Akole Taluka Education Society’s,

**Agasti Arts, Commerce & Dadasaheb Rupwate Science College, Akole.**

Tal. Akole, Dist. Ahmednagar (422 601)

**Department of Chemistry**

**Academic Year: 2018-19**

**Program Outcomes, Program Specific Outcomes & Course Outcomes for PG**

**Course outcomes: M. Sc. Part- I**

**Semester- I**

**Theory Courses:**

**Course: 1) CHP: 110 Fundamentals of Physical Chemistry P-I (4 Credits)**

The learner will be acquired with sound knowledge of **-**

1) Thermodynamics- Heat, work & Conservation of energy – The basic concepts, the first law,

 infinitesimal changes, mechanical work, work of compression & expansion, free expansion,

 expansion against constant pressure, reversible expansion. Heat:- heat capacity, enthalpy.

 State functions & differentials – State functions, exact & inexact differential, changes in

 internal energy, temperature dependence of the internal energy, temperature dependence of

 the enthalpy. Work of adiabatic expansion – Irreversible adiabatic expansion, reversible

 adiabatic expansion.

2) The second law of Thermodynamics: Measuring the dispersal the entropy. The second law,

 definition of entropy, the entropy changes in the system, natural events. Entropy changes in

 the universe – The enthalpy change when a system is heated. Entropy changes in

 surroundings.

3) Combining First & Second law – One way of developing the fundamental equations

 properties of Gibbs function. The temperature dependence of the Gibbs functions. The

 pressure dependence of the Gibbs functions. The chemical potential of a perfect gas. The open

 system & changes of composition.

4) Changes of State: Physical Transformation of pure materials. The stabilities of phases, Phase

 equilibrium & phase diagrams. The solid – liquid boundary. The liquid - vapor boundary. The

 solid-liquid-vapor boundary.

5) Quantum theory, failure of classical mechanics, black body radiation,

 photo electric effect, specific heats of solids, Atomic spectra, wave particle duality,

 uncertainty principles, Schrodinger equation.

6) The rates of reaction, reaction rate, rate laws & rate constants, the determination of the rate

 law, first order, second order reactions, half lives, fractional order reactions.

7) Accounting for rate laws, simple reactions, the temperature dependence of reaction rates,

 reactions approaching equilibrium, consecutive reactions, the steady state approximations, pre

 equilibria, unimolecular reactions.

8) The kinetics of complex reactions: chain reaction- explosion, photochemical reactions

 Quantum efficiency, fast reactions-flash photolysis, flow techniques, relaxation methods.

9) Molecular reaction dynamics- collision theory-the basic calculations, the steric requirements,

 Diffusion control reactions- classes of reactions, diffusion and reactions, the details of

 diffusion, Activated complex theory- the reaction coordinate and the transition state, the

 formation and decay of the activated complex, how to use the Eyring equation,

 thermodynamics aspects, reactions between ions.

10) Enzyme catalysts: Michaelis-Menten mechanism, limiting rate, Lineweaver Burk and Eadie

 plots enzyme inhibition.

11) Molecular Thermodynamics: Molecular energy levels, Boltzmann distribution law, partition

 functions and ensembles, translational, rotational and vibrational partition functions of

 diatomic molecules, Obtaining energy, heat capacity, entropy free energy, equilibrium

 constant.

**Course: 2) CHI-130: Molecular Symmetry & Chemistry of p-block elements (4 Credits)**

The learner will be acquired with sound knowledge of **–**

1) Defining properties of a group, group multiplication table, some examples of group,

 Sub groups, classes.

2) Molecular Symmetry and Symmetry Groups: **S**ymmetry elements and operations,

 Symmetry planes and reflections, the inversion centre, proper axes and proper rotations,

 improper axes and improper rotation, products of symmetry operations, equivalent symmetry

 elements.

3) Representations of Groups:Matrix representation and matrix notation for geometric

 transformation, The Great Orthogonality Theorem.

4) Group theory and quantum mechanics:Wave function as basis for irreducible representations.

5) Symmetry Adapted Linear Combinations:Projection operators and their use of construct

 SALC (Construction of SALC for sigma bonding for molecules belonging point groups: D2h,

 D3h, D4h, C4v, Td., Oh., normalization of SALC.

