Satyaniketan’s

Adv. M. N. Deshmukh Arts, Science and Commerce College, Rajur.

Tal. Akole. Dist. Ahmednagar.

Department of Chemistry

ANNUAL TEACHING PLANNING 2016-17

**TYBSc-Physical Chemistry ( Prof. R. C. Muthe )**

**Sem- III**

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| **July** | **1. Chemical Kinetics : [10 L]** - Recapitulation of Chemical Kinetics, - Third order reaction, - Derivation of integrated rate law for third order reaction with  equal initial concentration, - Characteristics of third order reaction,  |
| **August** | - Examples of third order reaction, - Methods to determine order of reaction using Integrated rate  equation method, - Graphical method, - Half-life method, Differential method. - Effect of temperature on reaction rate, - Arrhenius equation, related numerical.  |
| **September** | **4. Phase Rule: [08 L]** - Definitions, - Gibb’s phase rule, - one component system (moderate pressure only) for sulphur and water system,  |
| **October** | - two component system for silver-lead and zinc-cadmium.  |

 **TYBSc-Physical Chemistry**

**Sem- IV**

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| **December** | **1. Nuclear Chemistry [12 L]** - The atom, - nucleus and outer sphere, - classification of nuclides, - nuclear stability and binding energy.- Discovery of radioactivity,  |
| **January** | - types of radioactivity, - general characteristics of radioactive decay and decay kinetics,- Measurements radioactivity, gaseous ion collection method, proportional and G.M. counter. Applications of radioactivity- - Radiochemical principles in the use of tracers, -Typical applications of radioisotopes as a tracer- i) Chemical investigations- reaction mechanism, ii)Structure determination- phosphorus pentachloride and thiosulphate ion  |
| **February** | iii)Age determination- by Carbon-14 dating and Uranium-Lead/ Thorium-Lead Ratio iv) Medical applications-Assess the volume of bloodin patients body, Goiter**4. Quantum Chemistry [10 L]** - Concept of quantization, - Atomic spectra (no derivation), - Wave particle duality, - Uncertainty principle, - Wavefunction and its interpretation, - Well-behaved function, - Hamiltonian (energy) operator,  |
| **March** | - Formulation of Schrodinger equation, - Particle in box (1D, 2D and 3D box) (no derivations), - Sketching of wavefunction and probability densities for 1D box, - Correspondence principle, degeneracy(lifting of degeneracy), - Applications to conjugated systems, - Harmonic oscillator, - Wavefunction and probability densities (no derivation), - Zero point energy and quantum tunneling. |

**TYBSc-Industrial Chemistry**

**Sem- III**

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| **July** | **1. Modern Approach to Chemical Industry (08)** * Introduction,
* basic requirements of chemical industries,
* chemical production, raw materials,
* unit process and unit operations,
* Quality control,
* quality assurance,
* process control,
* research and development,
* pollution control, human resource,
* safety measures,
* classification of chemical reactions,
* batch and continuous process,
* Conversion, selectivity and yield,
* copy right act, patent act, trade marks

**2. Agrochemicals (08)** * General introduction and scope of agrochemicals,
* meaning and examples of: Insecticides, Herbicides, Fungicides, Rodenticides, Pesticides, Plant growth regulators.
* Pesticide formulation, slowrelease pesticide formulations,
* storage stability test, and Industrial entomology.
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| **August** | * Advantages and disadvantages of agrochemicals.
* Structure,: DDT, BHC, Warfarin, Aldrin, Endosulphan,
* synthesis and application:DDT, BHC andEndosulphan.
* Biopesticides like Neem oil and Karanj oil.

**3. Manufacture of Basic Chemicals (08)*** Ammonia: Physicochemical principles involved, Manufacture of ammonia by modified Haber-Bosch process, its uses.
* Sulphuric acid: Physicochemical principles involved, Manufacture of sulphuricacid by contact process, its uses.
* Nitric acid: Physicochemical principles involved, Manufacture of nitric acid by Ostwald’s process, its uses.
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| **September** | **4. Petrochemicals and eco-friendly fuels (08)*** Introduction, occurrence, composition of petroleum,resources, processing of petroleum, calorific value of fuel, cracking, octane rating (octane number), cetane number, flash 40 point, and petroleum refineries, applications of petrochemicals, synthetic petroleum, lubricating oils & additives
* Fuels and eco-friendly fuels: liquid, gaseous fuel (LPG, CNG), fossil fuels, diesel, bio diesel, gasoline, aviation fuels. Use of solar energy for power generation.

