B. Sc.

Department of Chemistry

Goals

The Bachelor of Science Degree in Chemistry intended for students who are primarily interested in careers as professional chemists or wish a thorough grounding in chemistry.
This three years' undergraduate program prepares students by developing knowledge base in theory as well as expertise in experimental science.
Because South Gujarat is famous Chemical Industrial Zone, the main objective of this course is to increase the job opportunity of the students by preparing them with the experimental and theoretical aspects of this continuously evolving subject.

Course Outcomes (CO)

F. Y. B. Sc.

Sem I Paper-I: Physical and Inorganic Chemistry
At the end of the course, student will be able to

CO-1: Study definition of space lattice, Unit cell, Difference between crystalline and amorphous state, types of crystals with illustrations, Law of crystallography. Steno's law and laws of symmetry, lattice planes, Miller indices, Bravais indices, type of cubic system, diagrammatic representation of cubic system and d100, d110, d111 planes, Bragg's equation (X-ray diffraction), Crystal structure of NaCl, KCl.(Numerical based on Bragg'sequation and Miller indices)

CO-2: understand basic concepts Arrhenius theory, Lowry Bronsted theory, Lewis theory, Solvent – Solute concept of acidbase, Soft-Hard acid base and its application

CO-3: Historical perspective of atomic structure; Ruatherford's atomic model, Bohr's theory and its limitation, Spectrum of Hydrogen atom (Lyman, Balmer, Paschen, Brackett &Pfund), Quantum numbers, Auf bau, Hund and Pauli exclusion principles, Penetration and shielding, Effective nuclear charge (Slater rule)

CO-4: Chemical kinetics and its scope, rate of reaction, factors affecting rate of reaction : temperature, concentration, pressure, solvent, light and catalyst, Molecularity of reaction, Classification of chemical reaction, Order of reaction with illustration (first order, second order, third order, zero order, pseudo first order) reaction, : second order (a=b), half life and mean life.

CO-5: Define of atomic and ionic radii, ionisation energy, electron affinity and electron negativity, S-Block elements: Comparative study, diagonal relationship, salient features of hydrides.

Sem I Paper-II: Organic Chemistry
At the end of the course, student will be able to

CO-1: describe and identify the isomerism to structures of organic compounds;

CO-2: define and identify the optical activity in to structures of organic compounds
CO-3: explain the chemical Preparation and separation of isomers;
CO-4: explain Stereochemistry of chiral and achiral chemistry organic compounds;
CO-5: interpret R/S Configurations of organic compounds;
CO-6: describe E/Z, Syn/Anti, D/L and R/S isomers;
CO-7: have basic information of heterocyclic compounds, nomenclature, classification, five and benzofused heterocyclic compounds, Aromaticity and resonance structure of heterocyclic compounds;
CO-8: five membered heterocyclic compound, synthesis and important chemical reactions and some examples, Benzofused heterocyclic compound, synthesis and important chemical reactions and some examples;
CO-9: have basic knowledge of poly cyclic aromatic hydrocarbon and type, classification and nomenclature, some examples of polycyclic aromatic hydrocarbon, important chemicals reactions of PAHs;
CO-10: understand oxidation and reduction and their uses.

Sem I: Chemistry Practical

At the end of course student will able to

CO-1: handle laboratory glassware's, hazardous chemicals safely in laboratory;
CO-2: set up the apparatus properly for the given experiments;
CO-3: perform all the activities in the laboratory with neatness and cleanness;
CO-4: to develop skills for quantitative estimation using the different branches of volumetric analysis;
CO-5: to develop skills required for the qualitative analysis of organic compounds.

Sem II Paper-I: Physical and Inorganic Chemistry

At the end of the course student will be able to

CO-1: Study definition of Electrical conductance, Specific conductance, equivalent conductance, Molar conductance, Effect of dilution on concentration, Cell constant, Determination of Cell constant, Ostwald's dilution law and its limitations, Acid & Basic buffer actions (Henderson-Hasselbach equation), Buffer capacity, Numeric
CO-2: understand Second law of thermodynamics (in detail), Carnot cycle and its efficiency, Entropy concept, Change of entropy for reversible isothermic, isobaric, isochoric and adiabatic processes. Entropy change for ideal gases (T & V as variables, P & T as variables), Numerical.
CO-3: Study [I] Dry Reaction: theory behind borax bead test with equation, Flame test (Theory, structure of non luminous Bunsen flame) [II] Analysis of Cation : Application of common ion effect, solubility product constant. Complexometric reactions involved in qualitative analysis; 1. For identification [reaction between Cu(II) ion with ammonia, Fe(III) with thiocyanide, NH^{4+} with Nessler Reagent]. 2. For masking [Cd^{+2}, Cu^{+2}]. 3. Separation of two ions [Ag-Hg, Zn^{+2}, Mn^{+2}]
CO-4: Study shape of d-orbitals, CFT – Basic assumption, splitting of d-orbitals in Octahedral, Tetrahedral, Square planer complexes, distribution of dx electrons in Octahedral and Tertahedral complexes and CFSE.
CO-5: Define chemical bonds (covalent, co-ordinate covalent, ionic, metallic, H-bond, Wan der walls forces of attraction), Polarisability (Fajan's rule), Molecular Orbital theory ; LCAO method, Bonding molecular orbital, non-bonding molecular orbital, anti-bonding molecular orbital, bond order, magnetic properties and molecular orbital energy level diagram of hetero diatomic molecule : CO and NO, VSEPR theory.
CO-6: Classification of physical properties (additive, constitutive, colligative, additive, constitutive), Atomic volume, Molar volume and Chemical constitution, Kopp's law,

Surface tension, Drop number method, Parachor, Viscosity, Determination of viscosity by Ostwald viscometer, Define: Refraction, Specific refraction, molar refraction, Numerical.

Sem II Paper-II: Organic Chemistry

After completion of course student will able to

CO-1: define the terms related to organic reactions such as Homolytic and Heterolytic fission free radicals carbonium ions, carbanions, carbenes, arynes and nitrenes;

CO-2: classify organic reactions like Addition, substitution, elimination, rearrange-ments, addition, and substitution with respect toelectrophilic and nucleophilic, SN_1, SN_2, Mechanism of addition reaction to alkenes and dienes, substitution in benzene, Perkin reaction, Benzoin condensation and Cannizero's reaction;

CO-3: determine empirical formula and its relation with molecular formula determination of molecular weight of organic acid by titration and silver salt method and organic base by chioroplatinate method and its limitations;

CO-4: define the term carbohydrate, its classification, structure of glucose and fructose, conversion of glucose to fructose and fructose to glucose, step up, step down and kilyani synthesis;

CO-5: identify Alkenes: Nomenclature, method of preparation, properties and uses of ethylene and propylene Morkwonikoffs rule and Satytzeff rule, polymerization of ethylene styrene and vinyl chloride;

CO-6: identify dienes: nomenclature, classification of dienes methods of formation of butadiene chemical reactions 1, 2 and 1, 4 additions, Diel's – Aider reaction;

CO-7: identify Alkynes: nomenclature, methods of formation, chemical reactions, electrophilic and nucleophilic addition reactions if acetylene.

Sem II: Chemistry Practical

At the end of course student will able to

CO-1: explain mole concept and its application in the preparation of normal and molar solutions, and use of mole concept in quantitative calculations for inorganic analysis;

CO-2: develop skills for quantitative estimation using the different branches of volumetric Analysis;

CO-3: impart the students a thorough knowledge of Systematic qualitative analysis of inorganic compounds.

S. Y. B. Sc.

Sem-III Paper-III: Inorganic Chemistry

After completion of course student will able to

CO-1: acquire working knowledge of the quantum mechanics postulate on the evolution of physical system;

CO-2: solve the time independent Schrodinger's equation, derive the equation for particle in the one dimensional box, applies boundary conditions to constraint the set of possible states;

CO-3: understand wave function, probability function, well behaved wave function.

CO-4: define and derivation of different operators, derivation of Hamiltonian equation, Hamiltonian operators for H – atom, H_2^+, He_2^+ and Li;

CO-5: principle of chromatography, classification of chromatography according to mobile phase and stationary phase, types of paper chromatography, Rf values, use of paper chromatography in inorganic analysis, separation of groups, halide and amino acid;

CO-6: define d-block elements; explain characteristic properties of d-block elements and properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states;

CO-7: understand L-S coupling, J-J coupling (introduction) and term symbol, determination of microstate of *p* and *d* orbital for several atom, calculation of term symbol of C, N, O, Ni, Ni^{+2}, Fe, Fe^{2+}, Fe^{3+}, Cr, Cr^{3+}, Co^{2+}, V, V^{+3} and Cl^{-};

CO-8: define potable water; explain different methods of purification of water for potable and industrial purposes, explain soft and hard water, discuss method of desalination of sea water by reverse osmosis and electro dialysis.

Sem-III Paper-IV: Organic Chemistry

After completion of course student will able to

CO-1: understand physical properties and chemical reactions of nitriles, isonitriles, carbamates, semi carbazides and their application in synthetic organic chemistry;

CO-2: learn structure and nomenclature of amines, preparation of aryl amines, physical properties and chemical reactions. Gabriel-pthalimide reaction, Hofmann Bromamide reaction;

CO-3: learn structure and nomenclature of acid chloride, ester, amides of monocarboxylic acid; method of formation of monocarboxylic acid derivatives and chemical reactions;

CO-4: recall Definition, Classification, IUPAC Nomenclature of heterocyclic compounds with synthesis of some heterocyclic compounds;

CO-5: define, classify, give nomenclature of polynuclear aromatic hydrocarbons with synthesis;

CO-6: study basics of Diazonium salt, its mechanism, mole ratio, different salts, preparation of the diazonium salt;

CO-7: give nomenclature of Diazonium salts;

CO-8: study reactions of Diazonium salts, replacement reactions in which nitrogen is eliminated, its application in the synthesis of aromatic compounds;

CO-9: study laws of coupling, coupling agents, synthesis of diazomino and aminizo compounds;

CO-10: learn to use of Reagents: Anhydrous aluminium chloride, NBS, Selenium oxide, Lithium aluminium hydride.

Sem-III Paper –V: Physical Chemistry

At the end of the course student will be able to

CO-1: explain Arrhenius theory and collision theory of rate of reaction, energy of activation, effect of catalysis on it. Solve numerical problems related to theories of reaction rate.

CO-2: understand fundamentals of photochemistry, Basics of electromagnetic radiations, photons, Thermal and Photochemical Laws (a) Grothus Draper's Law (b) Lambert Beer's Law (c) Einstein's Law of photochemical equivalence. Explain Quantum efficiency, Experimental determination of Quantum yields. Reasons of Low and high quantum efficiency, Primary and secondary photochemical reactions, Factors affecting quantum efficiency, Isomeric changes, polymerization, Photosensitization, Photophysical processes Fluorescence, Phosphorescence, Chemiluminescene. Factor affecting Fluorescence, Phosphorescence and Solve numerical problems related to quantum efficiency.

CO-3: Discuss formation of ions in solutions, Difference between metallic conductance and Electrolytic conductance, electrolysis, Migration of ions, Transport number of ions and its Determination by moving boundry method. Explain Kohlraush law of ionic conductance and application of Kohlraush law to (a) Determination of degree of dissociation of weak electrolyte. (b) Determination of equivalent conductivity of weak

electrolyte at infinite diluation. (c) Determination of solubility and solubility product of sparingly soluble salts. (d) Determination of ionic product of water. Solve numerical problems related to determination of transport number and applications of Kohlrausch law.

CO-4: Explain basics of electromagnetic radiation with wavelength and energy. Radio frequency, Microwave, IR, UV/visible region, Pure rotational spectra, Vibrational and Vibrational-Rotational spectra, Raman spectra. Rotational spectra, calculation of bond-length. Vibrational rotational spectra, Hook's law, vibrational energy level. Solve numerical Problems related to Moment of inertia, Force constant, Redced weight and Bond length.

Industrial Chemistry

At the end of the course student will be able to

CO-1: study manufacturing process of Synthetic fibers with uses;

CO-2: get general Information and Synthesis of some synthetic and natural Rubber with Flow sheet diagram;

CO-3: study industrial important and manufacturing process of Plastics and Resins with flow sheet diagram;

CO-4: get knowledge about the synthesis of some herbicides, pesticides, insecticides and fungicides used for household and agriculture purpose;

CO-5: learn manufacturing process of soap and detergents with the classification of detergents;

CO-6: get general information and manufacturing process of explosive;

CO-7: explain therapeutic uses and manufacture processes of drugs;

CO-8: study industrial uses and manufacturing process of some important dye pigment and dye intermediate;

Sem-III: Chemistry Practical:

At the end of the course, student will be able to

CO-1: study the reaction kinetics practically [1st order];

CO-2: study the conduct metric and pH metric principles and application of conduct metric, and pH metric measurement in quantitative analysis;

CO-3: do viscosity measurement and its application;

CO-4: study the adsorption of given organic acid on charcoal;

CO-5: get trained in the quantitative analysis using gravimetric method;

CO-6: develop skills required for the qualitative analysis of organic compounds.

Sem-IV Paper – III: Inorganic Chemistry

At the end of course, students will able to

CO-1: define lanthanides and actinides, electronic configuration, sources, occurrence, extraction by solvent and ion exchange, properties, lanthanide contraction, use of lanthanide compounds, industrial use uranium and plutonium, misch metal;

CO-2: study of theory of hydrogen bonding, classification, importance of hydrogen bonding in ice, Effect of hydrogen bonding in various fields;

CO-3: define CFSE, chromatography, ion exchange, influent, effluent, sorption, desorption, elution, eluant, eluate, break through capacity;

CO-4: understand basic concept of CFT, CFSE, splitting of d-orbital in octahedral and tetrahedral geometry, interaction of visible light and complex compound, ion exchange chromatography, separation of ion through ion exchange chroma-tography, purification of water;

CO-5: explain effect of strong and weak ligand on CFSE, magnetic property and color of the metal complexes, synthesis of ion exchange resin, type of resin, steps of ion exchange chromatography, application of ion exchange chromatography, function of various metals in to biological system, importance of metallo-propyrins, hemoglobin (with reactions), myoglobin.

Sem-IV Paper – IV: Organic Chemistry

At the end of course, students will able to

CO-1: write and explain mechanism of Michael reaction Wolf-Kishner reduction, Wittig reaction, Fridel-Craft reaction, Mannich reaction, Dickmann reaction, Reimer-Tiemann reaction, Aldol Condensation;

CO-2: explain the Elimination reactions, stereo chemistry of elimination reaction, elimination reaction vs substitution reaction;

CO-3: learn carbohydrates: (a) General introduction: (b) Disaccharides: Structure elucidation of maltose, lactose and sucrose (c) Methods of methylating sugar;

CO-4: synthesize and study application of compound containing reactive methylene group like malonic ester and aceto acetic ester, Keto-enol tautomerism: factors affecting Keto-enol tautomerism and its mechanism;

CO-5: study aliphatic sulfur compounds: nomenclature, general methods of preparation and Reaction, Aromatic sulfonic acid: nomenclature, preparation, reactions and uses of sulfonic acids of toluene;

CO-6: learn UV and visible spectroscopy, ultraviolet absorption spectroscopy, absorption laws (Beer-Lambert law) terminology used in UV and visible spectra, molar absorptivity, types of electronic transitions, effect of conjugation, concept of Chromophore and Auxochrome and Hypsochromic shifts UV spectra of conjugated enes and enones, effect of solvent substitution on electronic transition. Problems based on calculation of λ max for conjugated dienes and unsaturated carbonyl compounds and substituted Benzene derivatives using relevant rule.

Sem-IV Paper –V: Physical Chemistry

At the end of course, students will able to

CO-1: explain Nernst distribution law and its conditions for the validity, complications arising in distribution law due to association of solute in one of the phases, dissociation of solute in one of the phases, dissociation of solute in both the phase, derivation of distribution law from kinetic consideration explanation of solvent extraction process;

CO-2: distinguish between adsorption and absorption, physical adsorption and chemical adsorption, explain heat of adsorption, characteristics of adsorption, Freundlich's adsorption isotherm, Langmuir's adsorption isotherm, catalysis, general features of catalysis, heterogeneous catalysis, adsorption theory of catalysis;

CO-3: explain free energy or work function [Gibbs free energy (G) and Helmholtz free energy (A)], Derive equation $G = G^0 + RT \ln p$, relation of ΔG and equilibrium constant KP (Vant Hoff isotherm), derive Clapeyron and Clapeyron-Clausius equations, apply Clapeyron–Clausius equation in the derivation of molal elevation constant and molal depression constant; solve numerical problems related to latent heat of fusion, latent heat of vaporization, elevation of boiling point and depression of freezing point;

CO-4: use principle of conductometric titrations to explain following titrations: (1) strong acid v/s strong base (2) strong acid v/s weak base (3) weak acid v/s strong base (4) weak acid v/s weak base (5) mixture of strong acid and weak acid v/s strong base (6)

precipitation titrations of (i) $BaCl_2$ v/s K_2CrO_4 (ii) NaCl v/s $AgNO_3$, explain advantages of conductometric titrations over indicator method;

CO-5: discuss relation between degree of hydrolysis, hydrolysis constant and pH of solutions of (1) salts of weak acid and strong base (2) salts of strong acid and weak base (3) salts of weak acid and weak base, explain theories of acid-base indicators, choice of indicators, indicator exponent and useful range of pH of an indicator, solve numerical problems related to degree of hydrolysis, hydrolysis constant, determination of pH.

Industrial Chemistry

At the end of course, students will able to

CO-1: give details of the processes of manufacture of some industrial important inorganic chemicals with uses;

CO-2: industrial uses and manufacturing process of lime, cement and refractories;

CO-3: industrial preparation and uses of some important chemical such as potassium permanganate, potassium dichromate, titanium dioxide, bleaching powder, white lead;

CO-4: information about plant nutrient and symptoms of nutrient deficiency in plant kingdom. Classify fertilizer and industrial manufacturing process of widely used some fertilizer;

CO-5: classify fuel, information and synthesis of some synthetic and eco-friendly fuel;

CO-6: property, classification and industrial manufacturing process of glass use frequently for industries and house hold purpose;

CO-7: property and industrial making process of various ferrous and non-ferrous alloys;

CO-8: define fermentation, various factors affecting fermentation process, micro-organisms and various chemical nutrient uses for fermentation process.

Sem-IV: Chemistry Practical

At the end of course, students will able to

CO-1: develop laboratory skills for the purpose handling different instruments; interpret results of experiments and their correlation with theory;

CO-2: determine the molecular condition of benzoic acid in its solution in kerosene by the method of partition coefficient;

CO-3: determine the relative strength of mineral acids;

CO-4: study the conduct metric and pH metric principles and application of conduct metric, and pH metric measurement in quantitative analysis;

CO-5: maintain records of chemical and instrumental analysis; develop laboratory skills for the purpose of collecting, interpreting, analyzing, practical data;

CO-6: impart the students a thorough knowledge of systematic qualitative analysis of inorganic mixtures.