6) Molecular Orbital Theory, Application of Group theory to Infrared Spectroscopy.

7) Hydrogen and its compounds: Hydrides: Classification, electron deficient, electron precise

 and electron rich hydrides. PH3 , SbH3 , AsH3 , Selenides, Tellurides, Alkali and alkaline earth

 metals: Solutions in non-aqueous Media, Application of crown ethers in extraction of alkali

 and alkaline earth metals.

8) Organometallic Compounds, Boron group, Carbon group, Nitrogen, Oxygen, Halogen groups.

**Course: 3) CHO-150: Basic organic chemistry (4 Credits)**

The learner will be acquired with sound knowledge of **–**

1) Structure and reactivity, Bonding other than covalent bonding, Acidity and basicity,

 Aromaticity, Structure and stability of reactive intermediates, carbenes, nitrenes, carbocations,

 carbanions and free radicals.

2) Sterochemical principles, enantiomeric relationship, distereomeric relationship, R and

 S, E and Z nomenclature in C, N, S, P containing compounds, Prochiral relationship,

 stereospecific and stereoselective reactions, optical activity in biphenyls, spiranes,

 allenes and helical structures.

3) Aliphatic nucleophilic substitution-SN1, SN2, SET and SNV mechanism, NGP by pi

 and sigma bonds, classical and non-classical carbocations, phenonium ions, norbornyl

 system, carbocation rearrangement in NGP, SNi mechanism, nucleophilic substitution

 in allylic,Trigonal and vinylic carbon, effect of structure, nucleophile, leaving group.

4) Aromatic Electrophilic substitution- Arenium ion mechanism, orientation and reactivity,

 energy profile diagram, ortho, para, ipso attack, orientation in other ring systems, naphthalene,

 anthracene, six and five membered heterocycles, diazonium coupling. Important reactions like

 Friedel crafts alkylation and acylation, Nitration, halogenation, formylation,

 Chloromethylation, sulponation.

5) SNAr, SN1, Benzyne and SNR1 reactions, reactivity: effect of substrate structure, leaving group

 and attacking nucleophile.

6) Addition to C-C multiple bonds - mechanism and stereochemical aspects of addition

 reaction involving electrophile, nucleophile and free radicals, Regio and chemo

 selectivity, orientation and reactivity, conjugate addition.

7) E1, E2, E1cb mechanisms, orientation and stereochemistry in elimination reaction,

 reactivity effect of structure, attacking and leaving group, competition between

 elimination and substitution, syn eliminations.

**Course: 4) CHA-190: Safety in Chemical Laboratory and Good Laboratory Practices**

**(4 Credits)**

The learner will be acquired with sound knowledge of **–**

1) Importance of safety and health in Laboratory, Different types of Hazards at workplace

 handling chemicals, Personal Protective and other safety equipments and their uses.

2) Do’s and don’ts: Safe clothing, hair, dangling jewellery responsible attitude, good House

 Keeping, use proper PPE, No food in Labs.

3) First Aid- For contact of different chemicals on skin, eyes, and inhalation and ingestion.

4) Types of fire extinguishers, method of use.

5) Material Safety Data Sheets, Globally Harmonised System (GHS) Signs.

6) Inventory Management, Storage and Disposal.

7) OSHA laboratory Standards.

8) Good Laboratory Practices (GLP).

**Semester- II**

**Theory Courses:**

**Course: 1) CHP: 210 Fundamentals of Physical Chemistry P-I (4 Credits)**

The learner will be acquired with sound knowledge of **–**

1) Molecular Spectroscopy- Microwave Spectroscopy, Infra red spectroscopy : Harmonic and an

 harmonic oscillator, vibrational spectra of di – and poly- atomic molecules, coarse and fine

 structure, Nuclear spin effect, applications.

2) Raman Spectroscopy: Introduction, Rotational Raman- spectra, Vibrational Raman,

 Spectra, polarization of light and Raman effect, structure elucidation from combined

 Raman and IR spectroscopy, applications in structure elucidation.

