:** Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point. **Nature and structure of polymers-** Structure Property relationships. **Determination of molecular weight of polymers** (*Mn*, *Mw*, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance.	polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of polymers. **Functionality and its importance:** Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bi-functional systems, Poly-functional systems. **UNIT-II** **Kinetics of Polymerization:** Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques. **UNIT-III** **Crystallization and crystallinity:** Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point. **Nature and structure of polymers-** Structure Property relationships. **Determination of molecular weight of polymers** (*Mn*, *Mw*, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance.	

		Polydispersity index. **UNIT-IV** **Glass transition temperature (Tg) and determination of Tg**, Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg). **Polymer Solution** – Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory-Huggins theory, Lower and Upper critical solution temperatures. **UNIT-V** **Properties of Polymer**s (Physical, thermal, flow & mechanical properties). Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)]	Polydispersity index. **UNIT-IV** **Glass transition temperature (Tg) and determination of Tg**, Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg). **Polymer Solution** – Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory-Huggins theory, Lower and Upper critical solution temperatures. **UNIT-V** **Properties of Polymer**s (Physical, thermal, flow & mechanical properties). Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)]	
	BSC603 B	Green Chemistry **UNIT-I** **Introduction to Green Chemistry:** What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry. **Principles of Green Chemistry and Designing a Chemical synthesis I:**	**UNIT-I** **Introduction to Green Chemistry:** What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry. **Principles of Green Chemistry and Designing a Chemical synthesis I:**	

		Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following (1-2): 1. Designing a Green Synthesis using these principles; Prevention of Waste/byproducts; maximum incorporation of the materials used in the process into the final products , Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions. 2. Prevention/ minimization of hazardous/ toxic products reducing toxicity. risk = (function) hazard × exposure; waste or pollution prevention hierarchy. **UNIT-II** **Principles of Green Chemistry and Designing a Chemical synthesis II:** Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following (3-6): 3. Green solvents– supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes, immobilized solvents and how to	Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following (1-2): 1. Designing a Green Synthesis using these principles; Prevention of Waste/byproducts; maximum incorporation of the materials used in the process into the final products , Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions. 2. Prevention/ minimization of hazardous/ toxic products reducing toxicity. risk = (function) hazard × exposure; waste or pollution prevention hierarchy. **UNIT-II** **Principles of Green Chemistry and Designing a Chemical synthesis II:** Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following (3-6): 3. Green solvents– supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG, solventless processes, immobilized solvents and how to compare greenness of solvents.	

		compare greenness of solvents. 4. Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy. 5. Selection of starting materials; avoidance of unnecessary derivatization –careful use of blocking/protecting groups. 6. Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis. **UNIT-III** **Principles of Green Chemistry and Designing a Chemical synthesis II:** Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following (7-8): 7. Prevention of chemical accidents designing greener processes, inherent safer design, principle of ISD "What you don't have cannot harm you", greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to	4. Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy. 5. Selection of starting materials; avoidance of unnecessary derivatization –careful use of blocking/protecting groups. 6. Use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis. **UNIT-III** **Principles of Green Chemistry and Designing a Chemical synthesis II:** Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following (7-8): 7. Prevention of chemical accidents designing greener processes, inherent safer design, principle of ISD "What you don't have cannot harm you", greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) subdivision of ISD,	

		cyclohexanol) subdivision of ISD, minimization, simplification, substitution, moderation and limitation. 8. Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes. **UNIT-IV** **Examples of Green Synthesis/ Reactions and some real world cases I:** 1. Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis) 2. Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave assisted reactions in organic solvents Diels-Alder reaction and Decarboxylation reaction 3. Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine) 4 Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO2 for precision cleaning and dry cleaning of garments. **UNIT-V** **Examples of Green Synthesis/ Reactions**	minimization, simplification, substitution, moderation and limitation. 8. Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes. **UNIT-IV** **Examples of Green Synthesis/ Reactions and some real world cases I:** 1. Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis) 2. Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; microwave assisted reactions in organic solvents Diels-Alder reaction and Decarboxylation reaction 3. Ultrasound assisted reactions: sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine) 4 Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO2 for precision cleaning and dry cleaning of garments. **UNIT-V** **Examples of Green Synthesis/ Reactions and some real world cases II:**	

		and some real world cases II: 5 Designing of Environmentally safe marine antifoulant. 6 Rightfit pigment: synthetic azopigments to replace toxic organic and inorganic pigments. 7 An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn. 8 Healthier fats and oil by Green Chemistry: Enzymatic interesterification for production of no Trans-Fats and Oils 9 Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting **Future Trends in Green Chemistry** Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; co crystal ontrolled solid state synthesis (C2S3); Green chemistry in sustainable development.	5 Designing of Environmentally safe marine antifoulant. 6 Rightfit pigment: synthetic azopigments to replace toxic organic and inorganic pigments. 7 An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn. 8 Healthier fats and oil by Green Chemistry: Enzymatic interesterification for production of no Trans-Fats and Oils 9 Development of Fully Recyclable Carpet: Cradle to Cradle Carpeting **Future Trends in Green Chemistry** Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; co crystal ontrolled solid state synthesis (C2S3); Green chemistry in sustainable development.	
	BSC603C	Instrumental Methods of Analysis **UNIT-I** **Introduction to spectroscopic methods of analysis:** Recap of the spectroscopic methods covered in detail in the core chemistry syllabus: Treatment of analytical data, including error analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiation. **Molecular spectroscopy I:** *Infrared spectroscopy:*	**UNIT-I** **Introduction to spectroscopic methods of analysis:** Recap of the spectroscopic methods covered in detail in the core chemistry syllabus: Treatment of analytical data, including error analysis. Classification of analytical methods and the types of instrumental methods. Consideration of electromagnetic radiation. **Molecular spectroscopy I:** *Infrared spectroscopy:*	

		Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Samples and results expected. Applications: Issues of quality assurance and quality control, Special problems for portable instrumentation and rapid detection. **UNIT-II** **Molecular spectroscopy II:** *UV-Visible/ Near IR* – emission, absorption, fluorescence and photoaccoustic. Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoaccoustic, fluorescent tags). **UNIT-III** **Separation techniques** *Chromatography:* Gas chromatography,	Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Samples and results expected. Applications: Issues of quality assurance and quality control, Special problems for portable instrumentation and rapid detection. **UNIT-II** **Molecular spectroscopy II:** *UV-Visible/ Near IR* – emission, absorption, fluorescence and photoaccoustic. Excitation sources (lasers, time resolution), wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution), Detection of signal (photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoaccoustic, fluorescent tags). **UNIT-III** **Separation techniques** *Chromatography:* Gas chromatography, liquid chromatography, supercritical fluids,	

		liquid chromatography, supercritical fluids, Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis (use of tags and coupling to IR and MS), Electrophoresis (plates and capillary) and use with DNA analysis. *Immunoassays and DNA techniques:* *Mass spectroscopy:* Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio, Magnetic, Time of flight, Electric quadrupole. Resolution, time and multiple separations, Detection and interpretation (how this is linked to excitation). **UNIT-IV** **Elemental analysis:** Mass spectrometry (electrical discharges). Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength	Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electrical field), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis (use of tags and coupling to IR and MS), Electrophoresis (plates and capillary) and use with DNA analysis. *Immunoassays and DNA techniques:* *Mass spectroscopy:* Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio, Magnetic, Time of flight, Electric quadrupole. Resolution, time and multiple separations, Detection and interpretation (how this is linked to excitation). **UNIT-IV** **Elemental analysis:** Mass spectrometry (electrical discharges). Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique),	

		separation and resolution (dependence on technique), Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences). **UNIT-V** **NMR spectroscopy**: **P**rinciple, Instrumentation, Factors affecting chemical shift, Spin-coupling, Applications. **Electroanalytical Methods: P**otentiometry & Voltammetry **Radiochemical Methods** **X-ray analysis and electron spectroscopy (surface analysis)** **Reference books:** ➢ Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed. ➢ Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.	Detection of radiation (simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences). **UNIT-V** **NMR spectroscopy**: **P**rinciple, Instrumentation, Factors affecting chemical shift, Spin-coupling, Applications. **Electroanalytical Methods: P**otentiometry & Voltammetry **Radiochemical Methods** **X-ray analysis and electron spectroscopy (surface analysis)** **Reference books:** ➢ Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed. ➢ Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988. ➢ P.W. Atkins: Physical Chemistry. ➢ G.W. Castellan: Physical	

		➢ P.W. Atkins: Physical Chemistry. ➢ G.W. Castellan: Physical Chemistry. ➢ C.N. Banwell: Fundamentals of Molecular Spectroscopy. ➢ Brian Smith: Infrared Spectral Interpretations: A Systematic Approach. ➢ W.J. Moore: Physical Chemistry.	Chemistry. ➢ C.N. Banwell: Fundamentals of Molecular Spectroscopy. ➢ Brian Smith: Infrared Spectral Interpretations: A Systematic Approach. ➢ W.J. Moore: Physical Chemistry.	
	BSC603 D	Quantum Chemistry, Spectroscopy & Photochemistry **UNIT-I** **Quantum Chemistry I:** Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wavefunctions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy. Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of	**UNIT-I** **Quantum Chemistry I:** Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wavefunctions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy. Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wavefunctions.	

		solution and wavefunctions. Vibrational energy of diatomic molecules and zero-point energy. Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component. **UNIT-II** **Quantum ChemistryII:** Rigid rotator model of rotation of diatomic molecule. Schrödinger equation, transformation to spherical polar coordinates. Separation of variables. Spherical harmonics. Discussion of solution. Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus. Setting up of Schrödinger equation for many-electron atoms (He, Li). Need for approximation methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom). **UNIT-III** **Chemical Bonding:** Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H_2^+. Bonding and antibonding	Vibrational energy of diatomic molecules and zero-point energy. Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component. **UNIT-II** **Quantum ChemistryII:** Rigid rotator model of rotation of diatomic molecule. Schrödinger equation, transformation to spherical polar coordinates. Separation of variables. Spherical harmonics. Discussion of solution. Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus. Setting up of Schrödinger equation for many-electron atoms (He, Li). Need for approximation methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom). **UNIT-III** **Chemical Bonding:** Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H_2^+. Bonding and antibonding orbitals. Qualitative extension to H_2.	