**5. Food and Starch Industry (08)** **Food Industry:** * Definition and scope, nutritive aspects of foodconstituents, , food deterioration factors and their control;
* Preservation and processing:Heat and cold preservation and processing, cold storage, food dehydration and concentration, various foods, their processing and preservation methods, fruits, beverages, cereals, grains, legumes and oil seeds;
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| **October** | .* Food additives: Enhancers, sugar substitutes, sweeteners, food colors,

**Starch industries:** * Chemistry of starch,
* manufacturing of industrial starch and its applications,
* characteristics of some food starches,
* non-starch polysaccharides-cellulose-occurrence.

**6. Cement and Glass industry (08)** **Cement industry:** * Introduction,
* Importance, composition of portland cement,
* raw materials, proportioning of raw materials, setting and
* Hardening of cement,
* reinforced concrete.

**Glass industry** * Introduction,
* importance, physical and chemical properties of glass,
* chemical reaction, annealing of glass
* Special glasses: colored, safety, hard, borosilicate, optical, photosensitive, conducting, glass laminates.
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**TYBSc-Industrial Chemistry**

**Sem- IV**

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| **December** | **1. Polymer chemistry (10)*** Classification of Polymers: Organic and Inorganic polymers
* Basic concepts, nomenclature, degree of polymerization, classification of polymerization reactions, thermodynamic and transport properties of polymer

b)Commercial polymers and their importance: (a) Nylon, polyesters (terylene and dacron), rubber, vulcanization of rubber, synthetic rubber, Bun 2-N rubber, copolymers of butadiene, PVC, acrylic, teflon, polyethylene and acrylonitrile; (b) Silicone polymers: silicone oils, rubber, grease and resin; (c) Resins: Phenol-formaldehyde resins, urea-formaldehyde resins, epoxy resins, melamine-formaldehyde resins;**2. Sugar and Fermentation Industry (08)** **Sugar:** * Occurrence,
* Manufacturing of refine cane sugar from sugar cane, general idea of carbonation and sulphitation processes and their comparison, by-product and their use.
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| **January** | **Fermentation Industry:** * Introduction,
* importance, Basic requirement of fermentation process,
* Manufacture of industrial alcohol from molasses, fruits, food grains, & ethylene,
* Manufacturing of wine, beer, whisky, rum ;
* importance Power alcohol

**3. Soap, detergents and Cosmetics (08)*** Chemistry of soap, row material, chemical reaction,types of soap.
* Meaning of the terms detergent and surfactants, emulsion and emulsifying agents, wetting and non-wetting, hydrophobic and hydrophilic nature, amphipathic structures, types of surfactants, raw materials for detergents, washing action of soaps and detergents, detergent builders, additives.
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| **February** | * Raw materials: emulsifiers (natural, synthetic and finely dispersed solids), lipid components (oils, waxes, fats), humectants, colours (dyes and pigments), preservatives and antioxidants. (b) Cosmetics for skin: Types and problems of skin,key ingredients of skin cleansing, toners, moisturizers, nourishing, protective sunscreen, talcum powder and bleaching products. (c) Hair care: classification, ingredients, special additives for conditioning and scalp health, hair colourants (temporary, semi-permanent and gradual colourants), the plant materials (herbs) used in hair cosmetics.

**4. Dyes and paints** * (a)Dyes: Introduction, classification of dyes: Structures and applications, nitro, nitroso, azo, heterocyclic, phthalenes, xanthenes, rhodamines, thiazine, cyanine, anthraquinone, indigoids, thioindigoids, phthalocyanines, wet dyes.
* Paints: Introduction of paints, ingredients and classification, new technologies; properties of coatings; solvents, plasticizers, dyes and bioactive additives;
* Pigments: Introduction, classification and general physical properties.

**5. Chemistry of pharmaceutical industries (08)*** General aspects of drug action: Introduction, classification, nomenclature, structure-activity relationship, action of drugs, factors affecting drug action, metabolism of drugs, chemical structures, methods of production and pharmacological activity.
 |
| **March** | * Meaning of the terms: Prescriptions, doses, analgesic, antipyretic, diuretic, anesthetics, antibiotics, anti-inflammatory, anti-viral, tranquilizer, antiulcer, antialargic and bronchodilators, cardiovascular, cold preparations, anti-hypertensive, cough preparation, anti-neoplastic, sedative and hypnotics, steroidal, contraceptive, histamine and antihistamine.
* Synthesis and uses: Paracetamol, Aspirin, Sulphanilamide.