3) Electronic spectroscopy of molecules: Born – Oppenheimer approximation, electronic

 spectra of diatomic molecules, vibration, al coarse structure, rotational fine structure

 dissociation energy and dissociation products, electronic structure of diatomic molecules,

 molecular photoelectron spectroscopy, and application.

4) ESR and Mossbauer spectroscopy applications, Principles of NMR – Chemical applications of

 PMR in structure elucidation.

5) Type of radioactive decay, Decay Kinetics, Detection & measurement of radiation ( G.M. &

 Scintillation counter)

6) Elements of radiation chemistry – Radiation chemistry, interaction of radiation with

 miller, passage of nucleolus through matter, interaction of radiation with matter.

7) Nuclear Reactor: - The fission energy, The Natural uranium reactor, the four factor

 formula- The reproduction factor K, the classification of reactor. Reactor power.

8) Isotopes for nuclear reactors, Isotope separation, Applications of radioactivity.

**Course: 2) CHI-230: Coordination and Bioinorganic Chemistry (4 Credits)**

The learner will be acquired with sound knowledge of **–**

1) Ligand Field Theory of Coordination Complexes-Russell- Saunders terms

2) Electronic spectra of Transition Metal Complexes-Band intensities, band energies

3) Magnetic Properties of Coordination Complexes-types of magnetism, Curie law etc.

4) Principles of Coordination Chemistry related to Bioinorganic Research and Protein,

 Nucleic acids and other metal binding biomolecules, Biochemistry of Na, K and Ca w.r.t.

 Na/K pumps, Calmodulin and blood coagulation, Biochemistry of following elements:

 (a) Iron: Ferritin, Transferrin, Fe-S clusters, Porphyrin based systems

 (b) Manganese: Photosynthesis.

**Course: 3) CHO-250: Synthetic organic chemistry and spectroscopy (4 Credits)**

The learner will be acquired with sound knowledge of **–**

1) Oxidation reactions ofCrO3, PDC, PCC, KMnO4, MnO2, Swern, SeO2, Pb(OAc)4, Pd-C,

OsO4, m-CPBA, O3, NaIO4, HIO4

2) Reduction reactions of Boranes and hydroboration reactions,MPV reduction and reduction

 with H2/Pd-C, Willkinsons catalyst, DIBAL and Wolff Kishner reduction.

3) Rearrangements of Beckmann, Hofmann,, Curtius, Smith, Wolff, Lossen, Bayer-villiger,

 Sommelet, Favorskii, Pinacol-pinacolone, Benzil-benzilic acid.

4) Ylides- reactions of Phosphorus, Nitrogen and Sulphur ylides.

5) UV: Factors affecting UV absorption and interpretation of UV spectra

6) IR: Basic ideas about IR frequencies, interpretation of IR spectra

7) PMR: Fundamentals of PMR, factors affecting chemical shift, integration coupling (1st order

 analysis)

8) CMR and mass spectrometry.

**Course: 4) CHA-290: General Chemistry – II (4 Credits)**

**PART- C: Concept of Analytical Chemistry (2 Credits)**

The learner will be acquired with sound knowledge of **–**

1) Data Handing and Spreadsheets in Analytical Chemistry -Accuracy and Precision,

 classification of errors, Significant figures, rounding of

2) Sampling, Standardization and Calibration - Analytical Samples and Methods of Sampling,

 Sample Handling, Gross sample, Preparation of Laboratory samples.

3) Introduction to analytical separations - Separation by precipitation, separation of species by

 distillation, separation by extraction, separation by ion exchange chromatography.

**PART- D: Industrial Methods of Analysis (2 Credits)**

The learner will be acquired with sound knowledge of **–**

1) Concentration of solution based on volume and mass unit, calculations of ppm , ppb and

 dilution of the solutions , Concept of mmole, Stoichiometry of chemical reactions, Concept of

 gmole, Limiting reactants.

2) Quality systems in chemical laboratories, cost and benefits of quality system, types of quality

 standards for laboratories, total quality management, quality audits, and qualities reviews ,

 responsibility of laboratory staff for quality.

3) Industrial process analyzer, methods based on bulk properties, continuous online

 process control, automatic chemical analyzers, automatic elemental analyzers.