		orbitals. Qualitative extension to H_2. Comparison of LCAO-MO and VB treatments of H_2 (only wavefunctions, detailed solution not required) and their limitations. Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB). Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH). Localised and non-localised molecular orbitals treatment of triatomic (BeH2, H2O) molecules. Qualitative MO theory and its application to AH2 type molecules. **UNIT-IV** **Molecular Spectroscopy:** Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation. *Rotation spectroscopy:* Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution. *Vibrational spectroscopy:* Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules,	Comparison of LCAO-MO and VB treatments of H_2 (only wavefunctions, detailed solution not required) and their limitations. Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB). Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH). Localised and non-localised molecular orbitals treatment of triatomic (BeH2, H2O) molecules. Qualitative MO theory and its application to AH2 type molecules. **UNIT-IV** **Molecular Spectroscopy:** Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation. *Rotation spectroscopy:* Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution. *Vibrational spectroscopy:* Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation	

		modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches. *Raman spectroscopy:* Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion. **UNIT-V** *Electronic spectroscopy:* Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model. *Nuclear Magnetic Resonance (NMR) spectroscopy:* Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules. *Electron Spin Resonance (ESR) spectroscopy:* Its principle, hyperfine structure, ESR of simple radicals. **Photochemistry:** Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high	spectroscopy: diatomic vibrating rotator, P, Q, R branches. *Raman spectroscopy:* Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion. **UNIT-V** *Electronic spectroscopy:* Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model. *Nuclear Magnetic Resonance (NMR) spectroscopy:* Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules. *Electron Spin Resonance (ESR) spectroscopy:* Its principle, hyperfine structure, ESR of simple radicals. **Photochemistry:** Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitized reactions, quenching. Role of photochemical reactions in biochemical	

		quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitized reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.	processes, photostationary states, chemiluminescence.	
	BSC604 A	Quantum Mechanics **UNIT I:** **Time dependent Schrodinger equation**: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Position, momentum & Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle. **UNIT II:** **Time independent Schrodinger equation**-Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to the spread of Gaussian wavepacket for a free particle in one dimension; wave packets, Fourier transforms and momentum space wavefunction; Position-momentum uncertainty principle. **UNIT III:** **General discussion of bound states in an**	**UNIT I:** **Time dependent Schrodinger equation**: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Position, momentum & Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle. **UNIT II:** **Time independent Schrodinger equation**-Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to the spread of Gaussian wavepacket for a free particle in one dimension; wave packets, Fourier transforms and momentum space wavefunction; Position-momentum uncertainty principle. **UNIT III:** **General discussion of bound states in an**	

		arbitrary potential- continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem-square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions using Frobenius method. **UNIT IV:** **Quantum theory of hydrogen-like atoms**: time independent Schrodinger equation in spherical polar coordinates; separation of variables for the second order partial differential equation; angular momentum operator and quantum numbers; Radial wavefunctions from Frobenius method; Orbital angular momentum quantum numbers l and m; s, p, d,.. shells (idea only) **UNIT V:** **Atoms in Electric and Magnetic Fields**:- Electron Angular Momentum. Space Quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton. **Atoms in External Magnetic Fields**:- Normal and Anomalous Zeeman Effect. **Many electron atoms**:- Pauli's Exclusion Principle. Symmetric and Antisymmetric Wave Functions. Periodic table. Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total Angular Momentum. Vector Model. Spin-orbit coupling in atoms-L-S and J-J couplings.	**arbitrary potential**- continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem-square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions using Frobenius method. **UNIT IV:** **Quantum theory of hydrogen-like atoms**: time independent Schrodinger equation in spherical polar coordinates; separation of variables for the second order partial differential equation; angular momentum operator and quantum numbers; Radial wavefunctions from Frobenius method; Orbital angular momentum quantum numbers l and m; s, p, d,.. shells (idea only) **UNIT V:** **Atoms in Electric and Magnetic Fields**:- Electron Angular Momentum. Space Quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton. **Atoms in External Magnetic Fields**:- Normal and Anomalous Zeeman Effect. **Many electron atoms**:- Pauli's Exclusion Principle. Symmetric and Antisymmetric Wave Functions. Periodic table. Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total Angular Momentum. Vector Model. Spin-orbit coupling in atoms-L-S and J-J couplings.	

	BSC604B	Embedded System: Introduction to microcontroller **UNIT I:** **Embedded system introduction:** Introduction to embedded systems and general purpose computer systems, architecture of embedded system, classifications, applications and purpose of embedded systems, challenges and design issues in embedded systems, operational and non-operational quality attributes of embedded systems, elemental description of embedded processors and microcontrollers. **UNIT II:** **Review of microprocessors:** Organization of Microprocessor based system, 8085µp pin diagram and architecture, concept of data bus and address bus, 8085 programming model, instruction classification, subroutines, stacks and its implementation, delay subroutines, hardware and software interrupts. **UNIT III:** **8051 microcontroller:** Introduction and block diagram of 8051 microcontroller, architecture of 8051, overview of 8051 family, 8051 assembly language programming, Program Counter and ROM memory map, Data types and directives, Flag bits and Program Status Word (PSW) register, Jump, loop and call instructions. **8051 I/O port programming:** Introduction of I/O port programming, pin out diagram of 8051 microcontroller, I/O port pins description and their functions, I/O port programming in 8051, (Using Assembly Language), I/O programming: Bit manipulation.	**UNIT I:** **Embedded system introduction:** Introduction to embedded systems and general purpose computer systems, architecture of embedded system, classifications, applications and purpose of embedded systems, challenges and design issues in embedded systems, operational and non-operational quality attributes of embedded systems, elemental description of embedded processors and microcontrollers. **UNIT II:** **Review of microprocessors:** Organization of Microprocessor based system, 8085µp pin diagram and architecture, concept of data bus and address bus, 8085 programming model, instruction classification, subroutines, stacks and its implementation, delay subroutines, hardware and software interrupts. **UNIT III:** **8051 microcontroller:** Introduction and block diagram of 8051 microcontroller, architecture of 8051, overview of 8051 family, 8051 assembly language programming, Program Counter and ROM memory map, Data types and directives, Flag bits and Program Status Word (PSW) register, Jump, loop and call instructions. **8051 I/O port programming:** Introduction of I/O port programming, pin out diagram of 8051 microcontroller, I/O port pins description and their functions, I/O port programming in 8051, (Using Assembly Language), I/O programming: Bit manipulation.	