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Sem-V Paper-VI: Inorganic Chemistry

At the end of course, student will be able to

CO-1: study postulates of quantum mechanics, particles in three dimensional box, Schrodinger's wave equation in polar coordinates, its separation in to R, θ and Φ;

CO-2: Jahn Teller Theorem, distortation in octahedral complexes, crystal field splitting energy level diagram for octahedral and tetrahedral, tetragonal and square planar complexes;

CO-3: get concept of Ligand field theory;

CO-4: distinguish between atomic and molecular orbitals, bonding and antibonding molecular orbitals, different theories of co-ordination chemistry;

CO-5: draw MO energy level diagram for metal complexes and its magnetic properties;

CO-6: define and classify metal carbonyls, metal ligandπ–bonding (back bonding), Define EAN and 18-electron rule, calculate EAN for metal carbonyl, Bonding in metal carbonyl, structure and IR spectra in metal carbonyl. Differentiate between terminal and bridge carbonyl. Constitution of metal carbonyls $Ni(CO)_4$; $Fe(CO)_5$, $Fe_2(CO)_9$, $Mn_2(CO)_{10}$, $Cr(CO)_6$, $Co_2(CO)_8$;

CO-7: define boron hydride and its classification, Wade's rule, bonding and structure in tetra Borane (10), penta borane (9) and dodeca borane (12) anion;

CO-8: outline thermodynamic stability of metal complexes and factors affecting a stability of metal complexes. Lability and inertness, Factors affecting lability of metal complexes. Trans effect, theories of Trans effect (i) Electrostatic Polarization Theory (ii) - Bond Theory labile and inert complexes based on VBT and CFT;

CO-10: define and give importance of corrosion, types of corrosion: uniform, pitting, intercrystalline and stress cracking corrosion, electro-chemical theory of corrosion, protection methods and importance of coating, inhibitors (organic, inorganic, anodic, cathodic), anodic and cathodic protection.

Sem-V Paper-VII: Organic Chemistry

At the end of course, students will able to

CO-1: give (a) Different types of mechanism for esterification and hydrolysis: B_{AC}^2 A_{AC}^2 A_{AC}^1 A_{AL}^1 B_{AL}^2 (b) mechanism of formation and hydrolysis of amides. (c) pyrolytic elimination: Cope and Chugaev reactions;

CO-2: get introduction to Aromaticity, Huckel's Rule, Aromatic Character of Arenes, Definition & Examples of Aromatic, Non-Aromatic, Anti-Aromatic Compounds (Benzenoids and Non-Benzenoids);

CO-3: learn structural determinations of Pyriodoxine and Thyroxine and their synthesis, General introduction, structural determination of Ribofllevin (Lactoflavin) & its Synthesis;

CO-4: study basic concept of Alkaloids, Occurrence and classification of Alkalodis, General methods of determine of their structure, Analytical and synthetic evidence to prove the structure of Nicotine and papavarine (B) Vitamins and Hormons: 5 Hrs General Introduction, Classification, Structural determinations and Synthesis of Pyridoxine, Vitamin – C, Thyroxine and Adrenalene;

CO-5: have general discussion about carbohydrates, definition of carbohydrates, classification of carbohydrates with example, introduction of disaccharide and poly saccharide, structure determination of maltose, lactose starch;

CO-6: introduce drugs, definition of drugs and ideal drugs, classification of drugs based on pharmacological or functions, important synthesis and uses of Amylnitrate, Chloroquine, Pyrimethamine, Sulpha Pyrimidine, Diazepam, Lidocaine, Chlorpropamide, Dapsone, Isoniazide, 5-Fluoro Uracil;

CO-7: define and study structures of Amino Acid (In Tabular Form) Synthesis of Merry Field Method, Sangers method, Edman method, N-terminal determination, C-terminal determination by generation of amino alcohol and using digestive enzymes. End group analysis, selective hydrolysis of peptides classical levels of protein structure, protein denaturation / renaturation.

Sem-V Paper-VIII: Physical Chemistry

At the end of the course student will be able to

CO-1: understand and explain partial molal free energy, derive from Gibb's Duhem equation, chemical potential in case of a system of ideal gases, concept of fugacity, fugacity function, fugacity at low pressures, physical significance of fugacity, graphical

method for determination of fugacity, Lewis fugacity rule, activity and activity coefficient, standard state of solid, liquid and gas, the Nernst heat theorem, its limitations, statement of the third law of thermodynamics, consequence of third law of thermodynamics, determination of absolute entropy of gases and liquids and solid, applications of third law of thermodynamics, concept of residual entropy, exceptions to the third law of thermodynamics, solve numerical problems related to fugacity, graphical method to determine fugacity and determination of absolute entropy;

CO-2: explain and discuss concept of Oxidation and Reduction, Electrochemical series, definition of half-cell and cell, single electrode potential, sign of electrode potential, standard electrode potential, Electrochemical process, Galvanic cell with example of Daniel cell, EMF of a cell and its measurements, Standard Weston cell, Different types of reversible electrodes, Determination of single electrode potential, Calculation of standard EMF of cell and Determination of cell reaction, Standard Hydrogen Electrode, Calomel electrode and Ag-AgCl electrode, Chemical and concentration cell, electrode and electrolyte concentration cell, liquid junction potential (LJP), salt bridge in elimination of LJP, concentration cell with and without transference, Free energy change and Electrical energy, Prediction of spontaneity of cell reaction, Relation of standard free energy change with equilibrium constant, Temperature coefficient of EMF of a cell, Entropy change and Enthalpy change of cell reaction. Solve numerical problems related to cell construction from electrochemical reaction, electrode potential, EMF of various types of cell, rate constant, LJP;

CO-3: Explain Stable and unstable isotopes, separation of isotopes by different methods, gaseous diffusion, thermal diffusion, distillation, chemical exchange methods, Bainbridge velocity focusing mass spectrograph, Dempster's direction focusing mass spectrograph, Different types of Particle accelerators e.g. Linear accelerator, Cyclotron, Discovery of artificial disintegration, Classification of nuclear reaction based on overall energy transformations and - particles used as projectiles, Merits and demerits of different projectiles, Numerical problems on Cyclotron.

Sem-V Paper-IX: Industrial Chemistry

At the end of course, students will able to

CO-1: (A) study manufacture with flowsheet & uses of Acrylonitrile (Sohio Process), Bisphenol-A, Styrene, Industrial manufacture and uses of Polyolifines: Poly ethylene (HDPE & LDPE) and Polypropylene **(B)** Nomenclature of chlorofluoro derivatives of Methane & Ethane, General Methods of Preparation, Properties, Usesof fluoro carbons;

CO-2: study manufacture of Freon-12 from fluorspar, Manufacture of freon-12 fromvinylidene fluoride;

CO-3: pollution hazard of Fluoro carbons;

CO-4: Metallurgy of different metals (occurrence, extraction, properties and uses: (1) Tungsten (2) Molybdenum (3) Titanium (4) Chromium (5) Aluminium;

CO-5: learn small scale preparation of (1) Safety matches (2) Naphthalene balls (3) Wax candles (4) Shoe polish (5) Writing/ fountain pen ink (6) Chalk crayons (7) Plaster of paris;

CO-6: define nitration, Nitrating agent, Reaction mechanism of Nitration. Nitration of acetylene, nitration of Benzene, Nitration of Naphthalene, Nitration of Toluene, Artificial perfumes: Musk xylene, Musk ketone, Musk ambrette. Explosives: Trinitrophenol, Trinitrotoluene, Trinitro glycerine, Emitol;

CO-7: define amination, Amination by reduction: Metal - Acid reduction (strong & weak), Metal - Alkali reduction (strong and weak), Catalytic reduction, Sulphide reduction. Amination by ammonolysis: Amination of chlorobenzene, Phenol & Benzene

Sulphonic acid, importance of amination in industry in the manufacture of Bismark brown dye from m-Phenylenediammine, Synthetic fibre (Nylon 6,6) from HMDA, Methyl Red Indicator from Anthranilic acid, Cyclonite explosive from Hexamethylenetetramine;

CO-8: define Sulphonation, methods of sulphonation, sulphonating agents, mechanism of sulphonation. Sulphonationof Benzene, Toluene, & Anthracene, Preparation of Phenol and Resorcinol from benzene, Importance of Sulponation reaction in industry in the manufacture of Saccharine, Chloramine T and Alizarine Red.

Sem-V Paper-X: Analytical Chemistry

At the end of course, students will able to

CO-1: get introduction to chemical and instrumental Analysis, advantages and disadvantages, Overview of methods used in Quantitative analysis, classification of classical and instrumental analysis, factors affecting the choice of Analytical Method (in brief), step in quantitative analysis (Flow diagram), Analytical methods on the basis of Sample size (in brief), Sampling methods. Sampling in different physical states;

CO-2: define and explain error, types of errors: determinates errors, indeterminate errors, constant and proportional errors, define and explain the following terms – accuracy and precision, mean, median, deviation, average deviation, standard deviation, variance, coefficient of variation, relative mean deviation, range, absolute errors, relative errors, minimization of determinates errors, normal error curve, rejection of result from a set of results, 2.5 d rule, 4.0 d rule and Q-test;

CO-3: study factors affecting solubility of precipitates: (1) common ion (2) diverse ions (3) pH (4) hydrolysis (5) complex formation, the precipitation process, nucleation growth, Von Weimarn's theory of relative super saturation. digestion of precipitates;

CO-4: factors affecting quality of precipitate: Co-precipitation and post precipitation, Precipitation from homogeneous solution with illustration of barium and aluminum; thermogravimetry, general principle, application with following two specific examples (1) $CaC_2O_4.H_2O$ (2) $MgC_2O_4.2H_2O$;

CO-5: calculate pH at different stages of titrations of monobasic and dibasic acid with strong base construction of titration curve, titration of carbonate mixture, numerical;

CO-6: explain EDTA titration, absolute and conditional stability constant, distribution of various species of EDTA as function of pH, absolute and conditional stability constants, derivation of factors: α_4 for effect of pH, β_4 for the effect of auxiliary complexing agent, construction of titration curves: theory of metallochromic indicators, masking, demasking and kinetic masking, types of EDTA titrations.

Sem-V Paper-XI: General Chemistry

At the end of course, students will able to

CO-1: define spectroscopy, wavelength, frequency of radiation, wave number.

CO-2: classify spectroscopy atomic and molecular spectroscopy, different region of IR radiation.

CO-3: describe instrumentation of IR spectroscopy, preparation of sample for IR spectroscopy, stretching vibration of different molecule.

CO-4: explain effect of IR radiation on matter, factors affecting on absorption frequencies.

CO-5: calculate estimated absorption frequencies for various functional groups.

CO-6: understand laboratory hygiene and safety, handling of chemicals, general procedure foravoiding accidents, first aid techniques;

CO-7: understand Colour codes and symbols for safety in chemical plants, codes for gas cylinders and colour codes for pipelines

CO-8: general study including preparation and uses of the Chemistry of cosmetics and perfumes including Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavors. Essential oils

CO-9: define terms: solute, solvent, and solution composition of solution-normal solution, molar solution, molal solution, mole fraction, % solution, saturated, unsaturated and supersaturated solution and solubility, effect of temperature on various units of concentration, interconversion of one unit into another unit, preparation of solutions of some primary standard substances, standardization of the solution using primary standard solutions/standardized solution.

Sem-V: Petrochemicals

At the end of course, students will able to

CO-1: source of petrochemicals, natural gas: composition, natural gas as petro-chemical feed stock, crude oil: composition, distillation, and refining, utilization of various fractions;

CO-2: classify petrochemicals, first, second and third generation petrochemicals, conversion process: cracking reforming, isomerisation, hydrogenation, alkylation and hydrodealkylation, dehydrocyclisation of petroleum products, polymerization of gaseous hydrocarbons;

CO-3: study Petrochemicals obtained from C_1 cut of petroleum manufacture and application of methanol, synthesis gas, ammonia, HCN, formaldehyde, hexamethylenetetramine, chlorinated methanes, per chloroethelene;

CO-4: Synthesis and uses of H-acid, J-acid, Neville Winther'sacid, DASDA Procian Red dye, Cellitone scarlet-B, Indanthrene Khakhi GG, Blankophor B, Sulphamylon, Chloramphenicol;

CO-5: Industrial fuels, Natural fuels, synthetic fuels, hydrogen fuel of tomorrow, fuel for rocket, Intermediates of Pharmaceuticals and Dyes;

CO-6: Petrochemicals obtained from C_2 cut of petroleum, Manufacture and industrial applications of chemicals obtained from ethylene: ethanol, acetaldehyde, ethylene oxide, ethylene glycol, ethanolamines, acrylonitrile, styrene, vinyl acetate, Manufacture and industrial application of chemicals obtained from acetylene, acrylic acid, acrylonitrile, vinylchloride ,vinylacetate, acetaldehyde, chloroprene, trichloethylene, methyl vinyl ether;

CO-7: General account of petrochemicals used as monomers in the manufacture of nylon –6, nylon–6-6, nylon –6-10, nylon –12 and nylon –8-6 fibers, industrial production of caprolactum, HMDA, adipic acid, sabecic acid, lauryl lactum.

Sem-V: Chemistry Practical

At the end of course, students will able to

CO-1: study and justify kinetics of 2^{nd} order reactions practically;

CO-2: study precipitation titration, mix acid titration using conductivity meter;

CO-3: determine degree of dissociation and dissociation constant of weak monobasic acid using pH metry;

CO-4: determine solubility and solubility product of sparingly soluble salt using potentiometry;

CO-5: study angle of rotation as well as specific rotation of optically polar substances using polarimeter;

CO-6: maintain records of chemical and instrumental analysis. Develop laboratory skills for the purpose of collecting, interpreting, analyzing, practical data;

CO-7: develop laboratory skills for the purpose handling different instruments, interpretation of results of experiments and their correlation with theory;
CO-8: get training in the quantitative analysis using gravimetric method;
CO-9: develop skills required for the qualitative analysis of organic mixture.

Sem-VI Paper-VI: Inorganic Chemistry

At the end of course, students will able to

CO-1: define symmetry, symmetry elements, symmetry operations;
CO-2: enlist symmetry elements, types of planes;
CO-3: define point group, Classification of molecules into point- groups, point – group of different molecules;
CO-4: study basic properties of a group theory;
CO-5: derive the multiplication table for C_{2v}, C_{3v} and C_{2h} point group;
CO-6: understand reaction mechanisms of ligand substitution in octahedral complexes (i) SN_1 (ii) SN_2 Acid hydrolysis and Base hydrolysis-Redox (Single Electron Transfer) reactions;
CO-7: define of hybridization Bond angles in sp, sp^2 and sp^3 hybrid orbital using wave function;
CO-8: study water pollution: types of water pollutants, trace elements in water and their effects; Determination of BOD, COD, DO, Total hardness, Total dissolved solids, Ozone treatment process for waste water;
CO-9: define, classify learn the structure and bonding in ferrocene, dibenzene chromium, Zeise ion and gaseous dimethyl beryllium, Tetramethyl Lead.

Sem-VI Paper-VII: Organic Chemistry

At the end of course, students will able to

CO-1: have basic concept of green chemistry, fundamental principle of green chemistry, green chemistry examples, green synthesis of important compounds
CO-2: have general discussion on polymers, definition of polymer, and classification of polymer with example, introduction of various type of polymerization, some important method of polymerization;
CO-3: study various types of resin phenol- formaldehyde resin, urea-formaldehyde resin, epoxy resin, natural and synthetic rubbers;
CO-4: understand pigments, classification of pigments;
CO-5: have general introduction of careteniods, analytical and synthetic evidence of β-carotene;
CO-6: get general introduction of anthocyanines and anthocyanidines analytical and synthetic evidence of Cyandine chloride;
CO-7: have an introduction of flavones and flavonols analytical and synthetic evidence of quercetin;
CO-8: learn conformation, conformational analysis, conformations of ethane, Butane and Cyclohexane. Conformational analysis of cyclohexane. Axial and equatorial Hydrogen in cyclohexane. Stability of monosubstituted cyclohexane;
CO-9: have general discussion about dyes, definition of dyes and pigments;
CO-10: discuss color and constitution – Witt's theory difference between dyes and pigments;
CO-11: classify dyes with example, introduction of various types of dyes;
CO-12: study mechanism of rearrangements involving C to C migrations as illustrated by Wagner – Meerwein and Pinocol-Pinacolone rearrangements;
CO-13: study mechanism of rearrangements involving C to N migrations as illustrated by Hoffmann, Curtius, and Beckmann rearrangements.

Sem-VI Paper-VIII: Physical Chemistry

At the end of course, students will able to

CO-1: discuss application of radio isotopes as tracers in medicines, agriculture, in studying reaction mechanism in photosynthesis and age determination by Carbon- Dating method, Q-value of nuclear reactions, chemical and physical atomic weight scale, mass defect and binding energy, packing fraction and its relation with the stability of the nucleus, nuclear fission, atom bomb, nuclear reactor for power generation and critical mass, stellar energy and hydrogen bomb, hazards of nuclear radiation, numerical problems on Q-value, binding energy, packing fraction, and energy released during nuclear reactions;

CO-2: apply EMF measurements in the determination of (1) solubility product and solubility of sparingly soluble salts (2) ionic product of water by galvanic cell (3) transport number of ions (4) equilibrium constant (5) pH by hydrogen, glass and quinhydrone electrodes, solve numerical based on above applications to determine solubility, solubility product, ionic product of water, equilibrium constant, transport number and pH of solution, have detail information on energy sources like Ni-Cd Cell and Li- ion cell;

CO-3: discuss statement and meaning of the terms phase, component, degree of freedom, phase rule, phase equilibria of one component system like water, CO_2, sulphur system, phase equilibria of two component system like Pb-Ag systems, KI- Water system, desilverisation of lead, basics freezing mixtures and Definition of solid solutions with congruent and incongruent melting point using example;

CO-4: explain liquid-liquid mixtures, ideal liquid mixtures, Raoult's law, non-ideal or real solutions, positive and negative deviations from Raoult's law, temperature composition curves for ideal and non-ideal binary solutions of miscible liquids, azeotropes, partially miscible liquids explained using phenol-water systems, immiscible liquids, steam distillation, solve numerical problems related to this topic.

Sem-VI Paper-IX: Industrial Chemistry

At the end of course, students will able to

CO-1: understand pulp and paper industry, type of pulp, manufacture of chemical pulp and mechanical pulp;

CO-2: study manufacture of paper (conversion of pulp into paper, beating process, importance of fillings, sizing, colouring materials in manufacture of paper and calendaring);

CO-3: understand principles of detergency;

CO-4: classify of surface active agents, anionic detergents, cationic detergents, non-ionic detergents, amphoteric detergents, suds regulators, builders additives.

CO-5: get introduction, manufacture of sugar from sugarcane;

CO-6: study extraction of juice, purification of juice, concentration and crystallisation of purified juice, refining of sugar;

CO-7: define fermentation and fermentation process with example pH, temperature and substance;

CO-8: study various type compounds like ethanol, citric acid, acetone and penicillin –G manufacture and flow chart with uses;

CO-9: define insecticide type of insecticides, inorganic, organic, synthetic and natural insecticides, manufacture and uses of various type of compound like eldrin, dieldrin, BHC, TEPP;

CO-10: define of fungisides, bordex mixture, dithio carbamates, baygon, termik zineb

CO-11: study manufacture and uses of various compounds like methanol from synthesis gas, isopropanol from propylene, acetone from isopropanol, formaldehyde from methanol by oxidation dehydration method, acetylene from natural gas.