**6. Pollution prevention and waste management (06)*** Introduction,
* importance of waste management,
* concept of atom economy,
* Terms involved in waste minimization: source reduction, recycling, product changes, source control, use and reuse, reclamation, assessment procedures, types of wastes, treatment and disposal of industrial waste.
* Treatment of wastes or effluents with organic impurities.
* Treatment of wastes or effluents with inorganic impurities.
* The nature, effect and treatment of some important chemical wastes-(Pulp and paper industries, soap and detergent industries andfood processing industries).
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**T. Y. B. Sc. Semester – IVth**

**Physical Chemistry Paper I (Sem-IV) (Prof.H.M.Kakade)**

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| Sr. No. | Month |  Topic | Periods |
| 1 | December  | **2. Electrochemical cells (14 L)**- Reversible and irreversible cells,- Emf and its measurements,- Standard cells, cell reaction and Emf,- Single electrode potential and its calculation,- Calculation of cell Emf,- Thermodynamics of cell Emf,- Types of electrodes, | 06 |
| 2 | January | - Classification of electrochemical cells with and without transference,- Applications of Emf measurment)Solubility product of sparingly soluble salt,ii) Determination of pH,iii) Potentiometric titration | 06 |
| 3 | February  | **3. Crystal Structure (10)**- Crystallization and fusion process,- Crystallography, Crystal systems,- Properties of crystals,- Crystal lattice and unit cell, | 06 |
| 4 | March  | Crystal structure analysis by X ray - The Laue method and Braggs method,- X-ray analysis of NaCl crystal system,- Calculation of d and λ for a crystal system. | 06 |