		UNIT IV: **Programming of 8051:** 8051addressing modes and accessing memory using various addressing modes, assembly language instructions using each addressing mode, arithmetic & logic instructions, 8051 programming in C:- for time delay and I/O operations and manipulation, for arithmetic & logic operations, for ASCII and BCD conversions. **Timer and counter programming:** Programming 8051 timers, counter programming. **Serial port programming with and without interrupt:** Introduction to 8051 interrupts, programming timer interrupts, programming external hardware interrupts and serial communication interrupt, interrupt priority in the 8051. **UNIT V:** **Interfacing 8051 microcontroller to peripherals:** Parallel and serial ADC, DAC interfacing, LCD interfacing. **Programming Embedded Systems:** Structure of embedded program, infinite loop, compiling, linking and locating, downloading and debugging. **Embedded system design and development:** Embedded system development environment, file types generated after cross compilation, disassembler/ decompiler, simulator, emulator and debugging, embedded product development life-cycle, trends in embedded industry.	**UNIT IV:** **Programming of 8051:** 8051addressing modes and accessing memory using various addressing modes, assembly language instructions using each addressing mode, arithmetic & logic instructions, 8051 programming in C:- for time delay and I/O operations and manipulation, for arithmetic & logic operations, for ASCII and BCD conversions. **Timer and counter programming:** Programming 8051 timers, counter programming. **Serial port programming with and without interrupt:** Introduction to 8051 interrupts, programming timer interrupts, programming external hardware interrupts and serial communication interrupt, interrupt priority in the 8051. **UNIT V:** **Interfacing 8051 microcontroller to peripherals:** Parallel and serial ADC, DAC interfacing, LCD interfacing. **Programming Embedded Systems:** Structure of embedded program, infinite loop, compiling, linking and locating, downloading and debugging. **Embedded system design and development:** Embedded system development environment, file types generated after cross compilation, disassembler/ decompiler, simulator, emulator and debugging, embedded product development life-cycle, trends in embedded industry.	

	BSC604 C	Nuclear and Particle Physics (Theory + Tutorials 2*) **UNIT I:** **General Properties of Nuclei**: Constituents of nucleus and their Intrinsic properties, quantitative facts about size, mass, charge density (matter energy), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states. **UNIT II:** **Nuclear Models**: Liquid drop model approach, semi empirical mass formula and significance of various terms, condition of nuclear stability. Two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force. **Radioactivity decay**:(a) Alpha decay: basics of α-decay processes, theory of α-emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. (b) □-decay: energy kinematics for □-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion. **UNIT III:** **Nuclear Reactions:** Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction, Coulomb scattering (Rutherford	**UNIT I:** **General Properties of Nuclei**: Constituents of nucleus and their Intrinsic properties, quantitative facts about size, mass, charge density (matter energy), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states. **UNIT II:** **Nuclear Models**: Liquid drop model approach, semi empirical mass formula and significance of various terms, condition of nuclear stability. Two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force. **Radioactivity decay**:(a) Alpha decay: basics of α-decay processes, theory of α-emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. (b) □-decay: energy kinematics for □-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion. **UNIT III:** **Nuclear Reactions:** Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction, Coulomb scattering (Rutherford scattering). **Interaction of Nuclear Radiation with**	

		scattering). **Interaction of Nuclear Radiation with matter**: Energy loss due to ionization (Bethe-Block formula), energy loss of electrons, Cerenkov radiation, Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter. **UNIT IV:** **Detector for Nuclear Radiations:** Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si & Ge) for charge particle and photon detection (concept of charge carrier and mobility). **Particle Accelerators:** Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons. **UNIT V:** **Particle physics:** Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum number and gluons.	**matter**: Energy loss due to ionization (Bethe-Block formula), energy loss of electrons, Cerenkov radiation, Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter. **UNIT IV:** **Detector for Nuclear Radiations:** Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si & Ge) for charge particle and photon detection (concept of charge carrier and mobility). **Particle Accelerators:** Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons. **UNIT V:** **Particle physics:** Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum number and gluons.	
	BSC604 D	Medical Physics **UNIT I:** **PHYSICS OF THE BODY-I** Basic Anatomical Terminology: Standard Anatomical Position, Planes. Familiarity with terms like- Superior, Inferior,	**UNIT I:** **PHYSICS OF THE BODY-I** Basic Anatomical Terminology: Standard Anatomical Position, Planes. Familiarity with terms like- Superior, Inferior, Anterior,	

		Anterior, Posterior, Medial, Lateral, Proximal and Distal. **Mechanics of the body:** Skeleton, forces, and body stability. Muscles and dynamics of body movement. Physics of Locomotors 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. **(8 Lectures)** **UNIT II:** **PHYSICS OF THE BODY-II** **Acoustics of the body:** Nature and characteristics of sound, Production of speech, Physics of the ear, Diagnostics with sound and ultrasound. **Optical system of the body:** Physics of the eye. **Electrical system of the body:** Physics of the nervous system, Electrical signals and information transfer. **(10 Lectures)** **PHYSICS OF DIAGNOSTIC AND THERAPEUTIC SYSTEMS-I** **X-RAYS:** Electromagnetic spectrum, production of x-rays, x-ray spectra, Brehmsstrahlung, 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. **(7 Lectures)** **RADIATION PHYSICS:** Radiation units	Posterior, Medial, Lateral, Proximal and Distal. **Mechanics of the body:** Skeleton, forces, and body stability. Muscles and dynamics of body movement. Physics of Locomotors 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. **(8 Lectures)** **UNIT II:** **PHYSICS OF THE BODY-II** **Acoustics of the body:** Nature and characteristics of sound, Production of speech, Physics of the ear, Diagnostics with sound and ultrasound. **Optical system of the body:** Physics of the eye. **Electrical system of the body:** Physics of the nervous system, Electrical signals and information transfer. **(10 Lectures)** **PHYSICS OF DIAGNOSTIC AND THERAPEUTIC SYSTEMS-I** **X-RAYS:** Electromagnetic spectrum, production of x-rays, x-ray spectra, Brehmsstrahlung, 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. **(7 Lectures)** **RADIATION PHYSICS:** Radiation units	