Sem-VI Paper-X: Analytical Chemistry

At the end of course, students will able to

CO-1: explain components of spectrophotometer –sources, grating and prism as dispersing device, sample handling, detectors – photo tub e, photomultiplier tube, block diagram and working of single beam and double beam spectro-photometer, terms involved in beer's law, causes of deviation from beer's law, analysis of unknown by calibration curves method, standard addition method, and ratio method, determination of Cu^{+2}, Fe^{+3}, NO_2^{-1} using spectrophotometer, problems based on quantitative analysis;

CO-2: Discuss classification of chromatography. Principles of GC separation. Components of GC, Sample introduction system, Columns: Packed column Capillary Column (WCOT, SCOT), Carrier gas and its selection - stationary phases: solid adsorbents, inert supports (selection criteria, diatomaceous earths,) and liquid stationary phases, detectors: FID, TCD. Qualitative and quantitative analysis using GC;

CO-3: know the limitation of conventional liquid chromatography, technique of HPLC, elementary idea about technique and layout diagrams of instrument, components of instrument of HPLC technique, elementary idea of TLC;

CO-4: study titrations involving Silver salts, detection of end points by Mohr's method, Volhard's method, adsorption indicators, construction of titration curves;

CO-5: study construction of titration curves for titration of Fe^{+2} and Ce^{+4}, explain types of indicator and theory of redox indicator, know about oxidants – $KMnO_4$, $K_2Cr_2O_7$, reductants – sodium thiosulphate, sodium arsenite and problems.

Sem-VI Paper-XI: General Chemistry

At the end of course, students will able to

CO-1: define adulteration;

CO-2: understand different types of adulteration, techniques of adulteration, methods of detection of different adulterants in some common food items like milk, milk products, oil and fats, food grains and their products, spices and miscellaneous product , hazardous effect of adulteration of human, consumer's rights and some legal procedures;

CO-3: realize their social responsibility and inspire to think its solution on a student of chemistry;

CO-4: study nano-particles, properties of nano-particles, semiconductors, ceramic nano-particles, catalytic aspects of nano-particles, carbon nano-tubes, applications of nano particles;

CO-5: study different types of pollutions such as: (1) gaseous pollution in air, acid rain, green house effect and ozone depletion, (2) radiation pollution cause, effect and control, (3) noise pollution and their effect and control, (4) oil pollution and their control;

CO-6: study Nuclear Magnetic Resonance Spectroscopy–Proton Magnetic Resonance (^1H NMR) Spectroscopy - nuclear shielding and deshielding – chemical shift and molecule structure, spin-spin splitting and coupling constants – areas of signals – interpretation of NMR spectra of simple organic molecule such as ethyl bromide, acetaldehyde, 1,1,2-tribromoethane, ethylacetate, toluene, acetophenone, nitrobenzene, cyclopropane, isomers of pentane and hexane.

Sem-VI: Petrochemicals

At the end of course, students will able to

CO-1: petrochemicals obtained from C_3-cut of petroleum, manufacture and industrial applications of chemicals obtained from propylene: iso propyl alcohol, acetone, propylene oxide, acrylonitrile, glycerol and isoprene, propylene tetramer, acrylic acid, n-butyraldehyde, methyl isobutyl ketone, acrolein, acrylamide, methyl methacrylate;

CO-2: have general account of petrochemicals used as monomers in the manufacture of polyester fibers, manufacture of DMT, terphthalic acid, phthalic anhydride, maleic anhydride, 1:4 butanediol and other monomers like penta erithritol and di-isocyanates;

CO-3: study method for the large scale production with flow diagram and uses of: (i) acetoacetanilide (ii) anthraquinone (iii) β-naphthol from naphthalene (iv) Bon acid (v) aspirin (vi) chloramphenicol (vii) paracetamol (viii) p-amino phenol (ix) saccharin (x) 2,4-D acid;

CO-4: define synthetic detergents, hard and soft detergents, synthesis of DDBS, basic petrochemical raw materials for organic dyes, dyes derived from these raw materials with uses, synthesis of fluoresein, malachite green, chrysoidine and indigo, definition of explosive, list of basic raw materials for explosives and list of explosives derives from these raw materials, synthesis of tetryl, PETN and dynamite;

CO-5: define insecticides, classification of insecticides on basis of mode of action. Synthesis of Methoxychlor, Captan, Parathion, Malathion and Perthane;

CO-6: study chemicals obtained from C4 and C5 cut of petroleum, manufacture and industrial applications of butadiene, butylalcohols, methyl terbutyl ether (MTBE) cyclopentadiene, sulpholane;

CO-7: study recovery process of BTX, manufacture and industrial applications of benzene, toluene, xylene, naphthalene, phenol, styrene, aniline, maleic anhydride, cyclohexanol.

Sem-VI: Chemistry Practical:

At the end of course, students will able to

CO-1: study and justify kinetics of 2^{nd} order reactions practically;

CO-2: determine quantity of active ingredient in commercial product [Vanila] using conductometric principles and conductometric titration;

CO-3: determine degree of dissociation and dissociation constant of weak monobasic acid by titration method using pH metry;

CO-4: verify Lambert-Beer law for colored solution using colorimeter/ spectro-photometer;

CO-5: determine normality and amount of given acid in mixture using conductivity meter;

CO-6: maintain records of chemical and instrumental analysis, develop laboratory skills for the purpose of collecting, interpreting, analyzing, practical data;

CO-7: develop laboratory skills for the purpose handling different instruments, interprete of results of experiments and their correlation with theory;

CO-8: get knowledge of Systematic qualitative analysis of Inorganic mixtures.

Bachelor of Science (Mathematics)

Name of Program	**Bachelor of Science (Mathematics)**
Abbreviation	**B.Sc.- Mathematics**
Duration	**3 Years**
Eligibility Criteria	Passed 12^{th} Science with mathematics or equivalent Degree.
Objective of Program	The core objective of the B.Sc. in Mathematics is to prepare the students for productive career by providing a solid education in the basic subjects of mathematical knowledge and its applications with outstanding environment of teaching and research in the core and emerging areas of the discipline.
Program Outcome	**PO1 : Fundamental Knowledge Enrichment** Program trains students with the core Mathematics knowledge domains. It also makes students capable of using core concepts in the conceptualization of domain specific application. **PO2 : Critical Thinking Development** The program develops the skills of critical thinking, problem solving, evaluative learning of various techniques, and understanding the essence of the problem. **PO3 : Develop arguments in a logical manner** The program trains students to formulate and develop arguments in a logical manner and make them ready to prepare real world problem solution mathematically. **PO4 : Develop decision making ability** The program develop the skill in students to take decisions at intellectual, organizational and personal from different perspectives of life using analysis **PO5 : Computational Skill Development** The program develop basic computational skill in students for planning and managing process of complex real world. **PO6 : Provides an effective Mathematical communication skill** The program develop an effective Mathematical communication skill in the students. **PO7 : Team Work and Leadership Development** Trains students to work in a team and also to take leadership.
Program Specific Outcomes	PSO1 : Develop and strengthen the fundamental core concepts that are required to solve complex problems PSO2 : Develop the skills that needs independent logical and analytical thinking, teamwork and leadership PSO3 : Nurture the students to investigate and development of a workable solution for a real world problem PSO4 : Develop students for self-learning and practicing challenging problem solution PSO5 : Train students to apply mathematical skills for new investigation. PSO6 : Train students to expand their knowledge of fields related to their current areas of professional specialization. PSO7 : Train students to take-up the real world challenges to develop workable solution to a domain specific problem.

	PSO8 : Inculcate the passion for continuous learning and doing research for making a successful professional career.

Mapping between POs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
PO1								
PO2								
PO3								
PO4								
PO5								
PO6								
PO7								

Medium of Instruction	English
Program Structure	Semester 1

Course Code	Title	Teaching per week		Course Credits	University Examination		Internal Marks	Total Marks
		Theory	Practical		Duration	Marks		
MTH-101	Mathematics-I	3	0	3	2Hrs	50	20	70
MTH-102	Mathematics-II	3	0	3	2Hrs	50	20	70
	Total	6	0	6				

Program Structure	Semester 2

Course Code	Title	Teaching per week		Course Credits	University Examination		Internal Marks	Total Marks
		Theory	Practical		Duration	Marks		
MTH-201	Mathematics-III	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
MTH-202	Mathematics-IV	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
	Total	6	0	6				

Program Structure	Semester 3

Course Code	Title	Teaching per week		Course Credits	University Examination		Internal Marks	Total Marks
		Theory	Practical		Duration	Marks		
MTH-301	Mathematics-V	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
MTH-302	Mathematics-VI	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
MTH-303	Mathematics-VII	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
E.G.	3001-MathematicalMethods	**2**	**0**	**2**	**2Hrs**	**50**	**20**	**70**
	3002-	**2**	**0**	**2**	**2Hrs**	**50**	**20**	**70**

	GroupofSymmetries–I							
	Total	11	0	11				

Program Structure	Semester 4

Course Code	Title	Teaching per week		Course Credits	University Examination		Internal Marks	Total Marks
		Theory	Practical		Duration	Marks		
MTH-401	Mathematics-VIII	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
MTH-402	Mathematics-IX	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
MTH-403	Mathematics-X	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
E.G.	4001-MathematicalModeling	**2**	**0**	**2**	**2Hrs**	**50**	**20**	**70**
	4002-GroupofSymmetries–II	**2**	**0**	**2**	**2Hrs**	**50**	**20**	**70**
	Total	**11**	**0**	**11**				

Program Structure	Semester 5

Course Code	Title	Teaching per week		Course Credits	University Examination		Internal Marks	Total Marks
		Theory	Practical		Duration	Marks		
MTH-501	GroupTheory	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
MTH-502	LinearAlgebra-I	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
MTH-503	RealAnalysis-I	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
MTH-504	RealAnalysis-II	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
MTH-505	GraphTheory	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
MTH-506	NumberTheory-I	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
E.G.	5001-OperationsResearch– I	**2**	**0**	**2**	**2Hrs**	**50**	**20**	**70**
	5002-ComputerOrientedNumericalMethods–I	**2**	**0**	**2**	**2Hrs**	**50**	**20**	**70**
	5003-Fourier	**2**	**0**	**2**	**2Hrs**	**50**	**20**	

	Series							70
	Total	**20**	**0**	**20**				

Program Structure	Semester 6

Course Code	Title	Teaching per week		Course Credits	University Examination		Internal Marks	Total Marks
		Theory	Practical		Duration	Marks		
MTH-601	RingTheory	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
MTH-602	LinearAlgebra–II	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
MTH-603	RealAnalysis–III	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
MTH-604	RealAnalysis–IV	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
MTH-605	DiscreteMathematics	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
MTH-606	NumberTheory–II	**3**	**0**	**3**	**2Hrs**	**50**	**20**	**70**
E.G.	6001-OperationsResearch– II	**2**	**0**	**2**	**2Hrs**	**50**	**20**	**70**
	6002-ComputerOriented NumericalMethods –II	**2**	**0**	**2**	**2Hrs**	**50**	**20**	**70**
	6003-FourierTransformanditsApplications	**2**	**0**	**2**	**2Hrs**	**50**	**20**	**70**
	Total	**20**	**0**	**20**				

B.Sc. - Mathematics 1st Semester

Course: MTH-101: **Mathematics-I**

Course Code	**MTH-101**
Course Title	Mathematics-1
Credit	3
Teaching per Week	3 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June2020
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the concepts of Trigonometry .
Course Objective	To make students acquainted with concepts of Trigonometry

Course Outcomes	This course will enable the students to: CO1 : Explain the insight of the fundamental aspects of the Trigonometry . CO2 : Assimilate the De' Moivre's theorem and its applications, Trigonometric functions for multiple arguments. CO3 : Calculate the Indeterminate forms by using Euler's expressions, Hyperbolic functions.. CO4 : Understand the Logarithm of complex quantities, Separations of Logarithmic, Inverse circular and Inverse hyperbolic functions into real and imaginary parts. CO5 : Sketch curves in Trigonometric and hyperbolic functions. CO6 : Apply Trigonometry in social sciences, physical sciences, life sciences and a host of other disciplines
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Pre-requisite	Basics of Mathematics
Course Content	Unit –I De' Moivre's theorem and its applications, Trigonometric functions for multiple arguments. Unit-II Euler's expressions, Evaluation of Indeterminate forms by using Euler's expressions, Hyperbolic functions for real arguments and their inverses. Unit-III Exponential, Circular and Hyperbolic functions of complex variables and their identities, Euler's Theorem, Relations between circular and Hyperbolic functions. Unit-IV Logarithm of complex quantities, Separations of Logarithmic, Inverse circular and Inverse hyperbolic functions into real and imaginary parts.
Reference Books	1. S. L. Loney: Plane Trigonometry, Part I and II, McMillan and Co. London. 2. R. S. Verma, K. S. Shukla: Text book of Trigonometry, Pothishala Pvt. Ltd. Allahabad. 3. E. Kreyszig: Advanced Engineering Mathematics, Wiley India Pvt. Ltd. 4. N.P.Bhamore and et al: College AadhunikGanitshastra, Popular Prakashan, Surat
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. - Mathematics 1st Semester

Course: MTH-102: **Mathematics-II**

Course Code	**MTH-102**
Course Title	Mathematics-2

<table>
<tr><td>Credit</td><td>3</td></tr>
<tr><td>Teaching per Week</td><td>3 Hrs</td></tr>
<tr><td>Minimum weeks per Semester</td><td>15 (Including Class work, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective From</td><td>June 2020</td></tr>
<tr><td>Purpose of Course</td><td>The purpose of the course is to make the student capable to understand and implement the conceptscalculusofand learn its applications.</td></tr>
<tr><td>Course Objective</td><td>To make students acquainted with concepts of calculus.</td></tr>
<tr><td>Course Outcomes</td><td>This course will enable the students to
CO1 : Explain the insight of the historical and fundamental aspects the Calculus.
CO2 : Assimilate the Successive differentiation, Leibnitz theorem and its applications
CO3 : Understand the consequences of various mean value theorems for differentiable functions , Asymptotes, Concavity, Convexity and reduction function.
CO4 : Calculate the Curvature and radius of curvature.
CO5 : Apply concept of Increasing and Decreasing functions, Asymptotes, Concavity and Convexity
CO6 : Apply calculus in social sciences, physical sciences, life sciences and a host of other disciplines</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th><th>PSO7</th><th>PSO8</th></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Mathematics</td></tr>
<tr><td>Course Content</td><td>Unit –I
Successive differentiation, Calculation of n^{th} derivatives of some standard functions (rational functions and powers of sine, cosine functions), Leibnitz theorem and its applications

Unit-II
Rolle’s Theorems and its geometrical interpretation, Lagrange’s Theorem and its geometrical interpretation, Cauchy theorem, Maclaurin and Taylor series expansions

Unit-III
Curvature and radius of curvature (except Polar form), Increasing and Decreasing functions, Asymptotes, Concavity and Convexity

Unit-IV
Reduction formulae for integration of
$sin^n x, cos^n x, tan^n x, cot^n x, sec^n x, cosec^n x, sin^p x cos^q x, x^m cosnx, x^m sinnx.$</td></tr>
<tr><td>Reference Books</td><td>1. Shantinarayan: Differential Calculus, Revised EditionDecember-2004 , S. Chand and Co. New Delhi.
2. Shantinarayan: Integral Calculus, S. Chand and Co. New Delhi.
3. Gorakhprasad: Differential Calculus, Pothishala Pvt. Ltd. Allahabad.
4. M. R. Spigel: Theory and Problems of Advanced Calculus, Schaum’s Publishing Co., New York.
5. N. P. Bhamore and et al: College AadhunikGanitshastra, Popular Prakashan, Surat.</td></tr>
</table>

Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. - Mathematics 2nd Semester

Course: MTH-201: **Mathematics-III**

Course Code	**MTH-201**
Course Title	Mathematics-III
Credit	3
Teaching per Week	3 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2020
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the theory of matrices with its applications.
Course Objective	To make students acquainted with concepts of Theory of matrices.
Course Outcomes	This course will enable the students to: CO1 : Explain the insight of fundamental aspects the theory of matrices. CO2 : Understand the genesis of theory of matrices.. CO3 : Learn elementary raw operations, rank theory and matrix properties. CO4 : Find eigen values and corresponding eigenvectors for a square matrix. CO5 : Calculate solution of linear system of equation. CO6 : Apply matrix theory in social sciences, physical sciences, life sciences and a host of other disciplines.
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	■							
CO2	■	■	■	■				
CO3	■	■	■	■	■			
CO4	■	■	■	■	■			■
CO5	■	■	■		■	■	■	
CO6	■	■		■		■	■	

Pre-requisite	Basics of Matrices
Course Content	Unit-I Different types of matrices, Operation on matrieces, Properties of operation of matrices, Elementary row operations. Unit-II Row-reduced echelon forms. Inverse of matrix by Row-Reduced Echelon form, Row rank of a matrix, Quadratic form. Unit-III Trace of matrix and its properties, Solution of homogeneous system of linear equations using row –reduced echelon forms. Unit-IV Characteristic equation of a matrix, Method to find Characteristic equation using determinant and minors of a matrix, Eigen values and Eigen vectors of a matrix, Cayley-

	Hamilton theorem and its application to find an inverse of a matrix, Method of diagonalization.
Reference Books	1. Krishnamurthy, Mainra and Arora: An Introduction to linear Algebra, Affiliated West Press Pvt. Ltd., New Delhi. 2. Erwin Kreyszig: Advanced Engineering Mathematics, Wiley India (P) Ltd., 2009. 3. B.S.Vasta and SuchiVasta: Theory of Matrices; 4rd Edition -2014, New Age International (P) Ltd. Publishers, New Delhi. 4. Shantinarayan: Text book of Matrices, S. Chand and Co., New Delhi. 5. H. K. Dass, H. C. Saxena, M. D. Raisinghania: Simplified course in Matrices, S. Chand and Co., NewDelhi. 6. N.P.Bhamore and et al: College AadhunikGanitshastra, Popular Prakashan, Surat.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 2nd Semester

Course: MTH-202: **Mathematics-IV**

Course Code	**MTH-202**
Course Title	Mathematics-IV
Credit	3
Teaching per Week	3 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2020
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the Integral Calculus and Differential Equation.
Course Objective	The purpose of the course is to make the student capable to understand and implement the Integral Calculus and Differential Equation.
Course Outcomes	The course will enable the students to: CO1 : Understand the genesis of Integral Calculus and ordinary differential equations. CO2: Sketch curves in Cartesian coordinate systems. CO3 :To solve first order first degree and first order higher degree differential equation. CO4 : Grasp the concept of a general solution of a higher order linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations. CO5: To solve initial and boundary value problem. CO6 : Apply Integral Calculus and Differential Equations in social sciences, physical sciences, life sciences and a host of other disciplines

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	■		■					■
CO2	■	■	■		■			
CO3	■	■	■	■	■			
CO4	■	■	■	■	■	■	■	■
CO5	■	■	■		■			
CO6		■	■	■	■	■	■	■

Pre-requisite	Basics of Derivative
Course Content	Unit-I Curve Tracing : Equation of the form $y = f(x)$,Equation of the form $y^2 = f(x)$,Parametric equations, Tracing of Polar curves. Unit-II Application of Integral calculus: Length of a curve, Intrinsic equation (except polar coordinates). Unit:III Bernoulli's equation, Exact differential equation, Differential equations of first order and higher degree : Solvable for x, y, p and Lagrange's equation, Clairaut's equation. Unit-IV Linear Differential Equations with constant coefficients: Complimentary functions, Particular Integral, General Solution, Method for finding Particular Integral specially for e^{ax}, $\sin ax, \cos ax$, polynomial in terms of x, $e^{ax}V$ and xV, where V is a function of x.
Reference Books	1. 1.Shantinarayan : Differential calculus ,4th edition -2001,Shyamlal Charitable Trust,Ramnagar New Delhi, S. Chand and Company LTD. 2. Shantinarayan: Integral Calculus, Revised Edition-2009, S.Chand and Co., New Delhi. 3. Gorakhprasad: Integral Calculus, PothishalaPvt.Ltd., Allahabad. 4. D.A.Murray: Differential Equations, Tata Mc Graw Hills. 5. Frank Ayres: Theory and problems on Differential Equations, Mc Graw Hill Book Co., New York. 6. N.P.Bhamore and et al: College AadhunikGanitshastra, Popular Prakashan, Surat.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 3nd Semester

Course: MTH-301: **Mathematics-V**

Course Code	**MTH-301**
Course Title	Mathematics-V
Credit	3
Teaching per Week	3 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2021
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the function of two variable and their calculus.
Course Objective	To make students acquainted with concepts of the function of two variable and their calculus.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the function of two variable and their calculus. CO2 :Find the Limits and Continuity of a function of two variables, Partial Differentiation. CO3 :Calculate Jacobian as well as Maxima and Minima for function of two variable.