**T. Y. B. Sc. Semester – IIIrd**

**Inorganic Chemistry Paper I (Sem-III) (Prof.H.M.Kakade)**

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| Sr. No. | Month |  Topic | Periods |
| 1 | June  | 1. Molecular Orbital Theory 15 L Limitations of Valence Bond theory(VBT), Need of Molecular orbital theory (MOT), Features of MOT, Formation of molecular orbitals(MO’s) by LCAO principle, Rules of LCAO combination, Different types of combination of Atomic orbital(AO’s): S-S, S-P, P-P and d-d, Non-bonding combination orbitals(formation of NBMO), M.O. Energy level diagram for homonuclear diatomic molecules, Bond order and existence of molecule from bond order, Energy (β) and magnetic behavior for following ,molecules or ions: H2, H2+, He2+, Li2, Be2, B2, C2, N2, O2, O2+, O2-, O22-, F2, Ne2, M.O. energy level diagram, for heteronuclear diatomic molecule like CO, NO, HCl, HF. M.O. energy level diagram, for heteronuclear triatomic molecule like CO2, NO2 ,Comparison of VBT, CFT, and MOT.  | 12 |
| 2 | July  |  I. INTRODUCTION TO COORDINATION CHEMISTRY (03 L) 1. General account and meaning of the terms involved in coordination chemistry: Coordinate bond, central metal atom or ions, ligand, double salt, complex compound, coordination number, charge on the complex ion, oxidation numberof Metal ion, first and second coordination sphere. 2. Ligands: Definition, Classification, Chelates and chelating agents. 3. Formation Constant, inert and labile complexes. 4. IUPAC nomenclature of coordination compounds 5. Different geometries of coordination compounds with C.N.= 4 to C.N.=10 and examples of each geometry.  | 12 |
| 3 | August  | II. WERNER’S THEORY OF COORDINATION COMPOUNDS (02 L) Assumptions of Werner’s coordination theory, Werner’s formulation of Coordination compounds, Physical and chemical test to support his formulation of ionizable and non-ionizable complexes, Stereoisomerism in complexes with C.N.4 and C.N. 6 to identify the correct geometrical arrangement of the complexes. III. ISOMERISM IN COORDINATION COMPLEXES (04 L) Definition of isomerism in complexes-Structural Iso. and stereoiso. 1. Structural isomerism (ionization, hydrate, linkage, ligand, coordination position and polymerization isomers) 2. Stereoisomerism and its types-Geometrical iso. and optical iso. IV. SIDGWICK THEORY (02 L) Concept of Sidgwick’s model, Scheme of arrow indication for M-L bond suggested by Sidgwick, Effective Atomic Number rule (EAN), Calculations ofEAN value for different complexes and stability ofcomplexes, Advantages and Drawbacks of Sidgwick’s theory.  | 12 |
| 4 | September  | V. PAULING’S VALENCE BOND THEORY (06 L) Introduction of Valence Bond Theory (VBT), Need of concept of hybridization, Aspects of VBT, Assumptions, VB representation of tetrahedral, square planer, trigonalbipyramidal and octahedral complexes with examples, Inner and outer orbital complexes, Electro neutrality principle, Multiple bonding( dπ-pπ and dπ-dπ), Limitations of VBT. VI. CRYSTAL FIELD THEORY (10 L) Introduction and need of Crystal Field Theory(CFT),Assumptions, Shapes and degeneracy of d orbital, Splitting of d-orbitals, Application of CFT to octahedral complexes, pairing energy(P) and distribution of electrons in eg and t2glevel, calculation of magnetic moment using spin-only formula, Crystal Field Stabilization Energy (CFSE), calculation of CFSE in weak oh field and strong oh field complexes, Evidence for CFSE, Interpretation of spectra of complexes, calculation of 10 Dq and factorsaffecting magnitude of 10Dq, d-d transitions and colour of the complexes, Jahn-Teller distortion theorem for octahedral complexes and its illustration, CFT of tetrahedral and square planar  | 12 |
| 5 | October  | complexes, calculations of CFSE, Spectrochemical series, Nephelauxatic effect and Nephelauxetic series, Limitations of CFT, modified CFT (LFT), Problems related to calculation of 10 Dq, CFSE and spin only magnetic moment for octahedral, tetrahedral & square planar complexes. (i.e. for high spin & low spin complexes) VII. MOLECULAR ORBITAL THEORY OF COORDINATION COMPLEX Introduction, Assumptions, MO treatment to octahedral complexes with sigma bonding, Formation of MO’s from metal orbitals and CompositeLigand Orbitals (CLO), MO correlation diagram for octahedral complexes with sigma bonding, effectof π bonding, Charge transfer spectra | 12 |

