**SARDAR PATEL UNIVERSITY, VALLABH VIDYA NAGAR**
**Syllabus of M.Sc. Applied Chemistry, Semester- IV**
**(Effective from Academic Year 2020-21)**

## PT04CACH21Applied Organic Chemistry - II

### Unit – I Medicinal Chemistry

Synthesis and Applications of various drugs: Sedative and Hypnotics: Glutethimide, Oxazepam and methaquilone; Antianxiety agents: Diazepam, Nitroazepam, Maprobamate; Antidepressants: Isocarboxazide, Imipramine, Sertraline; Antipsychotics: Chlorpromazine, Thioridazine, Trifluoperazine, Haloperidol; Cardiovascular Drugs: Nitroglycerine, Nicorandil, Nifedipine, Bepridil, Minoxidil; Antihypertensive drugs: Ramipril; Antibiotics: Penicillins, Cephalosporins, Tetracyclines, Chloramphenicol.

### Unit-II Chemistry of Natural Products

Natural products - classification, source and methods of isolation, Synthesis, Structure determination and Applications: Vitamins: Vitamin A1, Vitamin B1 (Thiamine), Vitamin $B_6$ and Biotin (Vitamin H). Vitamin C, Vitamin B2 (Riboflavin); Alkaloids: Reserpine, Tylophorine, Cadinene, ß-Carotene, Caryophyllene and (-) Khusimone, molecular rearrangement of Caryophyllene and Logifolene; Steroids: Cholesterol, Testosterone, Oestrone, progesterone from cholesterol, Cortisone, α-Pinene,Camphor,Hofmann,EmdeandvonBraundegradation.

### Unit-III Hetero Cyclic Chemistry

Nomenclature ofsix membered heterocycles with one, two and more heteroatoms:Synthesis and reactions of pyrilium salts and pyrones and their comparison pyridinium,thiopyrylium salts and pyridines, coumarins, chromones,diazines&triazines. Seven membered Heterocycles:Synthesis and reactions of azepines, oxepinesand thiepines. Synthesis: Fischer-Indole synthesis, Skraup synthesis, Combes synthesis, Conrad Limpachand its Knorr synthesis, Pfitzinger synthesis: Bischler-Napieralski synthesis.

**Unit – IV Disconnection Approach**

Introduction of disconnection, One and two group disconnection, disconnection and synthesis of alcohols, olefins, simple ketones, acids and its derivatives, disconnections in 1,3 & 1,5-dioxygenated skeletons(Carbonyls) and application of Mannich reaction. Illogical Two group disconnection: 1,2- diols, 1,4- and 1,6- dicarbonyl compounds, Diels-Alder reaction and its use in organic synthesis, FGI & FGA. Synthesis of 3 and 4 membered small ring compounds,Use of ketenes as intermediate in organic synthesis. Protection of organic functional groups, protecting reagents and removal of protecting groups.

**Reference Books:**


1. Medicinal Chemistry and Drug Discovery,5$^{th}$Edn.,Ed.Manfred. E. Wolff, 1995, John Wiley & Sons Inc.
2. Natural Products Chemistry,1$^{st}$Edn., K. Nakanishi,T.goto, S. Natori, 1991, University Science Books.
3. Biogenesis of Natural Products,2$^{nd}$Edn.,Noam Lahav, 1963, Oxford University press.
4. Heterocyclic Chemistry,3$^{rd}$Edn.,Raj. K. Bansal, 2017, New Age International.
5. Work book for organic Synthesis the Disconnection Approach,2$^{nd}$Edn.,Stuart Warren and Paul Wyatt, 2008, Wiley.
6. Modern Organic Synthesis an Introduction, 2$^{nd}$Edn., G. S. Zweifel, 2017, Wiley.


**Books for further reading:**


1. Medicinal Chemistry,Gareth Thomas, 2000, John Wiley & Sons Inc.
2. An Introduction to Chemistry of Heterocyclic Compound,3$^{rd}$Edn., von R. M. Acheson, 2008, Wiley India Pvt. Limited.
3. Heterocyclic Chemistry, 3$^{rd}$Edn., Gilchrist and Thomas L, 1997, Pearson India.
4. Principals of Modern Heterocyclic Chemistry,Paquette, Leo. A, 1968, Pearson Benjamin Cummings.