	CO4 :Find vectorGradient, Divergence and Curl. CO5 : Apply multivariable calculus to solve function of two variable problems. CO6 : Apply function of two variable and vector calculus in social sciences, physical sciences, life sciences and a host of other disciplines
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Pre-requisite	Basics of calculus
Course Content	Unit I: Limits and Continuity of a function of two variables, Partial Differentiation, Total Differential, Composite function, Homogeneous functions. Unit II: Euler's theorem for Homogeneous functions, Taylor's theorem for functions of two variables, Maclaurian's expansions in power series, Jacobian. Unit III: Maxima-Minima for functions of two variables: Necessary and sufficient conditions for extreme points. Unit IV: Vector point function, Differentiation of a Vector point function, Gradient, Divergence and Curl and their properties, Line Integral.
Reference Books	1. Shantinarayan, P. K. Mittal : A course of Mathematical Analysis, S. Chand and Co., New Delhi. 2. Hari Kishan : Vector Algebra and Calculus, Atlantic Pub. & Distributors(P) Ltd., New Delhi. 3. T. M. Apostol : Mathematical Analysis, Narosa Publishing House, New Delhi. 4. S. C. Malik : Mathematical Analysis, Wiley-Eastern Ltd, New Delhi. 5. N. P. Bhamore& et el : Mathematics Paper III–IV, Popular Prakashan, Surat
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 3nd Semester

Course: MTH-302: **Mathematics-VI**

Course Code	**MTH-302**
Course Title	Mathematics-VI
Credit	3
Teaching per Week	3 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)

Effective From	June 2021
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the concepts of basics of numerical methods and its applications.
Course Objective	To make students acquainted with concepts of numerical methods
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the numerical analysis. CO2 :Recognize the errors and their numerical computation CO3 : Obtain numerical solutions of algebraic and transcendental equations. CO4 : Learn about various interpolating and extrapolating methods. CO5 : predict future trend by interpolating and extrapolating methods. CO6 : Apply numerical analysis in social sciences, physical sciences, life sciences and a host of other disciplines
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Pre-requisite	Basics of Mathematics
Course Content	Unit I: Error estimation: Errors and their computations, A general error formula. Unit II: Numerical Solutions of Algebraic and Transcendental Equations: Bisection Method, Method of False position, Iteration Method, Newton-Raphson's Method. Unit III: Forward Differences, Backward Differences, Central Differences, Symbolic relation and separation of symbols, Differences of Polynomials. Unit IV: Newton's Forward and Backward Formulae, Gauss' Interpolation formulae.
Reference Books	1. S. S. Sastry : Introductory methods of Numerical Analysis, Prentice-Hall of India Pvt. Ltd.; 5th Edition. 2. M. K. Jain, Iyenger, Jain : Numerical Methods for Scientific and Engineering Computations, New Age International Ltd. 3. Goel, Mittal : Numerical Analysis, PragatiPrakashan, Meerut. 4. Kaiser A. Kunz : Numerical Analysis, Mc Graw Hill Book Co., London. 5. James I. Buchanan, Peter R. Turner : Numerical Methods and Analysis, Mc Graw Hill Book Co., London. 6. P. C. Biswal:NumericalAnalysis,Prentice-HallofIndia, 2008. 7. H. C. Saxena: Finite Differences and Numerical Analysis, S. Chandand Co., 2005.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 3nd Semester

Course: MTH-303: **Mathematics-VII**

Course Code	**MTH-303**
Course Title	Mathematics- VII
Credit	3
Teaching per Week	3 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2021
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the higher order differential equation and basics of partial differential equation.
Course Objective	To make students acquainted with concepts of higher order differential equation and basics of partial differential equation.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the Linear Differential Equations with variable coefficients. CO2 :Find solution ofSecond order Differential Equations CO3 : Learn about Formation of Partial Differential Equation. CO4 : Solve Partial Differential Equations by direct integral methods. CO5 : Obtain solution Nonlinear Partial Differential Equations of first order. CO6 : Apply differential equation in social sciences, physical sciences, life sciences and a host of other disciplines
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Pre-requisite	Basics of ordinary differential equation and partial derivative
Course Content	Unit I: Linear Differential Equations with variable coefficients, Homogeneous Differential Equations, Legendre's Differential Equation. Unit II: Second order Differential Equations: Solution in terms of known Integral, Solution by method of removal of first order derivatives, Method of Changing Independent Variable. Unit III: Formation of Partial Differential Equation, Solution of Partial Differential Equations, Equations solvable by direct integral. Unit IV: Partial Differential Equations of first order, Nonlinear Partial Differential Equations of first order, Some special methods.
Reference Books	1. D. A. Murray: An Introductory Course in Differential Equations, Orient

	Longmans, Bombay. 2. N. Sneddon: Elements of Partial Differential Equations, McGraw Hill Book Company. 3. B. S. Grewal: Higher Engineering Mathematics, Khanna Publishers, New Delhi. 4. Gorakhprasad : Differential Equations, Pothishala Pvt. Ltd., Allahabad. 5. M. D. Rai Singhania : Differential Equations, S. Chand & Co., New Delhi. 6. Nita H. Shah : Ordinary and Partial Differential Equations : Theory and Applications, PHI Learning Pvt. Ltd, New Delhi. 7. N. P. Bhamore& et el. : Mathematics Paper III–IV, Popular Prakashan, Surat.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 3nd Semester

Course: E.G.-3001: Mathematical Methods

Course Code	**E.G.-3001**
Course Title	**Mathematical Methods**
Credit	2
Teaching per Week	2 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2021
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the difference method
Course Objective	To make students acquainted with concepts of Mathematical difference Method.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the difference calculus. CO2 :Find Finite difference and Method of unknown coefficients CO3 : Learn about Difference equation. CO4 : Solve problem of Difference equation. CO5 : Obtain solution of Homogeneous difference equations with constant coefficients. CO6 : Apply difference calculus in social sciences, physical sciences, life sciences and a host of other disciplines

Mapping between COs with PSOs

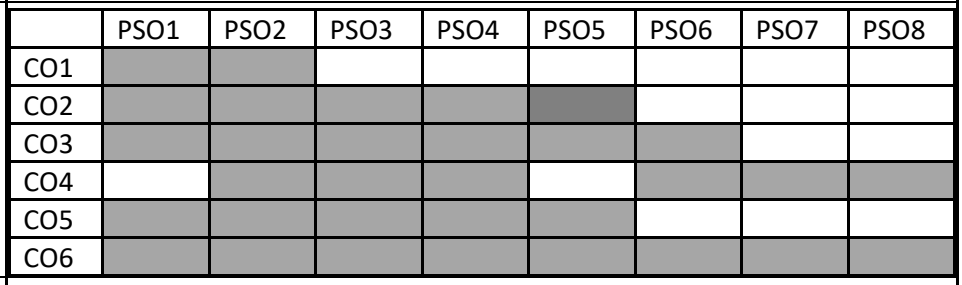
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Pre-requisite	Basics of Mathematics
Course Content	Unit I: Notations of finite difference calculus, Operators E, Δ , Relations between different operators and their prosperities, Relation between difference and differential operators, Method of constructing difference tables, Finding the missing terms. Unit II: Factorial notation, Expression of polynomials in factorial notation by using finite differences, Method of unknown coefficients. Unit III: Difference equations: Order and degree of a difference equation, Solution of difference equations, Homogeneous difference equations with constant coefficients.
Reference Books	1. S.S. Sastry : Introductory methods of Numerical Analysis, Prentice-Hall of India Pvt. Ltd.; 4th Edition. 2. M. K. Jain, Iyenger, Jain: Numerical Methods for Scientific and Engineering Computations, New Age International Ltd. 3. Goel, Mittal : Numerical Analysis, PragatiPrakashan, Meerut. 4. Kaiser A. Kunz : Numerical Analysis, McGraw Hill Book Co., London. 5. James I. Buchanan, Peter R. Turner : Numerical Methods & Analysis, McGraw Hill Book Co., London.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 3nd Semester

Course: E.G.-3002: Group of Symmetries-I

Course Code	**E.G.-3002**
Course Title	**Group of Symmetries-I**
Credit	2
Teaching per Week	2 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2021
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the Group of Symmetries.
Course Objective	To make students acquainted with concepts of Artificial Intelligence and its applications.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the Group theory. CO2 :Identify Sub group and their properties CO3 : Learn about Symmetry planes and reflection symmetry. CO4 : Solve problem of Product of symmetry operations.

	CO5 : Analyze consequences of Rotation axes and rotation symmetry CO6 : Apply Group of Symmetries in social sciences, physical sciences, life sciences and a host of other disciplines
Mapping between COs with PSOs	
Pre-requisite	Basics of Mathematics
Course Content	Unit I: Definition of a group and its elementary properties, Order of a group, Order of an element of a group, Group multiplication tables, Examples of groups including finite groups and infinite groups, Abelian groups, Cyclic groups. Unit II: Subgroup, Condition that a subset is a subgroup, Examples of subgroups, Basic concept of symmetry, Symmetry elements and symmetry operations in a space, Identity symmetry operation. Unit III: Symmetry planes and reflection symmetry, Inversion centre and inversion symmetry, Rotation axes and rotation symmetry, Improper axes and improper rotation symmetry, Product of symmetry operations.
Reference Books	1. F. A.Cotton: Chemical application of group theory, Wiley Inter Science, Wiley Eastern Ltd., New Delhi. 2. G. Davidson: Intro. Group Theory for Chemists, Applied Science Publisher. 3. I. N. Herstein: Topics in Algebra, Wiley Eastern Ltd., New Delhi
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 4th Semester

Course: MTH-401: Mathematics-VIII

Course Code	**MTH-401**
Course Title	Mathematics-VIII
Credit	3
Teaching per Week	3 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2021

Purpose of Course	The purpose of the course is to make the student capable to understand and implement the Special function, double Triple integral and Laplace transform
Course Objective	To make students acquainted with concepts of the Special function, double Triple integral and Laplace transform.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the beta gamma functio. CO2 : Find Double and triple integrals CO3 : Learn about Laplace transform . CO4 : Realize importance of Laplace transform. CO5 : Determine various Inverse Laplace transform. CO6 : Apply the Special function, double Triple integral and Laplace transform in social sciences, physical sciences, life sciences and a host of other disciplines
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Pre-requisite	Basics of Mathematics
Course Content	Unit I: Beta-Gamma functions: Relation between Beta and Gamma functions, Properties, Applications of Beta-Gamma function. Unit II: DoubleandTripleIntegrals:Changeoforder of Doubleintegrals, Area. Unit III: Laplace Transform of elementary functions, Properties of Laplace Transform, Differentiation and Integration of Laplace Transform, Laplace Transform of derivatives and integrals Unit IIV: Inverse of Laplace Transform: Method of Partial fractions, Properties of inverse Laplace Transform.
Reference Books	1. David V. Widder : Advanced Calculus, PHI Learning Pvt. Ltd, New Delhi 2. Kreysig: Advanced Engineering Mathematics, John Wiley, New York, 1999. 3. Shantinarayan, P. K. Mittal : A course of Mathematical Analysis, S. Chand and Co., New Delhi. 4. N. P. Bhamore& et al : Mathematics Paper III-IV, Popular Prakashan, Surat.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 4th Semester

Course: MTH-402:Mathematics-IX

Course Code	**MTH-402**
Course Title	Mathematics-IX
Credit	3
Teaching per Week	3 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2021
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the concepts of numerical methods and its applications.
Course Objective	To make students acquainted with concepts of numerical methods
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the numerical analysis. CO2 : Understand the Lagrange's Interpolation Formula, Divided Differences, Newton's General Interpolation Formula CO3 : Obtain numerical Differentiation. CO4 : Learn about Numerical Integration. CO5 :Determine Solution of Ordinary Differential Equations by Taylor's series method, Picard's approximation method, Euler's method. CO6 : Apply numerical analysis in social sciences, physical sciences, life sciences and a host of other disciplines
Mapping between COs with PSOs	

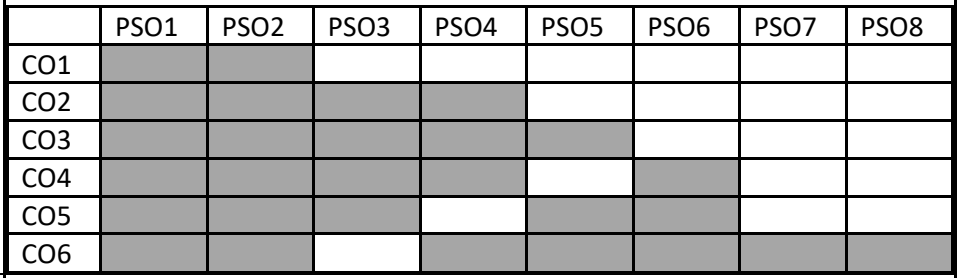
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	■	■						
CO2	■		■	■		■		
CO3	■	■	■	■	■			
CO4	■	■	■	■				■
CO5	■	■	■		■	■	■	■
CO6	■	■	■	■	■	■	■	■

Pre-requisite	Basics of Mathematics
Course Content	Unit I: Finite difference with unequal interval, Lagrange's Interpolation Formula, Divided Differences, Newton's General Interpolation Formula. Unit II: Numerical Differentiation: 1st and 2nd order derivatives based on Newton's forward and backward difference interpolation formulae. Unit III: Numerical Integration: General Integration formula, Trapezoidal Rule, Simpson's 1/3-Rule, Simpson's 3/8-Rule. Unit IV: Solution of Ordinary Differential Equations by Taylor's series method, Picard's approximation method, Euler's method.

Reference Books	1. S. S. Sastry : Introductory methods of Numerical Analysis, Prentice-Hall of India Pvt. Ltd.; 4th Edition. 2. M. K. Jain, Iyenger, Jain: Numerical Methods for Scientific and Engineering Computations, New Age International Ltd. 3. Goel, Mittal : Numerical Analysis, PragatiPrakashan, Meerut. 4. Kaiser A. Kunz : Numerical Analysis, McGraw Hill Book Co., London. 5. James I. Buchanan, Peter R. Turner: Numerical Methods and Analysis, McGraw Hill Book Co., London
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 4th Semester

Course: MTH-403: **Mathematics-X**

Course Code	**MTH-403**
Course Title	Mathematics – X
Credit	3
Teaching per Week	3 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2021
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the concepts of Basic real analysis and basic of number theory.
Course outcomes	To make students acquainted with concepts of Basic real analysis and basic of number theory.
Course Objective	The course will enable the students to: CO1 : Explain the insight of the Divisors GCD and LCM, prime number, Congruence relation. CO2 :Separate Countable & uncountable set CO3 :FindGreatest lower bound and least upper bound. CO4 :Learn about basics of Sequences of real numbers, Sub-sequences. CO5: IdentifyConvergent sequences, Divergent sequences CO6: Apply Basic of number theory in social sciences, physical sciences, life sciences and a host of other disciplines.
Mapping between COs with PSOs	
Pre-requisite	Basics of Mathematics
Course Content	Unit I: Sets and elements, Operations on sets, Functions, Real-valued functions. Unit II: Countable & Uncountable sets, Greatest lower bound and least upper bound.