**.Inorganic Chemistry Paper I (Sem-IV) (Prof.H.M.Kakade)**

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| Sr. No | Month |  Topic | Periods |
| 1 | December  | 1. Chemistry of f- block elements (08 L) Introduction of f-block elements- on the basis of electronic configurations, occurrence and reactivity, F-block elements as Lanthanide and Actinide series I. Lanthanides Position in periodic table, Name and electronic configuration of lanthanides, Oxidation States, Occurrence and separation (Group/ Individual) by modern methods (ion exchange and solvent extraction method), Lanthanide contraction & its effect on chemistry of Lanthanides and post-lanthanide elements, applications of lanthanides II. Actinides Position in periodic table, Name and electronic Configuration of actinides, Oxidation States, Occurrence, and general methods of preparation of transuranic elements [viz., a) Neutron Bombardment, b) Accelerated projectile bombardment and c) Heavy ion bombardment], Nuclear Fuels-Nuclear Fusion fuels & nuclear fission fuels,IUPAC nomenclature system for super heavy elements with atomic no. (z) greater than100, Comparison between Lanthanides and Actinides. 2. Metals, semiconductors and Super conductors (10 L) Introduction, Metallic bonding, Band theory in metals with respect to Na along with n (E) and N(E) diagrams, Electrical conductivity of metals (Na, Mg, Al), Valence electrons and conductivity  | 12 |
| 2 | January  | metals, Effect of temperature and impurity on electrical conductivity of metals, Semiconductors – types of Semiconductors: I. Intrinsic II. Extrinsic, effect of temperature and impurity on semiconductivity, N & P type semiconductors ZnO andNiO, Super conductivity- Discovery, Property, Models structure and superconductivity, Applications of superconductors, 3. Ionic Solids (06 L) Crystalline and amorphous solids, crystal structures simple cubic, body centered cubic and face centered cubic, Properties of ionic solids, packing arrangements of anions in an ionic solids, Voids in crystal structure- tetrahedral and octahedral, Ionic radius, Palings univalent and crystal radii, Conversion of univalent radii to crystal radii, problems based on conversion of radii, Radius ratio effect, Lattice energy, Born-Lande equation, Born Haber cycle and its applications, Schottky and Frenkel defect.  | 12 |
| 3 | February  | 4. Homogeneous Catalysis (06 L) Definition, types of homogeneous catalysts, Essential properties of homogeneous catalysts, Catalytic Reactions such as: a. Wilkinson’s Catalysis b. Zeigler Natta Catalysis c. Monsanto acetic acid synthesis 5. Heterogeneous Catalysis (08 L) Definition, types of heterogeneous catalysts-metals, semiconductors, solid acid catalysts and supported catalysts, Essential properties of heterogeneous catalysts, Catalytic Reactions such as: a. Oxidation- i. Synthesis of terephthalic acid from xylene using ZSM-5 ii. Synthesis of benzoic acid from toluene using KMnO4b. Reduction- i. Hydrogenation of alkene to alkane using Raney Ni catalyst. ii. Synthesis of p-aminophenol from nitrobenzene using Pd/C catalyst. c. Cyclization- Benzimidazole synthesis using o-phenenediamine and benzaldehyde by acidic support or clay-solid support, amberlist or NH4Cl. d. Biodiesel Synthesis- using heteropolyacid catalyst-Transesterification using phosphomolybdic or phosphotungstic acid.  | 12 |
| 4 | March  | 6. Bioinorganic Chemistry (06 L) I. Introduction, Role of metals in bioinorganic chemistry- a. Classification as enzymatic and non-enzymatic metals, Enzymatic redox metals such as Cu (SOD) and enzymatic non redox metals such as Zn (Hydrolase). b. Role of metal ions in non-enzymatic process- Na, K,Ca, Mg (one example of each and brief discussion). c. Role of metals in enzymatic processes-Transition metals- Catalase, peroxidase and nitrogenase (Redox active). II. Metalloproteins-Iron proteins-Introduction of Fe-S proteins, Electron transfer proteins (Fe-S, Fe2S2, Fe3S4, Fe4S4). Transport protein (transferrin) and Storage protein (ferritin) III. Bioinorganic Chemistry of Fe: Hemoglobin and myoglobin, its structure and functions. IV. Bioinorganic Chemistry of Co: Vitamin-B12, its structure and function. 2 transport and storage.  | 12 |

**Semester -III, First Term CH- Semester-III**

**Agriculture Chemistry (Prof. Salunke Mukund Shriram)**

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| Month | **Topic** | **Lectures** |
| **June** | **TERM- I****Chapter IV- Plant Nutrients (08 L)**4.1 Need of plant nutrients, forms of nutrients updates, nutrient absorption by plants4.2 Classification of essential nutrients4.2.1 Primary nutrients (N, P, K), its role and deficiency symptoms in plants | **(02)** |
| **July** | 4.2.2 Secondary nutrients, (Ca, Mg, S), its role and deficiency symptoms in plants4.2.3 Micronutrients, General functions of micronutrients (Zn, Fe, Mn, Cu, B, Mo, Cl)4.3 Effect of environmental condition, nutrient uptake**Chapter V- Fertilizers and Manures** **Fertilizers**5.1 Introduction, Classification & application of fertilizers5.2 Time and methods of fertilizersfertilizers5.3 Factors affecting efficiency of fertilizers5.4 Vermicompost preparation, effect of vermicompost on soil fertility | **(06)****(02)** |
| **August** | 5.5 Synthetic fertilizers definition, comparison of synthetic fertilizers with organic fertilizers ,environmental effect of synthetic**Manures**6.10 Introducation, Definition and classification of manures6.11 Effect of bulky organic manures on soil, farm yard manures (FYM), Factors affecting on FYM, method of preparation, losses during handling and storageBiogas plant. Human waste, sewage and sludge, types of sludge, carbon nitrogen ratio, sewage irrigation and uses6.13 Green manuring, types of green manuring, characteristics, advantages anddisadvantages of green manuring**Chapter VII- Protection of Plants** Pesticide Classification and mode of action 7.1 Insecticide- Definition, Classification, chemical properties, elemental composition,mode of action of synthetic and plant originated compounds organophosphates, malathion, parathion, carbamates | **(06)****(02)** |
| **September**  | 7.2 Fungicides- Definition, Classification, Chemical properties, mode of action of S& Cu fungicides7.3 Herbicides- Definition,, Classification, composition, mode of action of Selective andnon-selective herbicides | **(06)** |
| **October**  | Solve the problem Solve the Question paper  | **(02)** |
|  | December | **Semester-IV****Course: Dairy Chemistry (CH-336E)****Chapter V- Preservatives & Adulterants in milk** 1. Preservation of milk- Introduction, Common preservatives are used.2. Adulterants- Introduction, Modes of Adulteration and their detection such as skimming,addition of separated milk, skim milk, Water, Starch and cane suga | **(06)** |
|  | January | **Chapter VI- Milk Products** Cream, Butter, Cheese and Ice-Cream.1. **Cream**- Definition, Classification, Composition, Food & Nutritive value,Physicochemical properties, Manufacture and uses of cream.Ref-1 117, 118, 121 & 142 | **6** |
|  | February | 2. **Butter**- Definition, Classification, Composition, Food & nutritive value,Physicochemical properties, Manufacture and uses of Butter selection of milk/cream.Preheating of milk, Separating of milk, neutralization of cream, Pasteurization of cream,Cooking & ageing, repending of cream, salting of butter, washing of butter, packaging &Storage, use of butter.  | **6** |
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|  | March | **Chapter VII- Dried milk products.**  Introduction, butter milk powder, whey powder, cream powder, infact milk powder,Shrikand powder, Ice-cream mix powder, cheese powderSolve the problemSolve the question paper | **6** |
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T. Y. B. Sc.Semester – IIIrd (**Dr.V.N.Gite)**