**Semester – I & II**

**Practical Courses-**

**Course 1) CHP-107: Physical Chemistry Practical (6 Credits)**

The learner will be acquired with sound knowledge of **–**

1) Principles of Chemical kinetics, Viscosity, Adsorption, Colorimetry, Refractometry, pH

 metry, Potentiometry, Conductometry etc.

2) Handling of above instruments.

3) Data analysis & drawing of graph.

4) Preparation of stock solutions, Normal, Molar solutions.

5) Standardization of instruments.

**Course 2) CHI-127: Inorganic Chemistry Practical (6 Credits)**

The learner will be acquired with sound knowledge of **–**

1) Analysis of ore & alloy by gravimetric & Volumetrically

2) Synthesis & purity determination of Inorganic compounds.

3) Synthesis of Nanomaterial by using Muffle furnance.

4) Standardization & use of Conductometer.

5) Preparation of stock solutions, Normal, Molar solutions.

**Course 3) CHO-247: Organic Chemistry Practical (6 Credits)**

The learner will be acquired with sound knowledge of **–**

1) Purification of solvents and reagents using techniques like crystallization, distillation, steam

 distillation, vacuum distillation, drying and storage of solvents, sublimation etc.

2) Three component separation using ether.

3) Single stage preparation of some organic compounds by using micro scale technique.

4) Monitoring reactions using TLC.

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**Academic Year: 2018-19**

**Program Outcomes, Program Specific Outcomes & Course Outcomes for PG**

**Course outcomes: M. Sc. Part- II**

**Semester- III**

**Theory Courses:**

**Course: 1) CHO: 350 Organic Reactions Mechanisms (4 Credits)**

The learner will be acquired with sound knowledge of **-**

1) Formation & Stability of Carbanions.

2) Formation & Applications of Enamines.

3) Reactions of Carbenes & Nitrenes.

4) Free Radical Reactions.

5) Mechanisms in Biological Chemistry.

6) Neighboring group participation in Organic Reactions.

**Course: 2) CHO: 351 Spectroscopic Methods in Structure Determination (4 Credits)**

The learner will be acquired with sound knowledge of-

1) 1H NMR Spectroscopy.

2) 13C NMR Spectroscopy.

3) COSY, TOCSY, NOESY, HETERO COSY etc. techniques.

4) Mass Spectrometry.

**Course: 3) CHO: 352 Organic Stereochemistry. (4 Credits)**

The learner will be acquired with sound knowledge of-

1) Stereochemistry of Six membered rings.

2) Stereochemistry of rings other than Six membered rings.

3) Fused, Bridged & Caged rings.

4) Resolution of Racemic Modification.

5) Geometrical isomerism & Stereochemistry of Olefins.

**Course: 4) CHO: 353 Photochemistry, Pericyclic reactions & Heterocyclic Chemistry.**

 **(4 Credits)**

The learner will be acquired with sound knowledge of-

1) Photochemistry of Carbonyl compounds, Alkenes, Dienes, Polyenes & Aromatic Compounds.

2) Applications of Photochemical reactions in synthesis.

3) Electrocyclic, Cycloaddition, Sigmatropic & Ene Reactions.

4) Heterocyclic Chemistry

**Semester- IV**

**Theory Courses:**

**Course: 1) CHO: 450 Chemistry of Natural Products (4 Credits)**

The learner will be acquired with sound knowledge of **-**

1) Synthesis & Stereochemistry of Hardwickiic acid, Camptothecin & Podophyllotoxin.

2) Retro & Synthesis of Taxol, Javabione, Fredericamycine- A, Estrone & Miferitsone.

3) Metabolic pathways of Shikimic acid, Terpenoid, Stereoids, Alkaloids etc.

**Course: 2) CHO: 451 Advanced Synthetic Organic Chemistry (4 Credits)**

The learner will be acquired with sound knowledge of **-**

1) Transition metal complexes in organic synthesis ; only Pd, Ni, Co, Fe

2) C-X bond formation reactions: Suzuki, Heck, Sonogashira, Stille, Fukuyama, Kumada,

 Hiyama, Negishi, Buchwald-Hartwig, Noyori, Reppe, Oxo process.