	Unit III: Sequences of real numbers, Sub-sequences, limit of a sequence, Convergent sequences, Divergent sequences. Unit IV: Divisors, Greatest common divisor, Least Common multiple, Prime numbers, Fundamental theorem of Arithmetic, Congruence relation, Equivalence classes.
Reference Books	1. R. R. Goldberg : Methods of Real Analysis, Oxford & TBH Pub. Co. 2. I. N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 2006. 3. I. H. Sheth : Abstract Algebra, Nirav Prakashan, Ahmedabad. 4. T. M. Apostol : Mathematical Analysis, Narosa Publishing House, New Delhi. 5. S. C. Malik : Mathematical Analysis, Wiley-Eastern Ltd, New Delhi. 6. Shantinarayan : Modern Algebra, S. Chand and Co., New Delhi.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 4th Semester

Course: E.G.-4001: Mathematical Modelling

Course Code	**E.G.-4001**
Course Title	**Mathematical Modelling**
Credit	2
Teaching per Week	2 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2021
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the concepts of Mathematical Modelling .
Course Objective	To make students acquainted with concepts Mathematical Modelling.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the Mathematical Modelling. CO2 : explain the concept of mathematical modelling CO3 : formulate the real world problem into Mathematical form. CO4 :analyze the mathematical model. CO5 : Predict the future by using mathematical modelling. CO6 : Apply Mathematical modelling in social sciences, physical sciences, life sciences and a host of other disciplines

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Pre-requisite	Basics Ordinary differential equation

Course Content	Unit I: Mathematical modelling through ordinary differential equation of first order, Linear growth models; Linear decay models, Models for growth of Science and scientists. Unit II: Non-linear growth and decay models, Model of Logistic law of population, Spread of technological innovation, Spread of infectious diseases. Unit III: Mathematical models of geometrical problems through ordinary differential equation of first order, Simple geometrical problems, Orthogonal trajectories.
Reference Books	1. J. N. Kapoor: Mathematical Modelling, New Age International Publishers, New Delhi. 2. Kreysig: Advanced Engineering Mathematics, John Wiley, New York, 1999. 3. J. K. Sharma: OR Theory & Applications, Mac Milian India Ltd., 1998. 4. G.Hadley:Linear Programming, Narosa Publishing House, New Delhi,1995. 5. G. Paria : Linear Programming, Transportation, Assignment, Game, Books & Allied Pvt. Ltd. Calcutta.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 4th Semester

Course: E.G.-4002: Group of Symmetries-II

Course Code	**E.G.-4002**
Course Title	**Group of Symmetries-II**
Credit	2
Teaching per Week	2 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2021
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the Group of Symmetries.
Course Objective	To make students acquainted with concepts of Artificial Intelligence and its applications.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the Formation of groups of symmetries. CO2 : Understand formation of groups of symmetries of the Chemical Molecules CO3 : Learn about Concept of isomorphism of groups. CO4 : Recognize Isomorphism of group S3 of the symmetries of an equilateral triangle with the group of symmetries of NH3, PCl3, CHCl3. CO5 :Determine Isomorphism of group S3 of the symmetries of an equilateral triangle with the group of symmetries CO6 : Apply Group of Symmetries in social sciences, physical sciences, life

	sciences and a host of other disciplines
Mapping between COs with PSOs	<table><tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th><th>PSO7</th><th>PSO8</th></tr><tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>
Pre-requisite	Basics of Group of Symmetries
Course Content	Unit I: Formation of groups of symmetries (in space) of the following Plane figures (regarded as rigid objects): An isosceles triangle (cyclic group C2 of order 2) An equilateral triangle (the group S3 of order 6) A rectangle (the group V4) A square (the group D4) Unit II: Formation of groups of symmetries of the following Chemical Molecules (Configuration of atoms). H2O (the group V4) H2O2 Trans- N2 – F2 (the group V4) NH3, PCl3, CHCl3(the group S3) Unit III: Concept of isomorphism of groups, Isomorphism of multiplicative group with the group C2 of the symmetries of an isosceles triangle, Isomorphism of multiplicative group with the group V4 of the symmetries of a rectangle, Isomorphism of group V4 of the symmetries of a rectangle with the group of symmetries of H2O, Isomorphism of group S3 of the symmetries of an equilateral triangle with the group of symmetries of NH3, PCl3, CHCl3.
Reference Books	1. F. A.Cotton: Chemical application of group theory, Wiley Inter Science, Wiley Eastern Ltd., New Delhi. 2. G. Davidson: Intro. Group Theory for Chemists, Applied Science Publisher. 3. I. N. Herstein: Topics in Algebra, Wiley Eastern Ltd., New Delhi
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 5th Semester

Course: MTH-501: Group Theory

Course Code	**MTH-501**
Course Title	**Group Theory**
Credit	3
Teaching per Week	3 Hrs

Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2019
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the Group theory.
Course Objective	To make students acquainted with concepts of group theory.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the Formation of group theory. CO2 : Understand Cosets, Lagrange's theorem, Euler's theorem, Fermat's theorem, counting principle CO3 : Learn about Concept of Normal subgroup & Quotient groups, Homomorphism with their properties. CO4 : Recognize Automorphisms, Cayley's theorem and its applications CO5 :Determine different permutation and Permutation Groups, even permutation, odd permutation. CO6 : Apply group theory in social sciences, physical sciences, life sciences and a host of other disciplines
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Pre-requisite	Basics of Group theory
Course Content	Unit 1: Cosets, Congruence Relation in Group Lagrange's theorem, Euler's theorem, Fermat's theorem, Counting principle. Unit 2: Normal subgroups &Quotientgroups, Homomorphism, Isomorphism, Isomorphic groups, Fundamental theorem ofhomomorphism. Unit 3: Automorphisms, Cayley's theorem and its applications. Unit 4: Permutation Groups, Orbit& Cycles, Even permutation, Odd permutation, Alternating Group.
Reference Books	1. I. N. Herstein : Topics in Algebra, Wiley Eastern Ltd. New Delhi, 1983. 2. I. H. Sheth : Abstract Algebra, NiravPrakashan, Ahmedabad. 3. N. S. GopalKrishnan : University Algebra, Wiley Eastern Ltd. 4. P. R. Bhattacharya, S. K. Jain and S. R. Nagpaul : Basic Abstract Algebra, Cambridge University Press, Indian Edition, 1997. 5. Shantinarayan :Modern Algebra, S. Chand & Co. 6. Serge Lang : Algebra, ed. Addition Wesley, 1993. 7. Surjeet&KaziZameeruddin : Modern Algebra, Vikas Publishing House.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 5th Semester

Course: MTH-502: Linear Algebra - I

<table>
<tr><td>Course Code</td><td>MTH-502</td></tr>
<tr><td>Course Title</td><td>Linear Algebra – I</td></tr>
<tr><td>Credit</td><td>3</td></tr>
<tr><td>Teaching per Week</td><td>3 Hrs</td></tr>
<tr><td>Minimum weeks per Semester</td><td>15 (Including Class work, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective From</td><td>June 2019</td></tr>
<tr><td>Purpose of Course</td><td>The purpose of the course is to make the student capable to understand and implement theLinearAlgebra.</td></tr>
<tr><td>Course Objective</td><td>To make students acquainted with concepts of LinearAlgebra.</td></tr>
<tr><td>Course Outcomes</td><td>The course will enable the students to:</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th><th>PSO7</th><th>PSO8</th></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Pre-requisite</td><td>Basics of algebraic system</td></tr>
<tr><td>Course Content</td><td>Unit 1:
Definition and examples of Vector space, Subspace, Necessary and sufficient condition for a subspace, Illustrations.

Unit 2:
Span of a set, union and intersection of subspaces, sum and direct sum of subspaces.

Unit 3:
Linearly dependent and independent vectors, checking of Linear dependence or independence.

Unit 4:
Dimension and Basis of a vector space, extension of a linearly independent set to a basis, dimension of sum.</td></tr>
<tr><td>Reference Books</td><td>1. V. Krishnamurthy, V. P. Mainra& J. L. Arora : An Introduction to Linear Algebra, Affiliated East-West Press Pvt. Ltd., New Delhi.
2. I. H. Sheth : Linear Algebra, NiravPrakashan.
3. S. Kumaresan : Linear Algebra, Prentice Hall of India, 2000.
4. Serge Lang : Linear Algebra, Addition-Wesley Pub. Co. (Student Ed.).
5. Balakrishnan : Linear Algebra, Tata-McGraw Hill Ed.</td></tr>
<tr><td>Teaching Methodology</td><td>Classwork, Discussion, Self-Study, Seminars and/or Assignment</td></tr>
<tr><td>Evaluation Method</td><td>30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination</td></tr>
</table>

B.Sc. Mathematics 5th Semester

Course: MTH-503: Real Analysis - I

Course Code	**MTH-503**
Course Title	**Real Analysis – I**
Credit	3
Teaching per Week	3 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2019
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the Real analysis.
Course Objective	To make students acquainted with concepts of Real analysis.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the real analysis. CO2 : Understand the Countable & Uncountable sets, Greatest lower bound and least upper bound CO3 : Recognize Sequences of real numbers, Sub-sequences, limit of a sequence, Convergent sequences, Divergent sequences. CO4 : Learn about operations on convergent sequences. CO5 :Analyze Operations on divergent sequences, concepts of limit superior and inferior, Cauchy sequence. CO6 : Apply Basic of real analysis .in social sciences, physical sciences, life sciences and a host of other disciplines
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	■	■						
CO2	■		■	■				
CO3	■	■	■		■			
CO4	■	■	■	■		■	■	
CO5	■		■		■	■		■
CO6	■	■		■		■		

Pre-requisite	Basics of Mathematics
Course Content	Unit 1: Countable & uncountable sets, greatest lower bound and least upper bound. Unit 2: Sequences of real numbers, sub-sequences, limit of a sequence, convergent sequences, divergent sequences. Unit 3: Bounded sequences, monotone sequences, operations on convergent sequences. Unit 4: Operations on divergent sequences, concepts of limit superior and inferior, Cauchy sequence.
Reference Books	1. R. R. Goldberg : Methods of Real Analysis, Oxford & TBH Pub. Co. 2. T. M. Apostol : Mathematical Analysis, Narosa Publishing House, New Delhi. 3. S. C. Malik : Real Analysis, Wiley-Eastern Pub. Co., New Delhi. 4. Walter Rudin : Principles of Mathematical Analysis, McGraw Hill book Company.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment

Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 5th Semester

Course: MTH-504: Real Analysis - II

Course Code	**MTH-504**
Course Title	**Real Analysis – II**
Credit	3
Teaching per Week	3 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2019
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the Real analysis.
Course Objective	To make students acquainted with concepts of Real analysis.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the real analysis. CO2 : Understand the Limit and Continuity of a function on the real line, Definition & examples of Metric spaces CO3 : Recognize Open ball in R1, open ball in metric space, functions continuous on metric spaces. CO4 : Learn about Limit, Convergence and Cauchy sequence in metric space, Equivalent metrics.. CO5 :Analyze Open sets and their properties. CO6 : Apply real analysis .in social sciences, physical sciences, life sciences and a host of other disciplines
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Pre-requisite	Basics of Real analysis
Course Content	Unit 1: Revision of Limit and Continuity of a function on the real line, Definition & examples of Metric spaces. Unit 2: Limit, Convergence and Cauchy sequence in metric space, Equivalent metrics. Unit 3: Open ball in R1, open ball in metric space, functions continuous on metric spaces. Unit 4: Open sets, more about open sets.

Reference Books	1. R. R. Goldberg : Method of Real Analysis, Oxford & IBH Pub. Co. Ltd. New Delhi. 2. T. M. Apostol : Mathematical Analysis, Narosa Publishing House, New Delhi, 1985. 3. S. Lang : Undergraduate Analysis, Springer-Verlag, New York, 1983. 4. D. SomSundaram& B. Chaudhari : A first course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1997. 5. P. K. Jain & S. K. Kaushik : An Introduction to Real Analysis, S. Chand & Co. New Delhi, 2000. 6. E. T. Copson : Metric Spaces, Cambridge University Press, 1968. 7. P. K. Jain & K. Ahmed : Metric Spaces, Narosa Pub. House, New Delhi, 1996.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 5th Semester

Course: MTH-505: Graph Theory

Course Code	**MTH-505**
Course Title	**Graph Theory**
Credit	3
Teaching per Week	3 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2019
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the Graph theory
Course Objective	To make students acquainted with concepts of Graph Theory.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the graph theory. CO2 : Understand the graph theory and relevant term CO3 : Recognize Subgraphs, Isomorphism between two graphs. CO4 : Learn about Operations on graphs, Walks, Paths, Circuits, Connected graphs, Disconnected graphs and Components of graphs . CO5 :Analyze Euler graph and their properties. CO6 : Apply graph .in social sciences, physical sciences, life sciences and a host of other disciplines
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	■	■	■					
CO2	■		■					
CO3	■	■	■		■			
CO4	■	■	■	■		■	■	■
CO5	■		■		■	■		■
CO6	■	■		■		■	■	■

Pre-requisite	Basics of Mathematics
Course Content	Unit 1: Graphs, various type of graphs, incidence and degree, isolated and pendent vertices, Subgraphs, Isomorphism between two graphs. Unit 2:

	Operations on graphs, Walks, Paths, Circuits, Connected graphs, Disconnected graphs, Components of graphs. Unit 3: Euler graphs, Arbitrary traceable graph, Hamiltonian Graphs, Applications of graphs: Konigsberg Bridge Problem, Seating Arrangement Problem, Utility Problem. Unit 4: Trees, Properties of trees, Pendent vertices in a tree, Distance between two vertices, Centre, Radius and Diameter of a Tree, Rooted & Binary trees.
Reference Books	1. NarsinghDeo : Graph Theory with applications to Engineering & Computer Science, Prentice Hall of India Pvt. Ltd., 2000. 2. R. J. Wilson : Introduction to Graph Theory, Academic Press, New York, 1972. 3. E. Harray : Graph Theory, Addison Wesley Pub. Co., 1969. 4. C. Berge : The Theory of Graphs and its Applications, John Wiley & Sons, 1962.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 5th Semester

Course: MTH-506: Number Theory - I

Course Code	**MTH-506**
Course Title	**Number Theory - I**
Credit	3
Teaching per Week	3 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2019
Purpose of Course	The purpose of the course is to make the student capable to understand the Number theory
Course Objective	To make students acquainted with concepts of Number theory.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the number theory. CO2 : Understand the Divisibility of integers, the Division Algorithm, Greatest Common Divisor of two integers, the Euclidean algorithm CO3 : Compute the solutions of linear Diophantine equations in two variables CO4 :Learn about Sieve of Eratosthenes, infinitude of primes, upper bound for the primes, Theory of Congruences CO5 :Analyze Basic properties of Congruence, divisibility tests. CO6 : Apply Number theory .in social sciences, physical sciences, life sciences and a host of other disciplines

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								

	CO4								
	CO5								
	CO6								
Pre-requisite	Basics of Mathematics								
Course Content	Unit 1: Divisibility of integers, the Division Algorithm, Greatest Common Divisor of two integers, the Euclidean algorithm, relation between greatest common divisor and least common multiple of two integers. Unit 2: Computation of the solutions of linear Diophantine equations in two variables, Primes and composite numbers, the fundamental theorem of arithmetic, Pythagorean theorem for the irrationality of √2 . Unit 3: Sieve of Eratosthenes, infinitude of primes, upper bound for the primes, Theory of Congruences. Unit 4: Basic properties of Congruence, divisibility tests of 9 and 11.								
Reference Books	1. David M. Burton : Elementary Number Theory, Tata McGraw-Hill Pub. Co. Ltd., New Delhi, 6th Ed., 2006. 2. S. G. Telang : Number Theory, The Tata McGraw Hill Co. Ltd., New Delhi. 3. I. Niven, S. Zuckerman & L. Montgomery: An Introduction to Theory of Numbers, John Wiley, 1991. 4. George Andrews : Number Theory, The Hindustan Pub. Corporation, New Delhi.								
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment								
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination								

B.Sc. Mathematics 5th Semester

Course: E.G.-5001: Operations Research-I (Elective Generic)

Course Code	**E.G.-5001**
Course Title	**Operations Research-I**
Credit	2
Teaching per Week	2 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2019
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the Operations research.
Course Objective	To make students acquainted with concepts of Operations research.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the Operations research. CO2 : Understand Linear programming problem and their Graphical solution. CO3 : Compute the solutions LPP by dual simplex method CO4 :Learn about Definition of the dual problem and their properties

	CO5 : Find the solution of LPP by Big-M method. CO6 : Apply Operations Research in social sciences, physical sciences, life Science and a host of other disciplines
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Pre-requisite	Basics of Mathematics
Course Content	Unit 1: Graphical Solution of Linear programming problem (LPP). Definition of the dual problem, General rules for converting any primal problem into it's dual, The symmetric dual problems. Unit 2: Basic concept of basic, non-basic, degenerate, non-degenerate and basic feasible solutions of LPP, slack & surplus variables, LPP in the standard matrix form, Slack & surplus variables, Solution of LPP using Simplex method. Unit 3: Solution of LPP using Two Phase Simplex method and Big-M method.
Reference Books	1. J. K. Sharma : Operations Research: Theory & Applications, McMillan India Ltd., 1998. 2. KantiSwaroop, P. K. Gupta & Man Mohan : Operations Research, S. Chand & Sons, New Delhi, 1998. 3. G. Hadley : Linear Programming, Narosa Publishing House, New Delhi, 1995. 4. S. D. Sharma: Operations Research, KedarnathRamnath& Co. 5. P. M. Karak : Linear Programming, New Central Book Agency Pvt. Ltd. Calcutta - 9. 6. K. V. Mittal & L. Mohan : Optimization methods in O.R. and System Analysis, New Age International Publications. 7. Goel&Mittal : O.R., PragatiPrakashan, Meerut
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 5th Semester

Course: E.G.-5002: Computer Oriented Numerical Methods – I(Elective Generic)

Course Code	**E.G.-5002**
Course Title	**Computer Oriented Numerical Methods – I**
Credit	2
Teaching per Week	2 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2019

Purpose of Course	The purpose of the course is to make the student capable to understand and implement the Computer Oriented Numerical Methods.
Course Objective	To make students acquainted with concepts of Computer Oriented Numerical Methods.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the Computer Oriented Numerical Methods. CO2 : Understand Flow charts and symbols, More flow charting examples and FORTRAN language CO3 : Compute the operations in expressions CO4 :Learn about Arithmetic statement, Mode of Arithmetic expression, Special function, examples of use of functions, Program preparation preliminaries. CO5 : Familiarize with Input-Output statement, STOP and END statement, FORTRAN coding form, Simple FORTRAN program. CO6 : Apply Computer Oriented Numerical Methods in social sciences, physical sciences, life Science and a host of other disciplines
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Pre-requisite	Basics of Mathematics
Course Content	Unit 1: Flow charts and symbols, More flow charting examples. FORTRAN language, character used in FORTRAN, FORTRAN constants, FORTRAN variable names, Type declaration for integer and real, Arithmetic expression (real and integer expressions), Hierarchy of operations in expressions, Examples of Arithmetic expression. Unit 2: Arithmetic statement, Mode of Arithmetic expression, Special function, examples of use of functions, Program preparation preliminaries. Unit 3: Input-Output statement, STOP and END statement, FORTRAN coding form, Simple FORTRAN program, FORTRAN programming examples.
Reference Books	1. V. Rajaraman : Computer Programming in FORTRAN 77, PHI. 2. V. Rajaraman : Computer Oriented Numerical Methods, PHI. 3. Dhaliwal, Agarwal and Gupta : Programming with FORTRAN 77, Wiley Eastern Ltd. 4. R. S. Salaria : Computer Oriented Numerical Methods, Khanna Book Pub. Co. Ltd. 5. R. Sirkar : FORTRAN based Algorithms, New Central Book Agency, Calcutta. 6. V. Krishnamurthy : FORTRAN based Algorithms, East-West Press, N.Delhi.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 5th Semester

Course: E.G.-5003: Fourier Series (Elective Generic)

Course Code	**E.G.-5003**
Course Title	**Fourier Series**
Credit	2
Teaching per Week	2 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2019
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the Fourier Series.
Course Objective	To make students acquainted with concepts of Fourier Series.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the Fourier Series. CO2 : Understand the Definition of Fourier series, Euler's formulae, Evaluation of definite integrals, Conditions for a Fourier expansion CO3 : Compute the Fourier series of functions CO4 :Learn about Functions having points of discontinuity, change in intervals, even and odd functions, Expansion of even or odd periodic functions. CO5 : Familiarize with Half range series, Typical waveforms, Parseval's formula, Root mean square value, Complex form of Fourier series. CO6 : Apply Fourier series in social sciences, physical sciences, life Science and a host of other disciplines
Mapping between COs with PSOs	
Pre-requisite	Basics of Mathematics
Course Content	Unit 1: Definition of Fourier series, Euler's formulae, Evaluation of definite integrals, Conditions for a Fourier expansion. Unit 2: Functions having points of discontinuity, change in intervals, even and odd functions, Expansion of even or odd periodic functions. Unit 3: Half range series, Typical waveforms, Parseval's formula, Root mean square value, Complex form of Fourier series.
Reference Books	1. B. S. Grewal : Higher Engineering Mathematics, KhannaPrakashan, New Delhi. 2. S. K. Jain : Fourier series and Fourier Transforms, Swarup and Sons Pub., New Delhi. 3. R. R. Goldberg : Method of Real Analysis, Oxford & IBH Pub. Co. Ltd. New Delhi. 4. R. V. Churchil : Fourier series and Boundary value problems, McGraw Hill ISE.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

	5. Vashishtha and Gupta :Integral Transforms, Krishna Publications, Meerut
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 6th Semester

Course: MTH-601: Ring Theory

Course Code	**MTH-601**
Course Title	**Ring Theory**
Credit	3
Teaching per Week	3 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2019
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the Ring theory.
Course Objective	To make students acquainted with concepts of ring theory.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the Formation of Ring theory. CO2 : Understand Ring Homomorphism and Isomorphism, Ideals & Quotient rings, Maximal Ideal, Principal Ideal CO3 : Learn about different kinds of ring and their properties.. CO4 : Recognize Prime element in a Euclidean Ring, Unique factorization theorem in a Euclidean ring. CO5 : Link theParticular Euclidean Ring, Polynomial Ring, Degree of a Polynomial, Division Algorithm, Irreducible polynomial. CO6 : Apply Ring theory in social sciences, physical sciences, life sciences and a host of other disciplines
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Pre-requisite	Basics of group theory
Course Content	Unit 1: Ring Homomorphism and Isomorphism, Ideals & Quotient rings, Maximal Ideal, Principal Ideal. Unit 2: Euclidean rings, divisibility in commutative ring, gcd of two elements in a ring, units and associates in rings. Unit 3: Prime element in a Euclidean Ring, Unique factorization theorem in a Euclidean ring.