## PT04CACH22Process and Analysis in Industry

### Unit – I Unit Operation and Unit Processes

Basic concept, characteristics, equipment and instrumentation, Nitration, Sulphonation, halogenation, esterification, amination, saponification and hydrogenation, role of the above unit processes in such industries as petroleum, drugs, pharmaceuticals and organic synthesis.

### Unit – II Chemical Reactorand Process Equipment

Chemical reactors – Batch reactor – Flow reactor –Fixed bed, Fluidised bed andslurry reactor – fluid moving machinery – pumps – blowers – compressors. Storage vessels – humidification –cooling towers. Agitation – Mixing – Industrialdriers, crystallisers, absorbers. Extractors – Absorbers –Distillation – Extractivedistillation, H.T.equipment, furnaces, heaters.

### Unit – III Chemistry in Industryand Forensic Science

**Chemistry in Industry:** Introduction, Process Chemistry versus Research Chemistry, Pharmaceutical Industry: Drug Discovery, Drug development- Preclinical and clinical testing, Medicine, Future Problems and Opportunities. Agrochemical Industry: Herbicides, Fungicides and Insecticides. **Chemistry in Forensic Science:** Dyes Industry: Textile and Food dyes.Introduction, Drugs of Abuse: Categories, Presumptive Tests, Instrumental Methods and Designer Drugs, Poisoning, Testing of Blood, Dyes, Inks and Paper, Trace Evidence, Fingerprints Visualization.

### Unit – IV Analysis of Drugs and Pharmaceuticals

Modern methods of drug analysis- Principle of estimation of hemoglobin, cholesterol and Blood sugar. Theory of analysis of milk, butter, starch based food products and beverages. Analysis of fats and oils- Iodine value and saponification value – their significance.

Introduction and overview of pharmaceutical analysis, Sulfa drugs Antipyretic and Analgesics, and antibiotics, Instrumental and classical techniques used in pharmaceutical analysis; hyphenated techniques use for pharmaceutical analysis.

### Reference Books


1. Unit Operations of Chemical Engineering,6$^{th}$Edn., W.L.McCabe, J.C.Smith and P. Harriot, 2004, McGraw Hill Book Co.
2. Chemical Process Industries, B. Norris Shreve and Joseph A.Brink, 1991, McGraw Hill,Kogakusha Ltd.

3. Dryden's outlines of Chemical Technology,Edn. M. Gopala Rao, 1992, Affliated East West Press Pvt. Ltd.
4. Industrial Chemistry,B.K. Sharma, 1991, GOEL Publishing House.
5. Riegel's Industrial Chemistry**,**Ed. James A. Kent, 1989, Asia Publishing House.

**Books for further reading:**

1. Elementary Principles of Chemical Processes,2nd Edn.,Feeder and R. W. Roussean, 1986,John Wiley and Sons.
2. Chemical Technicians,3rd Edn.,G.J. Shugar, 1991, McGraw-Hill.
3. Industrial Organic Chemistry,3rd Edn.,K.Weissermel, and Arpe, 1993, Wiley-VCHVerlag GmbH.
4. Perry's Chemical Engineers'Handbook, 9th Edn., John H. Perry (Ed.), 2018, Mc Graw Hill Publisher.

## PT04CACH23Industrial Management and Hygiene

### Unit – I Hazards

Classification hazardous chemical, Transportation of hazardous chemicals, Storage, Handling and control measures for hazardous chemicals. Industrial hazards and Safety: Process hazards checklists, hazard surveys, safety program, Hazop safety reviews, Hazards and controls in Unit process and Unit operations, Hazards – fire, mechanical, electrical, chemical and pharmaceutical, Monitoring & prevention systems, industrial effluent testing & treatment. Control of environmental pollution.