3) C=C formation reactions: Wittig, Horner-Wordworth-Emmons, Shapiro, Bamford-Stevens,

 McMurry, Julia-Lythgoe and Peterson olefination reactions, Titanium-carbene mediated

 olefination: Tebbe, Petasis and Nysted reagent.

4) Multi-component reactions: Ugi, Passerini, Biginelli and Mannich reactions.

5) Ring formation reactions: Pausan-Khand, Bergman and Nazerov cyclization.

6) Click chemistry: criterion for click reaction, Sharpless azides cycloadditions.

7) Use of Boron and Silicon in organic synthesis.

**Course: 3) CHO: 452 Carbohydrate and Chiron approach, Chiral Drugs and**

 **Medicinal Chemistry (4 Credits)**

The learner will be acquired with sound knowledge of **-**

1) Carbohydrates- Introduction of sugars, structures of triose, tetrose, pentose, hexose,

stereochemistry and reactions of Glucose, conformation and anomeric effects in hexoses.

2) Chiron approach- Introduction,The concept of chiral templates and chirons wherein the carbon

 skeleton is the chiral precursor.

3) Utilisation of the basic concepts for retrosynthetic strategy and synthesis of the following – (S)

 Propanediol, (R) and (S) – Epichlorohydrin, L (+)-Alanine, (-) Multistratin, (-) Pentenomycin, (-)

 Shikimic acid

4) Chiral Drugs- Introduction of chiral drugs, Eutomer, Distomer and eudesmic ratio, Distomers-

 with no side effects b) with undesirable side effects Synthesis and

 pharmacological activity of S-Ibuprofen, S-Metaprolol

5) Medicinal Chemistry- Introduction, Reactivity, Drug targets, Antimicrobial drugs etc.

**Course: 4) CHO: 453 Designing Organic Synthesis and Asymmetric Synthesis (4 Credits)**

The learner will be acquired with sound knowledge of **-**

1) Designing of organic synthesis: Protection and de-protection of hydroxyl, amino, carboxyl,

 ketone and aldehyde functions as illustrated in the synthesis of polypeptide and polynucleotide,

 enamines, Umpolung in organic synthesis, Retrosynthesis.

2) Principles and applications of asymmetric synthesis- stereoselectivity in cyclic compounds,

 enantio-selectivity, diastereo-selectivity, enatiomeric and diastereomeric excess, stereoselective \

 aldol reactions. Cram’s rule, Felkin Anh rule, Cram’s chelate model, Asymmetric synthesis, use

 of chiral auxiliaries, chiral reagents and catalysts, asymmetric hydrogenation, asymmetric

 epoxidation and asymmetric dihydroxylation.

**Semester- III & IV**

**Practical Courses:**

**CHO-347: Single stage preparations [6 Credits]**

The learner will be acquired with sound knowledge of **-**

1) Micro scale technique for Synthesis of compounds by different methods like oxidation, reduction

 addition reactions.

2) Different Practical Conditions like reaction time, temperature, pressure etc.

3) Study of name reactions like benzil- benzilic acid rearrangement, Nitration, Pechmann

 Condensation, Fischer indole synthesis, Cannizzaro reaction etc.

4) Use of Magnetic stirrer, Suction pump, Digital Melting point apparatus, Alumina foil & UV

 chamber for TLC technique etc.

**CHO-447 : Two stage preparations [6 Credits]**

The learner will be acquired with sound knowledge of **-**

1) Multi stage preparation of different reactions.

2) Monitor the reaction by TLC.

3) Study of intermediate product & second stage product with different practical conditions.

4) Practical gives knowledge of reactions & its mechanism.

**CHO-448: Project/Industrial training/Green Chemistry and Chemical biology**

 **experiments [6 Credits]**

The learner will be acquired with sound knowledge of **-**

1) Approach of Green Chemistry.

2) Use of non toxic chemical for reactions.

3) Study of Solvent free reaction.

4) Use of Motor & Pistil for reaction.

5) Industrial training gives a basic knowledge of how large scale reactions are done at

 industry/ Company level.