	Unit 4: Particular Euclidean Ring, Polynomial Ring, Degree of a Polynomial, Division Algorithm, Irreducible polynomial.
Reference Books	1. I. N. Herstein : Topics in Algebra, Wiley Eastern Ltd. New Delhi, 1983. 2. I. H. Sheth : Abstract Algebra, NiravPrakashan, Ahmedabad. 3. N. S. GopalKrishnan : University Algebra, Wiley Eastern Ltd. 4. P. R. Bhattacharya, S. K. Jain and S. R. Nagpaul : Basic Abstract Algebra, Cambridge University Press, Indian Edition, 1997. 5. Shantinarayan :Modern Algebra, S. Chand & Co. 6. Serge Lang : Algebra, ed. Addition Wesley, 1993. 7. Surjeet&KaziZameeruddin : Modern Algebra, Vikas Publishing House.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 6th Semester

Course: MTH-602: Linear Algebra - II

Course Code	**MTH-602**
Course Title	**Linear Algebra - II**
Credit	3
Teaching per Week	3 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2019
Purpose of Course	The purpose of the course is to make the student capable to understand and implement theLinearAlgebra.
Course Objective	To make students acquainted with concepts of LinearAlgebra.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the Linear algebra. CO2 : Understand Linear Transformation and their properties CO3 : Learn about rank nullity and their properties CO4 : Recognize Matrix associated with linear transformations. CO5 :Analyze Inner product spaces, Norm of a vector and properties. CO6 : Apply linear algebra in social sciences, physical sciences, life sciences and a host of other disciplines
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Pre-requisite	Basics of linear algebra
Course Content	Unit 1: Definition and examples of Linear transformation, Range and kernel of a linear transformation.

	Unit 2: Rank-Nullity Theorem, Inverse of a linear transformation, Consequences of Rank-Nullity Theorem, Composition of linear transformations. Unit 3: Matrix associated with linear transformations, linear transformation associated with a matrix, Application of Rank-Nullity Theorem for matrix. Unit 4: Inner product spaces, Norm of a vector, Cauchy-Schwarz's inequality, Triangular inequality, Orthogonalvectors, Vector Projection, Gram-Schmidt Orthogonalization Process, OrthonormalSet.
Reference Books	1. V. Krishnamurthy, V. P. Mainra& J. L. Arora : An Introduction to Linear Algebra, Affiliated East-West Press Pvt. Ltd., New Delhi. 2. I. H. Sheth : Linear Algebra, NiravPrakashan. 3. S. Kumaresan : Linear Algebra, Prentice Hall of India, 2000. 4. Serge Lang : Linear Algebra, Addition-Wesley Pub. Co. (Student Ed.). 5. Balakrishnan : Linear Algebra, Tata-McGraw Hill Ed.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 6th Semester

Course: MTH-603: Real Analysis - III

Course Code	**MTH-603**
Course Title	**Real Analysis - III**
Credit	3
Teaching per Week	3 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2019
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the Real analysis.
Course Objective	To make students acquainted with concepts of Real analysis.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the real analysis. CO2 : Understand the Convergence and divergence of series of real numbers CO3 : Recognize Sets of measure zero, definition of the Riemann Integral, Algebraic properties of Riemann Integral. CO4 : Learn about different type of series . CO5 :Analyze Algebraic properties of Riemann Integral Fundamental theorems of Integral Calculus. CO6 : Apply real analysis .in social sciences, physical sciences, life sciences and a host of other disciplines

Mapping between COs with PSOs	<table><tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th><th>PSO7</th><th>PSO8</th></tr><tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>
Pre-requisite	Basics of Real analysis
Course Content	Unit 1: Convergence and divergence of series of real numbers, Series with non-negative terms, Alternating series, Conditional and absolute convergence. Unit 2: Tests for absolute convergence, Series whose terms form a non-increasing sequence. Unit 3: Sets of measure zero, definition of the Riemann Integral, Algebraic properties of Riemann Integral. Unit 4: Non Algebraic properties of Riemann Integral Fundamental theorems of Integral Calculus, Mean-value Theorems of Integral Calculus.
Reference Books	1. R. R. Goldberg : Method of Real Analysis, Oxford & IBH Pub. Co. Ltd., New Delhi. 2. T. M. Apostol : Mathematical Analysis, Narosa Publishing House, New Delhi, 1985. 3. S. Lang : Undergraduate Analysis, Springer-Verlag, New York, 1983. 4. Louis Leithold : Calculus with analytic Geometry, Harper and Collins Pub. Co. 5. J. B. Thomas and Finney : Calculus with analytic Geometry. 6. E. T. Copson : Metric Spaces, Cambridge University Press, 1968. 7. P. K. Jain & K. Ahmed : Metric Spaces, Narosa Pub. House, New Delhi, 1996
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 6th Semester

Course: MTH-604: Real Analysis - IV

Course Code	**MTH-604**
Course Title	**Real Analysis - II**
Credit	3
Teaching per Week	3 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2019
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the Real analysis.
Course Objective	To make students acquainted with concepts of Real analysis.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the real analysis.

	CO2 : Understand Limit points, closure of a set, closed sets, homeomorphism of metric spaces CO3 : Recognize Connected sets, Bounded sets, Totally bounded sets. CO4 : Learn about Complete metric spaces, Contraction mapping, Picard's fixed point theorem. CO5 :Analyze Open covering, Heine-Borel property. CO6 : Apply real analysis .in social sciences, physical sciences, life sciences and a host of other disciplines
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Pre-requisite	Basics of real analysis
Course Content	Unit 1: Limit points, closure of a set, closed sets, homeomorphism of metric spaces, dense set. Unit 2: Connected sets, Bounded sets, Totally bounded sets. Unit 3: Complete metric spaces, Contraction mapping, Picard's fixed point theorem. Unit 4: Compact metric spaces, Open covering, Heine-Borel property, Finite Intersection property.
Reference Books	1. R. R. Goldberg : Method of Real Analysis, Oxford & IBH Pub. Co. Ltd., New Delhi. 2. T. M. Apostol : Mathematical Analysis, Narosa Publishing House, New Delhi, 1985. 3. S. Lang : Undergraduate Analysis, Springer-Verlag, New York, 1983. 4. S. C. Malik : Real Analysis, Wiley-Eastern Pub. Co., New Delhi. 5. Walter Rudin : Principles of Mathematical Analysis, McGraw Hill book Company. 6. Copson : Metric Spaces, Cambridge University Press, 1968. 7. P. K. Jain & K. Ahmed : Metric Spaces, Narosa Pub. House, New Delhi, 1996.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 6th Semester

Course: 605: Discrete Mathematics

<table>
<tr><td>Course Code</td><td>MTH-605</td></tr>
<tr><td>Course Title</td><td>Discrete Mathematics</td></tr>
<tr><td>Credit</td><td>3</td></tr>
<tr><td>Teaching per Week</td><td>3 Hrs</td></tr>
<tr><td>Minimum weeks per Semester</td><td>15 (Including Class work, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective From</td><td>June 2019</td></tr>
<tr><td>Purpose of Course</td><td>The purpose of the course is to make the student capable to understand and implement the Discrete Mathematics</td></tr>
<tr><td>Course Objective</td><td>To make students acquainted with concepts of Discrete Mathematics.</td></tr>
<tr><td>Course Outcomes</td><td>The course will enable the students to:
CO1 : Explain the insight of the Discrete Mathematics.
CO2 : Understand the relation , lattice and relevant term
CO3 : Recognize Lattices as algebraic systems, Lattice homomorphism, Different types of lattices.
CO4 : Learn about Boolean Algebra as an algebraic system, Boolean expressions.
CO5 :Determine Minimization of Boolean functions by Karnaugh Map method.
CO6 : Apply Discrete Mathematics .in social sciences, physical sciences, life sciences and a host of other disciplines</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th><th>PSO7</th><th>PSO8</th></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Mathematics</td></tr>
<tr><td>Course Content</td><td>Unit 1:
Binary relations, Properties of binary relations, Equivalence relation, Partial ordered relation, Partially ordered sets, Upper bounds, Lower bounds, GLB & LUB of sets, Totally ordered sets, Well ordered sets, Hasse Diagram, Lattices and its properties.

Unit 2:
Lattices as algebraic systems, Lattice homomorphism, Different types of lattices.

Unit 3:
Boolean Algebra as an algebraic system, Boolean expressions (forms), Different representation of Boolean forms, Sum of products canonical form and product of sums canonical forms of Boolean expressions.</td></tr>
</table>

	Unit 4: Minimization of Boolean functions by Karnaugh Map method and Quine- McCluskey algorithm, AND, OR & NOT gates, Reduction of switching circuit diagram.
Reference Books	1. J. P. Tremblay & R. Manohar : Discrete mathematical Structures with Applications to Computer Science., McGraw Hill Book Co., 1999. 2. B. Kolman, R. C. Busby & S. Ross : Discrete Mathematical Structures, Prentice Hall of India Pvt. Ltd., 3rd ed. 2001. 3. Elements of Discrete Mathematics, C. L. Liu, D. P. Mohapatra, Tata McGraw Hill, 2008. 4. Discrete Mathematics with Applications, Thomas Koshy, Academic Press, 2004.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 6th Semester

Course: MTH-606: Number Theory - II

Course Code	**MTH-606**
Course Title	**Number Theory - II**
Credit	3
Teaching per Week	3 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2019
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the Number theory
Course Objective	To make students acquainted with concepts of Number theory.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the number theory. CO2 : Understand Fermat's little theorem, Pseudo-primes, Wilson's theorem CO3 : Compute the solutions of linear congruence , the Chinese Remainder Theorem CO4 :Learn about The number of positive divisors, multiplicative nature of functions, The Möbius Inversion formula CO5 :Analyze Euler's Phi-function and related theorem. CO6 : Apply Number theory .in social sciences, physical sciences, life sciences and a host of other disciplines
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								
CO6								

Pre-requisite	Basics of number theory
Course Content	Unit 1: Computation of the solutions of linear congruence , the Chinese Remainder Theorem.

	Unit 2: Fermat's little theorem, Pseudo-primes, Wilson's theorem. Unit 3: The number of positive divisors and sum of all positive divisors of an integer, basic properties and multiplicative nature of these functions, The Möbius Inversion formula (without proof), the greatest integer function. Unit 4: Introduction of Euler's Phi-function , multiplicative nature of (statement only), Euler's Theorem.
Reference Books	1. David M. Burton : Elementary Number Theory, Tata McGraw-Hill Pub. Co. Ltd., New Delhi, 6th Ed., 2006. 2. S. G. Telang : Number Theory, The Tata McGraw Hill Co. Ltd., New Delhi. 3. I. Niven, S. Zuckerman & L. Montgomery: An Introduction to Theory of Numbers, John Wiley, 1991. 4. George Andrews : Number Theory, The Hindustan Pub. Corporation, New Delhi.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 6th Semester

Course: E.G. 6001: Operations Research-II (Elective Generic)

Course Code	**E.G.- 6001**
Course Title	**Operations Research-II**
Credit	2
Teaching per Week	2 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2019
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the Operation research.
Course Objective	To make students acquainted with concepts of Operations research.
Course Outcomes	The course will enable the students to: CO1 : Explain the insight of the Operations research. CO2 : Understand the transportation problem and their solutions. CO3 : Compute the solutions of Assignment problem CO4 :Learn about Competitive games theory CO5 : Find the solution Game theory problem by graphical method CO6 : Apply Operations Research in social sciences, physical sciences, life Science and a host of other disciplines
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								

	CO5 CO6
Pre-requisite	Basics of Mathematics
Course Content	Unit 1: Transportation problem, methods for finding initial basic feasible solution, solution of Transportation problem by MODImethod, Unbalanced Transportation problem. Unit 2: Assignment problems, The Hungarian method, balanced & unbalance assignment problems. Unit 3: Competitive games, two-person zero-sum game, maximin and minimax principle, saddle points and the value of the game (based on pure strategies), mixed strategies, solution of games with saddle point, Game without saddle points, Dominance rule, solution of m×2 and 2×n games using graphical method.
Reference Books	1. J. K. Sharma : Operations Research: Theory & Applications, McMillan India Ltd., 1998. 2. KantiSwaroop, P. K. Gupta & Man Mohan : Operations Research, S. Chand & Sons, New Delhi, 1998. 3. G. Hadley : Linear Programming, Narosa Publishing House, New Delhi, 1995. 4. S. D. Sharma: Operations Research, KedarnathRamnath& Co. 5. P. M. Karak : Linear Programming, New Central Book Agency Pvt. Ltd. Calcutta - 9. 6. K. V. Mittal & L. Mohan : Optimization methods in O.R. and System Analysis, New Age International Publications. 7. Goel&Mittal : O.R., PragatiPrakashan, Meerut
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

B.Sc. Mathematics 6th Semester

Course: E.G.-6002: Computer Oriented Numerical Methods – II (Elective Generic)

Course Code	**E.G.-6002**
Course Title	**Computer Oriented Numerical Methods – II**
Credit	2
Teaching per Week	2 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	June 2019
Purpose of Course	The purpose of the course is to make the student capable to understand and implement the Computer Oriented Numerical Methods.
Course Objective	To make students acquainted with concepts of Computer Oriented Numerical Methods.

<table>
<tr><td>Course Outcomes</td><td>The course will enable the students to:
CO1 : Explain the insight of the Computer Oriented Numerical Methods.
CO2 :Recognize Control statements, Relational operators, Logical IF statement, Arithmetic IF statement, Block IF statement
CO3 : Apply the Statement labels, GO TO statement and DO statement
CO4 :Learn about Rules to be followed in utilizing DO loops, Subscripted variables, Subscripted expression, Dimension statement, DO type notation for input / output statement.
CO5 : Familiarize with FORMAT specification and FORMAT specification for a numerical data.
CO6 : Apply Computer Oriented Numerical Methods in social sciences, physical sciences, life Science and a host of other disciplines</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th><th>PSO7</th><th>PSO8</th></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Computer Oriented Numerical Methods</td></tr>
<tr><td>Course Content</td><td>Unit1:
Controlstatements,Relationaloperators,LogicalIFstatement,ArithmeticIFstatement,Block IFstatement. Statement labels, GO TO statement, Example of use of Logical IF statement.

Unit2:
Nested logical IF statement, Computed GO TO statement, DO statement, Examples of DO statement. Rules to be followed in utilizing DO loops, Subscripted variables, Sub scripted Expression. Dimension statement, DO type notation for input/output statement. FORMAT specification.

Unit3:
FORMAT specification for a numerical data, Iterative methods. Numerical integrations and differentiations. Numerical solution of ordinary differential equations.</td></tr>
<tr><td>Reference Books</td><td>1. V. Rajaraman : Computer Programming in FORTRAN 77, PHI.
2. V. Rajaraman : Computer Oriented Numerical Methods, PHI.
3. Dhaliwal, Agarwal and Gupta : Programming with FORTRAN 77, Wiley Eastern Ltd.
4. R. S. Salaria : Computer Oriented Numerical Methods, Khanna Book Pub. Co. Ltd.
5. R. Sirkar : FORTRAN based Algorithms, New Central Book Agency, Calcutta.
6. V. Krishnamurthy : FORTRAN based Algorithms, East-West Press, N. Delhi.</td></tr>
<tr><td>Teaching Methodology</td><td>Classwork, Discussion, Self-Study, Seminars and/or Assignment</td></tr>
<tr><td>Evaluation Method</td><td>30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination</td></tr>
</table>

B.Sc. Mathematics 6th Semester

Course: E.G.-6003: Fourier Transform and its Applications (Elective Generic)

<table>
<tr><td>Course Code</td><td>E.G.-6003</td></tr>
<tr><td>Course Title</td><td>Fourier Transform and its Applications</td></tr>
<tr><td>Credit</td><td>2</td></tr>
<tr><td>Teaching per Week</td><td>2 Hrs</td></tr>
<tr><td>Minimum weeks per Semester</td><td>15 (Including Class work, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective From</td><td>June 2019</td></tr>
<tr><td>Purpose of Course</td><td>The purpose of the course is to make the student capable to understand and implement the Fourier Transform and its Applications.</td></tr>
<tr><td>Course Objective</td><td>To make students acquainted with concepts of Fourier Transform and its Applications.</td></tr>
<tr><td>Course Outcomes</td><td>The course will enable the students to:
CO1 : Explain the insight of the Fourier Transform and its Applications.
CO2 : Understand the Integral transforms, Fourier Transforms, Properties of Fourier Transform
CO3 : Compute the Fourier Transform
CO4 :Learn about Convolution, Convolution theorem for Fourier transforms, Parseval’s Identity for Fourier transform
CO5 : Familiarize with Relation between Fourier and Laplace Transforms, Fourier transforms of the derivatives of a function
CO6 : Apply Fourier Transform in social sciences, physical sciences, life Science and a host of other disciplines</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th><th>PSO7</th><th>PSO8</th></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>CO6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Fourier series</td></tr>
<tr><td>Course Content</td><td>Unit 1:
Integral transforms, Fourier Transforms, Properties of Fourier Transform and its application.

Unit 2:
Convolution, Convolution theorem for Fourier transforms, Parseval’s Identity for Fourier transform.

Unit 3:
Relation between Fourier and Laplace Transforms, Fourier transforms of the derivatives of a function, Fourier transform and its applications.</td></tr>
<tr><td>Reference Books</td><td>1. B. S. Grewal : Higher Engineering Mathematics, KhannaPrakashan, New Delhi.
2. S. K. Jain : Fourier series and Fourier Transforms, Swarup and Sons Pub., New Delhi.
3. R. R. Goldberg : Method of Real Analysis, Oxford & IBH Pub. Co. Ltd. New Delhi.
4. R. V. Churchil : Fourier series and Boundary value problems, McGraw Hill ISE.</td></tr>
</table>

	5. Vashishtha and Gupta :Integral Transforms, Krishna Publications, Meerut
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Department of Biology

Goals

A major educational goal for the undergraduate degree programs:

- To build and strengthen in the basic fundamental of the theoretical aspect and experimental skills in Bioscience

Program Specific Outcomes (PO)

After completing B. Sc. (Bioscience) Program, the student will be able to:

- Apply the acquired basic concepts and principles of,
    1. Introduction to microbiology, genetics, microbial diversity & eucaryotic cell structure & function.
    2. Fundamentals of biochemistry, molecular biology, biophysics, biostatistics, physiology, immunology and microbiology.
    3. Histophysiology, endocrinology, metabolic processes, clinical biochemistry, hematology, biotechnology.
    4. Nutritional aspects, blood banking, medical microbiology, immunology, Parasitology, clinical microbiology and applied microbiology.
    5. Demonstrate one's laboratory skills, enabling them to take measurements in the clinical laboratory and analyze the measurements to draw conclusions, report the results of a complex extended experiment.