### Unit-II Concept of Industrial Safety

Accidents investigation and Analysis, Statutory provisions, control techniques, process flow chart and its importance for safety inspection, interpretation, use and training of MSDS, UN, HAZCHEM. **Safety in chemical industry:** General introduction, type of chemical hazards, Safety and risk phrases, Storage hazards and control, Prevention of overflow-pressure-temperature and process flow, Types of guards and valves for the vessel, its inlet and out let, need of remote and auto control valves, Process hazards and controls, Case studies: Bhopal gas tragedy, Vizag styrene accident, chernobyl disaster etc.

### Unit-III Industrial Hygiene

Concept, air and biological monitoring, occupational disease, operational control measures, personal protective equipments; Industrial pollution: storage, transportation, handling, risk assessments, challenges/solutions. Eco-friendly effluents disposal: Water pollutants, health

hazards, sampling and analysis of water, water treatment, different industrial and domestic effluents and their treatment and disposal, advanced waste water treatment, effluent quality standards and laws, chemical industries, tannery, dairy, textile effluents, common treatment. Sensors: Concept of molecular sensors its properties and applications.

**Unit – IV**

**Cost Effective Routes of Synthesis and Purification**

Introduction,Approaches for selection of most appropriate synthetic and scale up routs, Raw material and reagent selection, Quality control aspects, Material safety data sheet (MSDS), Scale up techniques in API manufacturing, Environment aspects in manufacturing of APIs, Work up and product isolation.

**Patent**

Introduction to IPR and its tools, Understanding Intellectual Property Rights (IPR), Definition and requirements for filing a patent, Types of Patents relevant to Pharmaceuticals, Parts of Patent, Filing a patent application and its prosecution in India, Rights Conferred by a Patent under Indian Regime, The Indian patent Act, 1970, Infringement of Patent.

**Reference Books:**


1. Industrial Chemistry, B. K. Sharma, 2000, Goel Publishing House Meerut.
2. Industrial Hygiene and Chemical Safety, M.H.Fulekar, 2008, I. K. International.
3. Speciality Inorganic Chemicals, Ed.,D. T. Thompson, 1996. RSC.
4. Shreve's Chemical Process Industries,Ed., Austin, 1984, McGraw-Hill.
5. Nolo's Patents for Beginners, Richard Stim and David Pressman, 2006, Nolo.
6. Patent Drafting & Specification Writing,S. R. Myneni, 2019, New Era Law Publication.
7. How to Patent an Idea in India, Prasad Karsad, 2018.


**Books for further reading:**


1. Reigel's Industrial Chemistry, James. A, Kent, 1997, CBS Publishers.
2. Industrial Chemistry, J. S.Jangwal and A. S.Mathuria, 2008, PragatiPrakashan Meerut
3. Chemical Approaches to Synthesis of Inorganic Materials, C. N. R. Rao, 1994, Wiley Eastern.
4. Principles of Patent Law, Roger E. Schechter and John R. Thomas, 2004, Thomson/West.

## PT04CACH24/25

**Project Work***

Project work to be offered to all students, based ontheir merit,interest and placement with the teachers/Industry (Marks: 200). The project shall have to becarried out under the allotted teacher(s)/assign industry and a dissertation shall be submitted and will be assessedfor internal (60 marks) and external (140 marks), in the usual manner.

## PT04EACH21 Advances in Polymers Chemistry

**Unit – I Processing of Polymers - I**

Introduction about processing in general, Classification of Polymer Processing,Rheology of Polymers, Rheological States of Polymer, Mixing and Compounding ofPolymers, Important Factors of the Feed Stock during processing, Different blendersand mixers for polymers for mixing and compounding of polymeric materials

**Unit – II Processing of Polymers - II**

Casting, Coating and Fibre Reinforced Plastics, Extrusion, Transfer Molding,Compression Molding, Injection Molding, Rotational Molding, Static Molding, Blow Molding, Spinning Processes, Thermoforming, Foaming, Calendaring, Welding and Joining, Finishing Operations

**Unit – III Preparation and production of polymer**

**Preparation of Monomers:** Introduction, Saturated hydrocarbons from natural gas, Acetylene,Ethylene, Aromatic Hydrocarbons, Chemical processes used in industrialorganic synthesis, hydrocarbon gases, ethylene hydrocarbons, aromatic hydrocarbons,Methanol, Phenol, Formaldehyde, Styrene, 1,3-butadiene,

**Production of Polymers**: Ethenoid plastics and Resins, Cellulose plasticsand resins, Silicone resins and plastics, Polymer nanocomposite, Bio-based polymer.