Agriculture Chemistry

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| Sr. No. | Month | Topic | Periods |
| 1 | June | Chapter I – Introduction to agricultural Chemistry  | 01 |
| 2 | July | Chapter I – Introduction to agricultural Chemistry Chapter II – Soil Chemistry  | 0106 |
| 3 | August | Chapter II – Soil Chemistry Chapter III – Problematic Soil and Soil testing  | 0305 |
| 4 | September | Chapter III – Problematic Soil and Soil testing Chapter IV- Quality of Irrigation Water | 0206 |
| 5 | October | Chapter IV- Quality of Irrigation Water  | 02 |

Semester – IVth

Dairy Chemistry

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| Sr. No. | Month | Topic | Periods |
| 1 | December | Chapter I – Market Milk | 02 |
| 2 | January | Chapter I – Market Milk Chapter II – Common Dairy Processes  | 0602 |
| 3 | February | Chapter II – Common Dairy Processes Chapter- III Special milks  | 0404 |
| 4 | March | Chapter- III Special milks Chapter IV- Milk proteins, Carbohydrates and Vitamins.  | 0404 |
| 5 | April | Chapter IV- Milk proteins, Carbohydrates and Vitamins. | 04 |

T. Y. B. Sc.Semester – IIIrd (**Dr.V.N.Gite)**

Organic Chemistry

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| Sr. No. | Month |  Topic | Periods |
| 1 | June | 1. Strength of Organic Acids and Bases  | 08 |
| 2 | July | 2.Stereochemistry of disubstituted cyclohexane 3.Nucleophilic substitution at aliphatic Carbon  | 0808 |
| 3 | August | 4.Reactions of Unsaturated Hydrocarbon (Carbon –Carbon double bond & triple bond) Reactions of Carbon –Oxygen double bond:  | 1006 |
| 4 | September | 5. Elimination Reactions 6.Aromatic Electrophilic and Nucleophilic Reactions | 0408 |
| 5 | October | 6.Aromatic Electrophilic and Nucleophilic Reactions  | 02 |

Semester – IVth

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| Sr. No. | Month | Topic | Periods |
| 1 | December | 1.Carbonions and their Reactions2.Retrosynthetic analysis and applications  | 0602 |
| 2 | January | 2.Retrosynthetic analysis and applications 3. Rearrangement Reactions | 0306 |
| 3 | February | 4. Spectroscopic methods in structure determination of Organic compounds A) IntroductionB) Ultra Violet SpectroscopyC) Infra red SpectroscopyD) NMR Spectroscopy (Only PMR) | 16 |
| 4 | March | D) NMR Spectroscopy (Only PMR) Natural Products  | 0804 |
| 5 | April | Natural Products  | 02 |