Course Outcomes

F. Y. B. Sc.

Course: **Introduction to microbiology** (BS 101)

After successfully completing this course, the student will be able to learn about,

- Understand history, scope & relevance of microbiology, biogenesis and abiogenesis, contribution of scientist in the field of microbiology.
- Know about the microscope – resolution power, NA & working principle, component of microscope, types of microscope and microscopy. Electron microscope
- Study dye, stain and staining techniques, Introduction to microbial control; antisepsis, sterilization, preservation, disinfection, sanitization, sterilization by heat, filtration & radiation. Control of microbes by chemicals.

Course: **Basic Genetics** (BS 102)

After successfully completing this course, the student will be able to learn about,

- Know the Mendelian genetics, Mendel's experiments, Mendel's law. Incomplete dominance & epistasis, multiple allele & Blood group inheritance. Gene concept, Morgan classical concept, modern concept of gene, Gene-enzyme relationship, Fine structure of gene.
- Understand sex-linked inheritance, X & Y linked inheritance, Intermediate inheritance & sickle cell anemia, Sex determination in drosophila & human.
- Study human karyotype, Banding technique, Chromosomal abnormality: Structural & Numerical.

Course: **Bioscience Practical** (BS 100P)

After successfully completing this course, the student will be able to:

- Demonstrate an understanding of laboratory procedures using scientific methods demonstrate an ability to collect data through observation;
- Acquire technical skills in using laboratory equipment, tools and materials, staining, microscopy.
- Demonstrate various microorganisms, Monochrome staining, viability staining, study barr body, human karyotype & chromosomal abnormalities.

Course: **Microbial Diversity** (BS 201)

After successfully completing this course, the student will be able to learn about,

- Understand the basics of microbial taxonomy, current position & 3 domains of life, Criteria for microbial taxonomy. Morphology & types of bacteria, Cyanobacteria & archeobacteria. Introduction to viruses.
- Know the general characteristics & classification of protozoan and algae. Study and importance of some protozoa and algae
- Study of some fungi. General characteristics and Outline classification of fungi. Life cycle & reproduction of Mucor, Yeast & Mushroom. Importance of fungi.

Course: **Eucaryotic cell structure & function** (BS 202)

After successfully completing this course, the student will be able to learn about,

- Understand the cell, cell theory, types, prokaryotic and eukaryotic cell, cell structure & eukaryotic cell organization.
- Study various cell organelles mitochondria, golgi body, lysosome, ER, chloroplast, cell membrane, ribosome, nucleus, centriole, cilia & flagella.
- Know about chromosome - morphology, types, structure, special chromosome and cell cycle – mitotic cell division, meiosis and apoptosis.

Course: **Bioscience Practical** (BS 200P)

After successfully completing this course, the student will be able to:

- Demonstrate an understanding of laboratory procedures using scientific methods demonstrate microscopic form of life
- Acquire technical skills in using laboratory equipment, tools and materials, staining, microscopic observation of cyanobacteria, algae, protozoa, fungi.
- Demonstrate various cell component, nucleus, chloroplast, mitotic cell division Chromosome, types and giant chromosomes.

S. Y. B. Sc.

Course: **Microbial Chemistry** (BS 301)

After successfully completing this course, the student will be able to:

- Basic knowledge of biological macromolecules. Classification, structure & biological importance of carbohydrates, amino acids, protein, fatty acids, lipid.
- Detail information regarding biocatalyst, Nomenclature, classification of enzymes. Mechanism of action & biological role
- Types of mixture; solution, colloids & suspension.

Course: **Microbial Genetics** (BS 302)

After successfully completing this course, the student will be able to:

- Basic knowledge of NA. Structure & component of nucleic acid. DNA structure, RNA structure & types. Central dogma of the life, flow of genetic information,
- DNA replication, Gene expression – Transcription, Genetic code. Gene mutation & DNA repair mechanism.

Course: **Instrumentation & Biostatistics** (BS 303)

After successfully completing this course, the student will be able to:

- Basic knowledge of electromagnetic radiation, types of EM radiation. Radioactivity & Radioisotopes, their uses. Radiation hazards.
- Introduction, principle, operational technique of pH meter, colorimeter, Basics of spectrophotometer & electrophoresis. Chromatographic technique, types. Detail about paper chromatography, TLC.
- Introduction to biostatistics, data, table & frequency, sampling, statistical averages. Graphical representation of data, normal curve, test of significance.

Course: **Bioscience Practical** (BS 300P)

After successfully completing this course, the student will be able to:

- Qualitative determination of monosaccharide, disaccharides, polysaccharides, protein.
- Preparation of normal, molal, molar, % & buffer solutions.
- Measurement of pH of samples, take the OD of sample, prepare a standard graph of protein & sugar.
- Paper chromatography of amino acids, sugar.
- Separation of chlorophyll by ascending chromatography.

Course: **Microbial Cytology & Physiology** (BS 401)

After successfully completing this course, the student will be able to:

- Bacterial & archaeal cell wall and membrane. Structure & functions of various cell components. Uptake of nutrient & membrane transport. Nutritional requirement & types.
- Culture media: Ingredients, types and application of media.
  Isolation techniques, Anaerobic cultivation, Preservation & maintenance of culture.
- Microbial growth, Mathematics of growth, Generation time and growth rate.
  Measurement of growth, Growth curve.

Course: **Introductory Medical Microbiology** (BS 402)

After successfully completing this course, the student will be able to:

- Basic knowledge of immune system, cell, tissue & organs of immune system, immune response, immunity; natural & acquired.
- Host defense system – internal & external. Detail aspect of antigen, types.
  Immunoglobulins – structure and types.
- Normal flora, Pathogen & their entery. Infection, its types, virulence & virulence factor, pathological condition. Types of diseases.

Course: **Human Physiology** (BS 403)

After successfully completing this course, the student will be able to:

- Basic knowledge regarding tissues, Types of tissue, detail about various tissues.
  Detail about the blood, its component and its functional aspect.
- Blood coagulation, mechanism, pathway, Blood pressure & its measurement.
- Temperature regulation, heat regulation mechanism.
- Osmoregulation and body fluids.

Course: **Bioscience Practical** (BS 400P)

After successfully completing this course, the student will be able to:

- Determination of blood groups, Blood cell count: RBC, WBC & Differential counts DC.
- Estimation of hemoglobin, Measurement of blood pressure, Determination of clotting time.
- Various types of bacterial staining: Gram's staining, Acid -fast staining, Spirochete staining, Capsule and Cell wall staining, Volutin and Endospore staining.
- Preparation culture media, biochemical media, study of biochemical properties of some bacteria.
- Study of bacterial growth curve, effect of heat, chemical agents on bacterial growth.
- Pure culture study of *Escherichia coli, Klebseilla mobillis* (*E. aerogenes), Proteus vulgaris, Serratia marcescens, B. megaterium, B. subtilis, B. cereus, Staph. aureus* & *S. epidermidis.*

T. Y. B. Sc.

Course: **Microbial Taxonomy & Virology** (BS 501)

After successfully completing this course, the student will be able to learn about,

- Basic knowledge of Microbial Taxonomy, microbial phylogeny, higher level of classification.
- Bergey's Manual of Systematic Bacteriology & major physiological groups of Archea
- Viral classification, viral cultivation, viral replication, basics of Viriods, Prions, Oncoviruses & emerging viruses.

Course: **Microbial Genetics** (BS 502)

After successfully completing this course, the student will be able to learn about,

- Basic knowledge of Gene expression in prokaryotes and eukaryotes, Regulation of gene expression, Gene transfer & recombination:
- Recombinant DNA technology, Basic fundamental process & application.
- Advanced techniques like PCR, Blot tech, DNA finger printing etc.

Course: **Microbial Metabolism** (BS 503)

After successfully completing this course, the student will be able to learn about,

- Basic knowledge of microbial metabolism, fermentation, EMP, TCA, ETC, Protein lipid catabolism, Nitrification.
- Principle and precursor metabolites of Anabolism, Reductive TCA cycle, Glyoxylate cycle & Peptidoglycan synthesis.

Course: **Medical Physiology** (BS 504)

After successfully completing this course, the student will be able to learn about,

- Microscopic organization of organs of alimentary tract, other organs & their physiological functions, details of digestive juices.
- Introduction to endocrine glands, hormone, neurohormone, Microscopic organization of endocrine gland, their physiological functions & abnormalities.

Course: **Clinical Biochemistry** (BS 505)

After successfully completing this course, the student will be able to learn about,

- Basic knowledge & details of organ function tests; LFT, KFT, PFT, CPT, thyroid function test.
- Physiology, collection of body fluids. Physical, chemical & microscopic examination of Urine, CSF, semen. Routine examination of Sputum and of Stool.

Course: **Hematology & Blood Banking** (BS 506)

After successfully completing this course, the student will be able to learn about,

- Basic knowledge & detail of hematopoietic system of the body, Blood collection and Clinical hematology, Blood disorder, coagulation disorder. Automation in hematology
- Blood transfusion practice, Documentation & QC in blood banking, transfusion practice, testing of blood, Transfusion complications – types, investigation, prevention.

Course: **Bioscience Practical** (BS 500P)

After successfully completing this course, the student will be able to:

- Study of various system of Rat, microscopic structure of organs, gonads, endocrine gland
- Physical, chemical & microscopic examination of urine, CSF, Semen
- Quantitative estimation of various blood constituents and enzymes.
- Skill to collect the blood & hematological analysis of various parameters.
- Blood banking, grouping techniques & Cross-matching.
- Basic operational skill regarding Electrophoresis, technique for serum protein & Hb electrophoresis.
- Isolation of mutants.

Course: **Medical Microbiology & Immunology** (BS 601)

After successfully completing this course, the student will be able to learn about,

- Basic knowledge & detail of various bacterial, some viral & fungal diseases, some parasitic & worm infection.
- In immunology they learn about Cytokines, various antigen antibody reactions, Allergic reaction & some autoimmune diseases.

Course: **Clinical Microbiology** (BS 602)

After successfully completing this course, the student will be able to learn about,

- Basic knowledge & detail of various aspects of epidemiology, about epidemics: prevention & control,
- Collection & aseptic handling of clinical specimen, microbiological examination of clinical sample.
- Chemotherapeutic agents, Antimicrobial sensitivity testing in detail, MIC, MBC. They also learn some advanced technique like ELISA, RIA, Hybridoma, Immunoblot, Immunofluorescence, Immunochromatographic technique

Course: **Food & Dairy Microbiology** (BS 603)

After successfully completing this course, the student will be able to learn about,

- Basic knowledge & detail of food microbes, food preservation technique, food spoilage, food borne diseases, detection of food pathogen, food intoxication.
- Microbiology of fermented food, production of alcoholic beverages, breads. Microbiology of milk, pasteurization, curdling, spoilage of milk. Microbiological analysis of milk, Milk products cheese, probiotics

Course: **Environmental Microbiology** (BS 604)

After successfully completing this course, the student will be able to learn about,

- Basic knowledge & detail about microbiology of water, water quality, microbiological analysis of water. Sewage, water quality, municipal sewage treatment.
- Agriculture microbiology, soil fertility, nitrogen fixation, PGPR. Biofertilizer, Biopesticide, Bioenergy.
- General aspects of bioremediation, bioremediation of hydrocarbon, xenobiotics, industrial waste. Biodegradation process & types, Phytoremediation.

Course: **Fermentation Technology** (BS 605)

After successfully completing this course, the student will be able to learn about,

- Basic knowledge of fermentation process, screening technique & detail of fermentation media, Media sterilization & types
- Essential features of bioreactor. Complete detail regarding bioreactor & types. Downstream processes, Cell harvesting, product recovery, some important industrial products.

Course: **Fundamentals of Bioinformatics** (BS 606)

After successfully completing this course, the student will be able to learn about,

- Basic knowledge & detail about genomics and genome sequencing. Introduction to proteomics, amino acid sequencing, structural & functional proteomics.
- Introduction to bioinformatics, present scenario, application Bioinformatics database, types of data, structural database.
- Bioalgorithm tools, sequence alignment. Phylogenetic, molecular evolution and Phylogenetic tree.

Course: **Bioscience Practical** (BS 600P)

After successfully completing this course, the student will be able to:

- Various immunological test like Widal, RPR, RA test
- Demonstration of Gel precipitate, ELISA, immunodot, Immunochromatographic test.
- Microbiological analysis of milk, water and sewage sample.
- Diagnostic medical problem: Collection of clinical sample - Blood / Urine / Stool & Wound/Abscess/ Purulent exudates. Routine examination of stool & sputum.
- Pure culture study of Salmonella group, UTI pathogen & Staphylococci.
- Antibiotic sensitivity testing & Determination of MIC.
- Primary screening of amylase, organic acid, antibiotic producers, Production of amylase and its activity check
- Demonstration of recovery of crude protein / amylase from fermentation broth, Bioassay of penicillin.
- Separation of nucleic acid by agarose gel electrophoresis.

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Department of Physics

Goals

The Department has formulated two broad educational goals for the undergraduate degree programs:

Physics Fundamentals: To build and strengthen the basic foundation of the students in Physics by having interplay between theory and experiment and to inculcate scientific enthusiasm and curiosity among them through the joy of learning.

Problem solving skills: To provide students with the tools needed to understand and then analyze problems, apply mathematical formalism and experimentation and synthesize ideas of solving them in the best possible way.

Course Outcomes

F. Y. B. Sc.

Course: Vector analysis (PH – 101)

After successfully completing this course, the student will be able to:

CO1: understand the difference between vectors and scalars, combinations of vectors, their products and solve Physics problems using them;

CO2: study vector and scalar fields and functions along with their properties;

CO3: understand the concept of scalar and vector operators;

CO4: study gradient, divergence and curl and their examples;

CO5: be familiar with some vector identities and verify them which will be useful to them in the study of Electrodynamics and Plasma Physics.

Course: Force and Newton's Laws (PH – 101)

After successfully completing this course, the student will be able to:

CO1: understand Newton's laws of motion in detail;

CO2: use knowledge of Newton's laws and equations of motion to solve problems;

CO3: study law of conservation of momentum and its applications;

CO4: understand uniform circular motion and relative motion.

Course: Momentum and System of Particles (PH – 101)

After successfully completing this course, the student will be able to:

CO1: obtain knowledge of collision and its types; study some real life examples of collisions;

CO2: establish relations between linear and angular variables.

Course: Elasticity (PH – 101)

After successfully completing this course, the student will be able to:

CO1: understand one of the basic properties of a material: elasticity, stress and strain, difference between stress and pressure;

CO2: study Hooke's law and various types of moduli;

CO3: establish relations among elastic constants and problems based on them.

Course: Electrostatics I (PH – 102)

After successfully completing this course, the student will be able to:

CO1: understand Coulomb's law and its applications;

CO2: study some basic quantities such as field, electric field, flux, electric flux etc.;

CO3: understand Gauss's law for electrostatics and its applications for some specific charge distributions;

CO4: solve numerical problems based on Coulomb's law, principle of superposition and Gauss's law.

Course: Electrostatics II (PH – 102)

After successfully completing this course, the student will be able to:

CO1: study electrostatic potential and potential energy;

CO2: establish relationship between electric field and electrostatic potential;

CO3: discuss equi-potential surfaces and their significance;

CO4: understand electric current and emf;

CO5: do some circuit analysis and analysis of RC circuit.

Course: Diode Circuits (PH – 102)

After successfully completing this course, the student will be able to:

CO1: study transformer and rectification;

CO2: understand half-wave rectifier, full-wave rectifier and full-wave bridge rectifier along with their parameters;

CO3: study necessity of filter circuits and understand different types of filters;

CO4: discuss clippers, clampers and limiters.

Course: Optics (PH – 102)

After successfully completing this course, the student will be able to:

CO1: understand the basic nature of light;

CO2: study Fermat's principle and use it to establish laws of reflection and those of refraction;

CO3: study lens, lens system and cardinal points of a lens system;

CO4: use mathematical analysis to obtain properties of image, formed by combination of lenses and apply theory of optics to calculate the cardinal points of an optical system

CO5: establish Newton's formula of a lens and study its uses;

CO6: study aplanatic points and aplanatic surfaces;

CO7: study combination of two thin lenses and its cardinal points.

Course: Angular Momentum and Gravitation (PH – 201)

After successfully completing this course, the student will be able to:

CO1: understand rotational motion in detail along with its properties;

CO2: study torque and moment of inertia, relation between them, significance of moment of inertia, their applications and real life problems related to it;

CO3: understand the concept of angular momentum;

CO4: discuss the case of spinning top;

CO5: understand Newton's law of gravitation, gravitation near the earth's surface,

CO6: study gravitational field and gravitational potential.

Course: Oscillations and Waves (PH – 201)

After successfully completing this course, the student will be able to:

CO1: have basic ideas of oscillations and oscillatory motion, waves and its classification;

CO2: use knowledge of superposition principle to analyze the combinations of SHOs;
CO3: study law of conservation of momentum and its applications;
CO4: understand various wave properties.

Course: Particle Properties of Waves (PH – 201)

After successfully completing this course, the student will be able to:

CO1: study blackbody radiation and photoelectric effect, obtain their experimental results;
CO2: discuss dual nature of light;
CO3: study X-rays, their production, their properties and diffraction of X-rays;
CO4: discuss Compton Effect and establish particle nature of radiation;
CO5: study pair production and mass-energy relation.

Course: Elasticity (PH – 201)

After successfully completing this course, the student will be able to:

CO1: understand twisting of a cylinder, torsional pendulum and related problems;
CO2: study bending of a beam and a cantilever, to discuss real world problems of beams/ cantilevers;
CO3: determine elastic constants by Searle's method.

Course: Magneto-statics and Electromagnetic Induction (PH – 202)

After successfully completing this course, the student will be able to:

CO1: study the basics of magnetism;
CO2: study force on a moving charge and solve problems based on it;
CO3: understand torque on a current carrying loop;
CO4: Faraday's experiments on electromagnetic induction;
CO5: understand Faraday's and Lenz's law;
CO6: study motional *emf* and its applications;
CO7: understand the working of generator and motor.

Course: Thermodynamics (PH – 202)

After successfully completing this course, the student will be able to:

CO1: study the basic ideas such as that of temperature, thermal equilibrium, thermal expansion, pressure, mean free path and entropy;
CO2: discuss ideal gas and its equation;
CO3: discuss laws of thermodynamics;
CO4: change in entropy during various processes;
CO5: understand the efficiency of heat engines.

Course: Special purpose Diodes and BJTs (PH – 202)

After successfully completing this course, the student will be able to:

CO1: study the basic ideas of construction and working of special purpose diodes;
CO2: understand characteristics of zener diode and its application as a voltage regulator;
CO3: study the basic ideas of construction of transistors and its biasing;
CO4: discuss characteristics of transistors.

Course: Optics (PH – 202)

After successfully completing this course, the student will be able to:

CO1: understand the wave nature of light based on Huygens' theory;
CO2: study recti-linear propagation of light;
CO3: apply superposition principle to the waves of light;
CO4: study coherence, interference of light and diffraction of light;

CO5: obtain intensity distribution on the screen because of two waves of light under different conditions;
CO6: understand single-slit diffraction pattern.