		exposure, absorbed dose, units: rad, gray, 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, ionization chamber, Dosimeters, survey methods, area monitors, TLD, Semiconductor detectors. **UNIT III:** **MEDICAL IMAGING PHYSICS:** Evolution of Medical Imaging, X-ray diagnostics and imaging, Physics of nuclear magnetic resonance (NMR), NMR imaging, MRI Radiological imaging, Ultrasound imaging, Physics of Doppler with applications and modes, Vascular Doppler. Radiography: Filters, grids, cassette, X-ray film, film processing, fluoroscopy. **Computed tomography scanner**- principle & function, display, generations, mammography. Thyroid uptake system and Gamma camera (Only Principle, function and display). **RADIATION ONCOLOGY PHYSICS:** External Beam Therapy (Basic Idea): Telecobalt, Conformal Radiation Therapy (CRT), 3DCRT, IMRT, Image Guided Radiotherapy, EPID, Rapid Arc, Proton Therapy, Gamma Knife, Cyber Knife. Contact Beam Therapy (Basic Idea): Brachytherapy-LDR and HDR, Intra Operative Brachytherapy. Radiotherapy, kilo voltage machines, deep therapy machines, Telecobalt machines ,Medical linear accelerator. Basics of Teletherapy	exposure, absorbed dose, units: rad, gray, 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, ionization chamber, Dosimeters, survey methods, area monitors, TLD, Semiconductor detectors. **UNIT III:** **MEDICAL IMAGING PHYSICS:** Evolution of Medical Imaging, X-ray diagnostics and imaging, Physics of nuclear magnetic resonance (NMR), NMR imaging, MRI Radiological imaging, Ultrasound imaging, Physics of Doppler with applications and modes, Vascular Doppler. Radiography: Filters, grids, cassette, X-ray film, film processing, fluoroscopy. **Computed tomography scanner**- principle & function, display, generations, mammography. Thyroid uptake system and Gamma camera (Only Principle, function and display). **RADIATION ONCOLOGY PHYSICS:** External Beam Therapy (Basic Idea): Telecobalt, Conformal Radiation Therapy (CRT), 3DCRT, IMRT, Image Guided Radiotherapy, EPID, Rapid Arc, Proton Therapy, Gamma Knife, Cyber Knife. Contact Beam Therapy (Basic Idea): Brachytherapy-LDR and HDR, Intra Operative Brachytherapy. Radiotherapy, kilo voltage machines, deep therapy machines, Telecobalt machines ,Medical linear accelerator. Basics of Teletherapy	

		units, deep x-ray, Telecobalt units, medical linear accelerator, Radiation protection, external beam characteristics, dose maximum and build up – bolus, percentage depth dose, tissue maximum ratio and tissue phantom ratio, Planned target Volume and Gross Tumour Volume. **UNIT IV:** **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. **UNIT V:** **PHYSICS OF DIAGNOSTIC AND THERAPEUTIC SYSTEMS-II** Diagnostic nuclear medicine: Radiopharmaceuticals for radioisotope imaging, Radioisotope imaging equipment, Single photon and positron emission tomography. Therapeutic nuclear medicine: Interaction between radiation and matter Dose and isodose in radiation treatment. Medical Instrumentation: Basic Ideas of Endoscope and Cautery, Sleep Apnea and Cpap Machines, Ventilator and its modes.	units, deep x-ray, Telecobalt units, medical linear accelerator, Radiation protection, external beam characteristics, dose maximum and build up – bolus, percentage depth dose, tissue maximum ratio and tissue phantom ratio, Planned target Volume and Gross Tumour Volume. **UNIT IV:** **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. **UNIT V:** **PHYSICS OF DIAGNOSTIC AND THERAPEUTIC SYSTEMS-II** Diagnostic nuclear medicine: Radiopharmaceuticals for radioisotope imaging, Radioisotope imaging equipment, Single photon and positron emission tomography. Therapeutic nuclear medicine: Interaction between radiation and matter Dose and isodose in radiation treatment. Medical Instrumentation: Basic Ideas of Endoscope and Cautery, Sleep Apnea and Cpap Machines, Ventilator and its modes.	

	BSC605 A	Polymer Chemistry Lab 1. **Polymer synthesis** 1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA). a. Purification of monomer b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bisisobutylonitrile (AIBN) 2. Preparation of nylon 66/6 1. Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein a. Preparation of IPC b. Purification of IPC c. Interfacial polymerization 3. Redox polymerization of acrylamide 4. Precipitation polymerization of acrylonitrile 5. Preparation of urea-formaldehyde resin 6. Preparations of novalac resin/resold resin. 7. Microscale Emulsion Polymerization of Poly(methylacrylate). **Polymer characterization** 1. Determination of molecular weight by viscometry: (a) Polyacrylamide-aq.NaNO2 solution (b) (Poly vinyl proplylidine (PVP) in water 2. Determination of the viscosity-average	1. **Polymer synthesis** 1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA). a. Purification of monomer b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bisisobutylonitrile (AIBN) 2. Preparation of nylon 66/6 1. Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein a. Preparation of IPC b. Purification of IPC c. Interfacial polymerization 3. Redox polymerization of acrylamide 4. Precipitation polymerization of acrylonitrile 5. Preparation of urea-formaldehyde resin 6. Preparations of novalac resin/resold resin. 7. Microscale Emulsion Polymerization of Poly(methylacrylate). **Polymer characterization** 1. Determination of molecular weight by viscometry: (a) Polyacrylamide-aq.NaNO2 solution (b) (Poly vinyl proplylidine (PVP) in water 2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of "head-to-head" monomer linkages in the polymer.	

		molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of "head-to-head" monomer linkages in the polymer. 3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group). 4. Testing of mechanical properties of polymers. 5. Determination of hydroxyl number of a polymer using colorimetric method. **Polymer analysis** 1. Estimation of the amount of HCHO in the given solution by sodium sulphite method 2. Instrumental Techniques 3. IR studies of polymers 4. DSC analysis of polymers 5. Preparation of polyacrylamide and its electrophoresis *at least 7 experiments to be carried out.	3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group). 4. Testing of mechanical properties of polymers. 5. Determination of hydroxyl number of a polymer using colorimetric method. **Polymer analysis** 1. Estimation of the amount of HCHO in the given solution by sodium sulphite method 2. Instrumental Techniques 3. IR studies of polymers 4. DSC analysis of polymers 5. Preparation of polyacrylamide and its electrophoresis *at least 7 experiments to be carried out.	
	BSC605 B	Green Chemistry Lab **1. Safer starting materials** Preparation and characterization of nanoparticles of gold using tea leaves. **2. Using renewable resources** Preparation of biodiesel from vegetable/ waste cooking oil. **3. Avoiding waste** Principle of atom economy. Use of molecular model kit to stimulate the reaction to investigate how the atom	**1. Safer starting materials** Preparation and characterization of nanoparticles of gold using tea leaves. **2. Using renewable resources** Preparation of biodiesel from vegetable/ waste cooking oil. **3. Avoiding waste** Principle of atom economy. Use of molecular model kit to stimulate the reaction to investigate how the atom	

		economy can illustrate Green Chemistry. Preparation of propene by two methods can be studied (I) Triethylamine ion + OH^- → propene + trimethylpropene + water (II) 1-propanol H_2SO_4/Δ propene + water Other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy. **1. Use of enzymes as catalysts** Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide. **5. Alternative Green solvents** Extraction of D-limonene from orange peel using liquid CO2 prepared form dry ice. Mechanochemical solvent free synthesis of azomethines **6. Alternative sources of energy** Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II). Photoreduction of benzophenone to benzopinacol in the presence of sunlight.	economy can illustrate Green Chemistry. Preparation of propene by two methods can be studied (I) Triethylamine ion + OH^- → propene + trimethylpropene + water (II) 1-propanol H_2SO_4/Δ propene + water Other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy. **1. Use of enzymes as catalysts** Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide. **5. Alternative Green solvents** Extraction of D-limonene from orange peel using liquid CO2 prepared form dry ice. Mechanochemical solvent free synthesis of azomethines **6. Alternative sources of energy** Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II). Photoreduction of benzophenone to benzopinacol in the presence of sunlight.	
	BSC605C	Instrumental Methods of Analysis Lab 1. Safety Practices in the Chemistry Laboratory 2. Determination of the isoelectric pH of a protein. 3. Titration curve of an amino acid.	1. Safety Practices in the Chemistry Laboratory 2. Determination of the isoelectric pH of a protein. 3. Titration curve of an amino acid.	

		4. Determination of the void volume of a gel filtration column. 5. Determination of a Mixture of Cobalt and Nickel (UV/Vis spec.) 6. Study of Electronic Transitions in Organic Molecules (i.e., acetone in water) 7. IR Absorption Spectra (Study of Aldehydes and Ketones) 8. Determination of Calcium, Iron, and Copper in Food by Atomic Absorption 9. Quantitative Analysis of Mixtures by Gas Chromatography (i.e., chloroform and carbon tetrachloride) 10. Separation of Carbohydrates by HPLC 11. Determination of Caffeine in Beverages by HPLC 12. Potentiometric Titration of a Chloride-Iodide Mixture 13. Cyclic Voltammetry of the Ferrocyanide/Ferricyanide Couple 14. Nuclear Magnetic Resonance 15. Use of fluorescence to do “presumptive tests” to identify blood or other body fluids. 16. Use of “presumptive tests” for anthrax or cocaine 17. Collection, preservation, and control of blood evidence being used for DNA testing 18. Use of capillary electrophoresis with laser fluorescence detection for nuclear	4. Determination of the void volume of a gel filtration column. 5. Determination of a Mixture of Cobalt and Nickel (UV/Vis spec.) 6. Study of Electronic Transitions in Organic Molecules (i.e., acetone in water) 7. IR Absorption Spectra (Study of Aldehydes and Ketones) 8. Determination of Calcium, Iron, and Copper in Food by Atomic Absorption 9. Quantitative Analysis of Mixtures by Gas Chromatography (i.e., chloroform and carbon tetrachloride) 10. Separation of Carbohydrates by HPLC 11. Determination of Caffeine in Beverages by HPLC 12. Potentiometric Titration of a Chloride-Iodide Mixture 13. Cyclic Voltammetry of the Ferrocyanide/Ferricyanide Couple 14. Nuclear Magnetic Resonance 15. Use of fluorescence to do “presumptive tests” to identify blood or other body fluids. 16. Use of “presumptive tests” for anthrax or cocaine 17. Collection, preservation, and control of blood evidence being used for DNA testing 18. Use of capillary electrophoresis with laser fluorescence detection for nuclear DNA (Y chromosome only or multiple chromosome)	