Course: Physics Practical
After successfully completing this course, the student will be able to:
CO1: demonstrate an ability to collect data through observation;
CO2: acquire technical skills in using laboratory equipment, tools and materials;
CO3: experimentation and interpretation of data;
CO4: demonstrate an understanding of laboratory procedures using scientific methods;
CO5: demonstrate a deeper understanding of the basic concepts and theories gained by experiencing and visualizing them as authentic phenomena;
CO6: acquire complementary skills of collaborative learning and teamwork in the laboratory work.

S. Y. B. Sc.

Course: Kinetic theory of gases (PH – 303)
After successful completion of the course the student will be able to:
CO1: understand how statistics of the microscopic world can be used to explain the thermal features of the macroscopic world;
CO2: use thermal and statistical principles in a wide range of applications.

Course: Damped Oscillations (PH – 303)
After successful completion of the course the student will be able to:
CO1: have basic concepts of oscillations, SHM and damping;
CO2: obtain equation of motion of damped harmonic oscillator;
CO3: discuss various parameters associated with damped harmonic oscillator.

Course: Forced Oscillations (PH – 303)
After successful completion of the course the student will be able to:
CO1: study forced harmonic oscillator and resonance;
CO2: obtain equation of motion of forced harmonic oscillator;
CO3: discuss various parameters associated with forced harmonic oscillator;
CO4: understand Q-factor and sharpness of resonance;
CO5: study resonance in LCR circuit.

Course: Charged Particles in Electromagnetic Fields (PH – 303)
After successful completion of the course the student will be able to:
CO1: understand the behavior of charged particles in a crossed electric and magnetic fields;
CO2: understand the construction and working of the mass spectrograph and electron microscope.

Course (PH304): Wave Properties of Particles (PH – 304)
After successful completion of the course the student will be able to:
CO1: have basic concepts of the wave-particle duality of matter and radiation;
CO2: study de Broglie's theory and the concept of photon, along with its properties;
CO3: establish an equation of a wave and its differential equation;
CO4: have understanding of phase velocity and group velocity – the velocity with which matter waves propagate;

CO5: study of experimental confirmation of wave nature of particle by particle diffraction;
CO6: understand behavior of a particle confined to one-dimensional box which will effectively lead to further strengthen the basic concepts Quantum Mechanics;
CO7: describe uncertainty principle and its applications.

Course: Atomic Structure (PH – 304)

After successful completion of the course the student will be able to:

CO1: revise the old atomic models;
CO2: outline the basic structure of an atom and the concept of nucleus;
CO3: explain the origin of atomic spectra;
CO4: classify the atomic spectra;
CO5: have a basic understanding of atomic orbits and quantized energy levels of electrons in an atom through the study of Bohr's atomic model;
CO6: understand the correspondence principle;
CO7: study the basic idea of nucleus;
CO8: have basic concepts of absorption, spontaneous emission and stimulated emission
CO9: study production and properties of laser.

Course: Fraunhofer Diffraction (PH – 304)

After successful completion of the course the student will be able to:

CO1: revisit the wave nature of light, the concept of wave-front, Huygens' Principle, diffraction of light and types of diffraction;
CO2: understand diffraction of light by a circular aperture;
CO3: study resolving powers of various optical instruments;
CO4: explain the construction of diffraction grating;
CO5: establish the theory of transmission grating for different ways of incident light and solve problems based on it;
CO6: study X-ray diffraction and Bragg's law.

Course: Aberrations (PH – 304)

After successful completion of the course the student will be able to:

CO1: outline the basic idea of aberrations produces in the image using monochromatic light and white light;
CO2: describe optical aberrations produced in image by lenses and methods;
CO3: find methods of the removal of these aberrations;
CO4: design eyepieces free from aberrations which can then be used in microscopes and telescopes;
CO5: solve problems based on the phenomenon of aberration of light.

Course (PH305): Complex Variable (PH – 305)

After successful completion of the course the student will be able to:

CO1: redefine complex number and its complex conjugate, learn graphical representation of complex numbers;
CO2: understand functions of complex variables and analytical functions;
CO3: establish Cauchy-Riemann conditions;
CO4: study some special integrals;
CO5: understand Cauchy's theorem, Cauchy's integral formula and Cauchy's residue theorem;
CO6: solve problems using complex algebra and complex calculus.

Course: Thermoelectricity (PH – 305)

After successful completion of the course the student will be able to:

CO1: outline the basic idea of thermo-electricity and thermos-emf;
CO2: study Seeback effect, Peltier effect, Thomson effect and their applications;
CO3: discuss thermos-couple, thermopile and bolometer**.**

Course: Transistor Biasing and AC Models (PH – 305)

After successful completion of the course the student will be able to:

CO1: outline the voltage and current sources, network theorems and network analysis;
CO2: understand the load line and Q-point;
CO3: describe different types of biasing and their comparison;
CO4: explain amplifiers and amplification, small-signal operation of amplifiers;
CO5: understand two-transistor model.

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Course: Voltage and Power Amplifiers (PH – 305)

After successful completion of the course the student will be able to:

CO1: outline the basic concept of gain in an amplifier;
CO2: understand multistage amplifiers and swamped amplifiers;
CO3: get the concept of feedback in the circuits;
CO4: describe class A, class B and class C amplifiers;
CO5: study transistor power rating.

Course: Physics Practical (PH – 306)

After successfully completing this course, the student will be able to:

CO1: demonstrate an ability to collect data through observation;
CO2: use various instruments and equipment used in the laboratory;
CO3: design an experiment to test a hypothesis and/or determine the value of some unknown physical quantity;
CO4: set up experimental equipment to implement an experimental approach;
CO5: describe the methodology of science and the relationship between observation and theory;
CO6: obtain and analyze data, plot appropriate graphs and reach conclusions from the data analysis;
CO7: work in a group to plan, implement and report on a project/experiment;
CO8: keep a well-maintained and instructive laboratory record book;
CO9: express their knowledge and ideas through oral and written language.

Course: Thermodynamic relations, free energies and Thermodynamic equilibrium (PH – 403)

After successful completion of the course the student will be able to:

CO1: have basic concepts of the thermodynamic variables and their classification;
CO2: study Maxwell's thermodynamic variables and Maxwell's thermodynamic relations;
CO3: solve problems using TdS equations and laws of thermodynamics;
CO4: study Gibbs-Helmholtz equation;
CO5: study various thermodynamic processes;
CO6: discuss Gibbs phase rule.

Course: Production of low temperatures (PH – 403)

After successful completion of the course the student will be able to:

CO1: discuss Ordinary methods of cooling;
CO2: understand adiabatic cooling;

CO3: study Joule-Thomson effect and Joule-Kelvin effect: An isenthalpic process;
CO4: understand adiabatic demagnetisation;
CO5: study third law of thermodynamics its consequences.

Course: Crystal Structure (PH – 403)
After successful completion of the course the student will be able to:
CO1: understand the Periodic array of atoms;
CO2: describe fundamental type of lattices;
CO3: understand index system for crystal planes;
CO4: describe simple crystal structure and direct imagining of atomic structure and non-ideal crystal structure;
CO5: explain diffraction of waves by crystals;
CO6: describe Brillouin zones.

Course: Crystal Vibrations (PH – 403)
After successful completion of the course the student will be able to:
CO1: study vibrations of crystals with monoatomic bases;
CO2: understand two atoms per primitive bases.

Course: Quantum Mechanics (PH – 404)
After successful completion of the course the student will be able to:
CO1: get some flavor of Quantum Mechanics;
CO2: distinguish Classical Mechanics and Quantum Mechanics;
CO3: get the concept of wave function of a particle and its properties;
CO4: establish time-dependent Schrodinger's Equation and its steady state form;
CO5: obtain expectation value of an observable within the given interval;
CO6: understand the significance of operators of some physical quantities/ observables in Quantum Mechanics.

Course: Quantum Mechanics (PH – 404)
After successful completion of the course the student will be able to:
CO1: establish time-dependent Schrodinger's Equation and its steady state form;
CO2: use Schrodinger's Equation for solving problems of particle in a box finite potential and harmonic oscillator;
CO3: understand tunnel effect based on Schrodinger's Equation and its solution.

Course: Polarization and Double Refraction (PH – 404)
After successful completion of the course the student will be able to:
CO1: define unpolarized and polarized light, polarization of light, polarizers;
CO2: study various methods of polarizing an unpolarized light;
CO3: understand and study applications of fundamental laws associated with polarization of light: Brewster's Law and Malus' Law;
CO4: have an understanding of optical activity and specific rotation and real life problems.

Course: Lasers: An Introduction and Optical Fiber Basics (PH – 404)
After successful completion of the course the student will be able to:
CO1: outline the importance of coherence in optical phenomena;
CO2: describe different types of coherence and the factors affecting it;
CO3: understand the concept of stimulated emission on the basis of Einstein's theory;

CO4: define absorption, spontaneous emission and stimulated emission processes and describe lasing action through EDFA;
CO5: generate different types of Lasers;
CO6: study properties and applications of Laser
CO7: outline the phenomena such as reflection, refraction, total internal reflection and interference of light;
CO8: study the structure of optical fiber, its significance in context to communication.

Course: Fourier series (PH – 405)
After successful completion of the course the student will be able to:
CO1: outline the harmonic functions, odd and even functions and their expansion as Fourier series;
CO2: establish Dirichlet's condition for the function to be Fourier expandable;
CO3: solve problems and obtain Fourier series of some definite harmonic functions;
CO4: discuss properties and advantages of Fourier series.

Course: AC bridges (PH – 405)
After successful completion of the course the student will be able to:
CO1: study phase analysis in ac circuits containing different combinations of components;
CO2: do mathematical analysis of balancing an ac bridge having arms containing circuit components such inductor, resistor, capacitor etc;
CO3: study different ac bridges and their applications.

Course: Emitter Follower (PH – 405)
After successful completion of the course the student will be able to:
CO1: have basic idea of CC amplifier and its parameters;
CO2: study Darlington connections;
CO3: understand Class B push-pull emitter follower;
CO4: describe Class B amplifiers;
CO5: discuss voltage regulation.

Course: JFETs (PH – 405)
After successful completion of the course the student will be able to:
CO1: distinguish between BJT and FET;
CO2: study FET, JFET, MOSFET and their parameters;
CO3: discuss FET amplifiers and its applications.

Course: Physics Practical (PH – 406)
After successfully completing this course, the student will be able to:
CO1: demonstrate an ability to collect data through observation;
CO2: use various instruments and equipments used in the laboratory;
CO3: design an experiment to test a hypothesis and/or determine the value of some unknown physical quantity;
CO4: set up experimental equipment to implement an experimental approach;
CO5: describe the methodology of science and the relationship between observation and theory;
CO6: obtain and analyze data, plot appropriate graphs and reach conclusions from the data analysis;
CO7: work in a group to plan, implement and report on a project/experiment;

CO8: keep a well-maintained and instructive laboratory record book;
CO9: express their knowledge and ideas through oral and written language.

DEPARTMENT OF BOTANY

B. Sc. Botany

Botany is a scientific study of plants. It includes the study of their structure, how they grow, how they can be effectively classified, the things that impact their development etc. Botany is the branch of biology, which is study of all living organism.

Course Outcomes

F. Y. B. Sc. Sem I

Course 101: Plant Diversity

After successfully completing this course, students will be able to:

CO1: outline the Eichler classification system;
CO2: position the plants in five kingdom system;
CO3: describe prokaryotic and Eukaryotic cell structure;
CO4: classify the members of plants groups in to cryptogams and Phanerogams;
CO5: describe the general characters, structure and importance of Bacteria,
CO6: describe the general characters, structure and importance of Virus;
CO7: describe Nostoc and Spirogyra and their characters;
CO8: describe Mucor and Agaricus and their characters;
CO9: describe characters and importance of Lichen.

Course 102: Plant Diversity, Nursery management and utilization

After successfully completing this course, students will be able to:

CO1: describe Funaria and its characters;
CO2: describe Nephrolepis and its characters;
CO3: practice cutting, layering, budding and grafting;
CO4: describe the importance of Fertilizers and pesticides;
CO5: describe the importance of methods of irrigation;
CO6: describe the morphology of root, stem, leaves and flowers;
CO7: describe the cultivation of Sugarcane, Paddy, Mango and Brinjal.

Course: Botany Practical (103)

After successfully completing this course, students will be able to:

CO1: examine the growth of bacteria in curd under microscope;
CO2: identify the thallus structure in Nostoc and Spirogyra;
CO3: identify Mucor and Agaricus;
CO4: identify the Lichen Usnea;
CO5: identify Funaria and Nephrolepis;
CO6: demonstrate the methods of vegetative propagation;
CO7: illustrate the root, stem, leaves, flowers and its types.

F. Y. B. Sc. Sem II

Course 201: Physiology, Ecology and Anatomy of Plants, Medicinal plants and plant pathology:

After successfully completing this course, students will be able to:

CO1: describe imbibitions, osmosis and plant movement;
CO2: describe Light and Dark reaction;
CO3: describe C_3 and C_4 cycle;
CO4: describe the ecological adaptation, morphology and anatomy of Hydrophytes, Mesophytes and Xerophytes;
CO5: describe the tissue system and vascular bundle in plants;
CO6: describe the types of stele;
CO7: describe the Ergastic matter;
CO8: describe the medicinal plants;
CO9: describe the plant pathology.

Course 202: Plant Diversity and Weed management:

After successfully completing this course, students will be able to:

CO1: describe weed management;
CO2: describe Cycas and its characters;
CO3: describe the types of phyllotaxy and aestivation;
CO4: describe the types of Inflorescence and placentation;
CO5: describe some angiospermic families;
CO6: describe the methods of in-situ and ex-situ conservation;
CO7: describe botanical garden;
CO8: describe the importance of forest and their conservation.

Course: Botany Practical 203

After successfully completing this course, students will be able to:

CO1: demonstrate the plant physiological experiments;
CO2: identify and categorize hydrophytes, mesophytes and xerophytes;
CO3: identify different types of tissue;
CO4: identify different types of stele;
CO5: identify different types of vascular bundle;
CO6: identify and prepare slide of different types of Ergastic matter;
CO7: identify different medicinal plant;
CO8: diagnosis of different diseases in plants;
CO9: identify weed plants;
CO10: identify and prepare the slides of Cycas;
CO11: identify the morphological characters of plants;
CO12: identify the Morphological characters and floral dissection of some angiospermic families.

S. Y. B. Sc. Sem III

Course 301: **Plant Physiology and Plant Ecology**

After successfully completing this course, students will be able to:

CO1: explain water potential and root absorption;

CO2: explain respiration, its types and mechanism;
CO3: explain ascent of sap and transpiration;
CO4: explain types and components of ecosystem;
CO5: explain energy flow in ecosystem;
CO6: explain plant communities- Halophytes, Epiphytes and Lithophytes;
CO7: explain Ecological factors;
CO8: explain Soil erosion and conservation.

Course 302: **Plant anatomy, Plant Embryology and Genetics**

After successfully completing this course, students will be able to:

CO1: explain the structure of primary tissue of roots, stem and leaves in monocot and dicot plants;
CO2: explain normal and anomalous secondary growth in some plants;
CO3: explain microsporangium and male gametophyte;
CO4: explain megasporangium and female gametophyte;
CO5: explain fertilization;
CO6: explain Mendel's laws of inheritance and his experiments in heredity;
CO7: explain genetic material and its structure.

Course 303: Diversity of Gymnosperms and Angiosperms

After successfully completing this course, students will be able to:

CO1: describe the gymnosperms Pinus and Gnetum;
CO2: describe weak stem plants and bracts;
CO3: describe special types of inflorescence and fruits;
CO4: explain Pollination and its types;
CO5: describe the defensive devices of plants;
CO6: explain aims and objectives of plant taxonomy;
CO7: describe and classify with reason some angiospermic families.

Course ID: **Nutrition and Dietetics**

After successfully completing this course, students will be able to:

CO1: explain classification of food groups and its importance;
CO2: describe nutritive value of food groups;
CO3: explain the concept of balance diet;
CO4: explain the use of RDI in planning balance diet;
CO5: explain the macro nutrients – carbohydrate, protein, fats and lipids;
CO6: describe the micro nutrients – vitamins, minerals and water;
CO7: explain food preservation and its methods;
CO8: explain meal planning and its principles.

Course 304 Botany practical

After successfully completing this course, students will be able to:

CO1: demonstrate the physiological experiment;
CO2: explain the working method of ecological instruments;
CO3: recognize ecological peculiarities of Orchid and Avicennia;
CO4: identify the primary tissue structure in stem of Sunflower and Maize;
CO5: identify the anomalous secondary in some plants;
CO6: identify the permanent slides of embryology;

CO7: prepare the slide of Pinus and Gnetum;
CO8: identify the weak stem plants, bracts, defensive devices of plants and special types of inflorescences;
CO9: identify the morphological characters of some angiospermic families and its floral dissection.

S. Y. B. Sc. Sem IV

Course 401: **Lower Cryptogams**
After successfully completing this course, students will be able to:
CO1: explain general characters and structure of phytoplankton;
CO2: explain general characters and economic importance of algae;
CO3: explain the classification of algae given by G. M. Smith;
CO4: explain and classify Oscillatoria, Oodogonium, Ectocapus and Batrachospermum;
CO5: explain the general characters, structure and economic importance of fungi;
CO6: explain the classification of fungi given by Alexopoulos;
CO7: explain and classify Pythium, Aspergillus, Peziza and Puccinia.

Course 402: **Higher Cryptogams**
After successfully completing this course, students will be able to:
CO1: explain the general characters, classification and economic importance of bryophytes;
CO2: explain the general account of Hepaticopsida, Anthocerotopsida and Bryopsida;
CO3: describe the amphibian adaptation of bryophytes;
CO4: explain classification and life history of Riccia and Anthoceros;
CO5: explain the general characters, classification, Habitat and Habit of Pteridophytes;
CO6: explain the general account of Lycopsida, Sphenopsida and Pteropsida;
CO7: explain the classification and life history of Equisetum, Marsilea and Selaginella.

Course 403: Plant Geography, Economic Botany, Seed Plants and Plant Pathology
After successfully completing this course, students will be able to:
CO1: describe minor forest product of Gujarat;
CO2: describe the cultivation of some economically importance plants;
CO3: explain the uses of some medicinal plants;
CO4: explain and classify with reason some seed plant;
CO5: explain pathogens and symptoms of some plant diseases.

Course ID: **Biodiversity**
After successfully completing this course, students will be able to:
CO1: describe the introduction and scope of biodiversity.
CO2: explain the general pattern of vegetation of Gujarat;
CO3: explain the conservation of biodiversity;
CO4: describe the endangered, endemic, threatened and rare species of Gujarat;
CO5: explain the biodiversity of Flora, Fauna, Mangroves and Medicinal plants of Gujarat;
CO6: explain In-situ and Ex-situ Conservation;
CO7: explain biodiversity act and biological Hot-Spots.

Course 404: Botany practical

After successfully completing this course, students will be able to:

CO1: identify Oscillatoria, Oodogonium, Ectocarpus and Batrachospermum;

CO2: identify Pythium, Aspergillus, Peziza and Puccinia;

CO3: identify Anthoceros, Marsilea and Selaginella;

CO4: identify the minor products of forest;

CO5: identify the economically important plants;

CO6: identify the medicinally important plants;

CO7: identify the morphological characters of some angiospermic families and its floral dissection;

CO8: identify some plant diseases.