		DNA (Y chromosome only or multiple chromosome) 19. Use of sequencing for the analysis of mitochondrial DNA 20. Laboratory analysis to confirm anthrax or cocaine 21. Detection in the field and confirmation in the laboratory of flammable accelerants or explosives 22. Detection of illegal drugs or steroids in athletes 23. Detection of pollutants or illegal dumping 24. Fibre analysis *At least 10 experiments to be performed*	19. Use of sequencing for the analysis of mitochondrial DNA 20. Laboratory analysis to confirm anthrax or cocaine 21. Detection in the field and confirmation in the laboratory of flammable accelerants or explosives 22. Detection of illegal drugs or steroids in athletes 23. Detection of pollutants or illegal dumping 24. Fibre analysis *At least 10 experiments to be performed*	
	BSC605 D	Quantum Chemistry, Spectroscopy & Photochemistry Lab **UV/Visible spectroscopy** I. Study the 200-500 nm absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values. Calculate the energies of the two transitions in different units (J molecule-1, kJ mol-1, cm-1, eV). II. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$. III. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds. **Colourimetry** **I.** Verify Lambert-Beer's law and determine the concentration of $CuSO_4/KMnO_4/K_2Cr_2O_7$ in a solution of unknown concentration. II. Determine the concentrations of	**UV/Visible spectroscopy** I. Study the 200-500 nm absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values. Calculate the energies of the two transitions in different units (J molecule-1, kJ mol-1, cm-1, eV). II. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$. III. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds. **Colourimetry** **I.** Verify Lambert-Beer's law and determine the concentration of $CuSO_4/KMnO_4/K_2Cr_2O_7$ in a solution of unknown concentration. II. Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture.	

		$KMnO_4$ and $K_2Cr_2O_7$ in a mixture. III. Study the kinetics of iodination of propanone in acidic medium. IV. Determine the amount of iron present in a sample using 1,10-phenathroline. V. Determine the dissociation constant of an indicator (phenolphthalein). **VI.** Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide. VII. Analyse the given vibration-rotation spectrum of HCl(g)	III. Study the kinetics of iodination of propanone in acidic medium. IV. Determine the amount of iron present in a sample using 1,10-phenathroline. V. Determine the dissociation constant of an indicator (phenolphthalein). **VI.** Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide. VII. Analyse the given vibration-rotation spectrum of HCl(g)	
	BSC606 A	Quantum Mechanics Lab 1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom: $\frac{d^2y}{dr^2} = A(r)u(r), A(r) = \frac{2m}{\hbar^2}[V(r) - E]$, where $V(r) = -\frac{e^2}{r}$. Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wave functions. Remember that the ground state energy of the hydrogen atom is $\approx -13.6\, eV$. Take $e = 3.795(eV\text{Å})^{1/2}$, $\hbar c = 1973\ (eV\text{Å})$ and $m = 0.511 \times 10^6 eV/c^2$. 2. Solve the s-wave radial Schrodinger equation for an atom: $\frac{d^2y}{dr^2} = A(r)u(r), A(r) = \frac{2m}{\hbar^2}[V(r) - E]$. Where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential $V(r) = -\frac{e^2}{r}e^{-r/a}$. Find the	Quantum Mechanics Lab 8. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom: $\frac{d^2y}{dr^2} = A(r)u(r), A(r) = \frac{2m}{\hbar^2}[V(r) - E]$, where $V(r) = -\frac{e^2}{r}$. Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wave functions. Remember that the ground state energy of the hydrogen atom is $\approx -13.6\, eV$. Take $e = 3.795(eV\text{Å})^{1/2}$, $\hbar c = 1973\ (eV\text{Å})$ and $m = 0.511 \times 10^6 eV/c^2$. 9. Solve the s-wave radial Schrodinger equation for an atom: $\frac{d^2y}{dr^2} = A(r)u(r), A(r) = \frac{2m}{\hbar^2}[V(r) - E]$. Where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential $V(r) = -\frac{e^2}{r}e^{-r/a}$. Find the energy (in eV) of the ground state of the atom to an accuracy of	

		energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wave function. Take $= 3.795(eV\text{Å})^{1/2}$, $\hbar c = 1973\ (eV\text{Å}), m = 0.511 \times 10^6 eV/c^2$ and $a = 3\ \text{Å}, 5\ \text{Å}, 7\ \text{Å}.$. The ground state energy is expected to be above $-12\ eV$ in all three cases. 3. Solve the s-wave radial Schrodinger equation for a particle of mass m: $\frac{d^2y}{dr^2} = A(r)u(r), A(r) = \frac{2m}{\hbar^2}[V(r) - E]$. For the anharmonic oscillator potential $V(r) = \frac{kr^2}{2} + \frac{br^3}{3}$. For the ground state energy (in MeV) of the particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose $\hbar c = 197.3\ MeV\ fm$, $m = 940 MeV/c^2$, k = 100 MeV fm^{-2} and $b = 0, 10, 30\ MeV\ fm^{-3}$. The ground state energy I expected to lie between 90 and 110 MeV for all three cases. 4. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule: $\frac{d^2y}{dr^2} = A(r)u(r), A(r) = \frac{2\mu}{\hbar^2}[V(r) - E]$. where μ is the reduced mass of the two-atom system for the Morse potential $V(r) = D\left(e^{-2\alpha r'} - e^{-\alpha r'}\right), r' = \frac{r - r_0}{r}$. Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant	three significant digits. Also, plot the corresponding wave function. Take $= 3.795(eV\text{Å})^{1/2}$, $\hbar c = 1973\ (eV\text{Å}), m = 0.511 \times 10^6 eV/c^2$ and $a = 3\ \text{Å}, 5\ \text{Å}, 7\ \text{Å}.$. The ground state energy is expected to be above $-12\ eV$ in all three cases. 10. Solve the s-wave radial Schrodinger equation for a particle of mass m: $\frac{d^2y}{dr^2} = A(r)u(r), A(r) = \frac{2m}{\hbar^2}[V(r) - E]$. For the anharmonic oscillator potential $V(r) = \frac{kr^2}{2} + \frac{br^3}{3}$. For the ground state energy (in MeV) of the particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose $\hbar c = 197.3\ MeV\ fm$, $m = 940 MeV/c^2$, k = 100 MeV fm^{-2} and $b = 0, 10, 30\ MeV\ fm^{-3}$. The ground state energy I expected to lie between 90 and 110 MeV for all three cases. 11. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule: $\frac{d^2y}{dr^2} = A(r)u(r), A(r) = \frac{2\mu}{\hbar^2}[V(r) - E]$. where μ is the reduced mass of the two-atom system for the Morse potential $V(r) = D\left(e^{-2\alpha r'} - e^{-\alpha r'}\right), r' = \frac{r - r_0}{r}$. Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding	

		digits. Also plot the corresponding wave function. Take: $m = 940MeV/c^2$, D = 0.755501 eV, α = 1044, r_0 = 0.131349 Å. **Laboratory based experiments:** 5. Study of Electron spin resonance-determine magnetic field as a function of the resonance frequency. 6. Study of Zeeman effect: with external magnetic field; Hyperfine splitting. 7. To study the quantum tunnelling effect with solid state device, e.g. tunneling current in backward diode or tunnel diode.	wave function. Take: $m = 940MeV/c^2$, D = 0.755501 eV, α = 1044, r_0 = 0.131349 Å. **Laboratory based experiments:** 12. Study of Electron spin resonance-determine magnetic field as a function of the resonance frequency. 13. Study of Zeeman effect: with external magnetic field; Hyperfine splitting. 14. To study the quantum tunnelling effect with solid state device, e.g. tunneling current in backward diode or tunnel diode.	
	BSC606B	Embedded System: Introduction to microcontroller Lab 1. To find that the given numbers is prime or not. 2. To find the factorial of a number. 3. Write a program to make the two numbers equal by increasing the smallest number and decreasing the largest number. 4. Use one of the four ports of 8051 for O/P interfaced to eight LED's. Simulate binary counter (8 bit) on LED's. 5. Program to glow first four LED then next four using TIMER application. 6. Program to rotate the contents of the accumulator first right and then left. 7. Program to run a countdown from 9-0 in the seven segment LED display. 8. To interface seven segment LED display with 8051 microcontroller and display 'HELP' in the seven segment LED display. 9. To toggle '1234' as '1324' in the seven segment LED.	1. To find that the given numbers is prime or not. 2. To find the factorial of a number. 3. Write a program to make the two numbers equal by increasing the smallest number and decreasing the largest number. 4. Use one of the four ports of 8051 for O/P interfaced to eight LED's. Simulate binary counter (8 bit) on LED's. 5. Program to glow first four LED then next four using TIMER application. 6. Program to rotate the contents of the accumulator first right and then left. 7. Program to run a countdown from 9-0 in the seven segment LED display. 8. To interface seven segment LED display with 8051 microcontroller and display 'HELP' in the seven segment LED display. 9. To toggle '1234' as '1324' in the seven segment LED.	

		10. Interface stepper motor with 8051 and write a program to move the motor through a given angle in clock wise or counter clockwise direction. 11. Application of embedded systems: Temperature measurement, some information on LCD display, interfacing a keyboard.	10. Interface stepper motor with 8051 and write a program to move the motor through a given angle in clock wise or counter clockwise direction. 11. Application of embedded systems: Temperature measurement, some information on LCD display, interfacing a keyboard.	
	BSC606D	Medical Physics Lab 1. Understanding the working of a manual Hg Blood Pressure monitor and measure the Blood Pressure. 2. Understanding the working of a manual optical eye-testing machine and to learn eye-testing. 3. Correction of Myopia (short sightedness) using a combination of lenses on an optical bench/breadboard. 4. Correction of Hypermetropia/Hyperopia (long sightedness) using a combination of lenses on an optical bench/breadboard. 5. To learn working of Thermoluminescent dosimeter (TLD) badges and measure the background radiation. 6. Familiarization with Geiger-Muller (GM) Counter and to measure background radiation. 7. Familiarization with Radiation meter and to measure background radiation. 8. Familiarization with the Use of a Vascular Doppler.	1. Understanding the working of a manual Hg Blood Pressure monitor and measure the Blood Pressure. 2. Understanding the working of a manual optical eye-testing machine and to learn eye-testing. 3. Correction of Myopia (short sightedness) using a combination of lenses on an optical bench/breadboard. 4. Correction of Hypermetropia/Hyperopia (long sightedness) using a combination of lenses on an optical bench/breadboard. 5. To learn working of Thermoluminescent dosimeter (TLD) badges and measure the background radiation. 6. Familiarization with Geiger-Muller (GM) Counter and to measure background radiation. 7. Familiarization with Radiation meter and to measure background radiation. 8. Familiarization with the Use of a Vascular Doppler.	