**Unit – IV Testing of Polymers**

Identification of a polymer by various chemical tests,Effect of Polymer Structure on Properties: Molecular Weight, Strength,Plastic Deformation, Physical state of Polymer, Elastic Property, ChemicalResistance, Solubility, Intermolecular forces in Monomers and Polymers,Mechanical behavior of polymers, Physical testing of plastics and elastomers before and after processing.

**Reference Books:**


1. Principles of Polymer Processing,2nd Edn.,Z. Tadmor and C.G. Gogos, 1979, John Wiley & Sons. Inc. Publication
2. Mixing and Compounding of Polymers: Theory and Practice,Ica Manas-Zloczower, Jean-François Agassant, 2009, Carl HanserVerlag GmbH & Co. KG.
3. Polymer Processing, D.H.Morton-Jones, 1989, Champman& Hall Inc.
4. Plastics Materials,7th Edn.,J. A. Brydson, 1999, Elsevier.
5. Handbook of Plastic Processes,Charles A. Harper, 2006,John Wiley & Sons.
6. Industrial Polymer Handbook: Products, Processes, Applications, Ed., E. S. Wilks, 2001. Wiley VCH Verlag GmbH.
7. Handbook of Plastics Testing and Failure Analysis,3rd Edn.,Vishu Shah, 2007, John Wiley & Sons.


**Books for further reading:**


1. Plastic Engineering, R. J.Crawford, 1987, Pergamon Press.
2. Text Book of Polymer Science,2nd Edn.,F. W. Billmeyer, 1971, John Wiley & Sons.
3. Concise Encyclopedia of Polymer Science and Engineering, JacquelineI.Kroschwitz, 1998, John Wiley & sons.
4. Specialty Polymers, R.W. Iyson, 1992, Blackie Academic & Professional.
5. Rubber Technology,Mourice Morton, 1987, Van Nostrand Reinhold.
6. Plastics Engineering Hand Book,5th Edn.,Michael L. Berins, 1991, Chapman & Hall.

## PT04EACH22Selected Topics in Applied Chemistry

### Unit – I Science of Nanomaterials

Fundamental of nanomaterial, variouschemical methods of synthesis of nanomaterials, gold nanoparticles, carbon nanotubes.Characterization of nanomaterials-AFM, STM, TEM.Introduction to supramolecular chemistry, self-assembly and supramolecular interactions, bio-nanotechnology.Surface and chemical modification, induction plasma technology and its applications, methods of synthesis-radiofrequency plasma, chemical methods, thermolysis, pulsed-laser methods.

### Unit – II Advanced Nanomaterials

Types of nanomaterials, e.g. nanotubes, nanorods, solid spheres, core-shell nanoparticles, Mesoporous materials; Some important properties of nanomaterials: optical properties of metal and semiconductor nanoparticles, magnetic properties, Porous silicon: Preparation and mechanism of porous silicon formation, Factors affecting porous structure, properties of porous silicon; Aerogels: Types of aerogels, Properties and applications of aerogels, Various promising applications of nanomaterials, Environmental effects of nanotechnology.

### Unit – III Industrial Carbon & Advanced Cementitious materials

Manufacture of various carbon modifications - Lamp black, carbon black, Acetylene black activated carbon by chemical activation and gas activation process. Reactivation, regeneration of activated carbon, Applications. Manufacture of graphite – and amorphous carbon electrodes, carbon fibres. Manufacture of Portland cement-Setting and hardening of cement, Special cements, Coloured cements, Blended cements- additives (plasticisers, organic additives) for quality improvements.

### Unit – IV Topics in Applied Chemistry

**Membrane technology**

Types of materials for membrane applications, polymeric membranes, asymmetric membranes, surface modifications for membrane applications, concepts of reverse osmosis, ultra filtration and electro dialysis.

**Carbon Capture and Sequestration**

Global warming and Climate change, Concept of Carbon Credit and Carbon Footprint, Carbon capture techniques, Carbon dioxide sequestration, Design of Green Belt and its advantages

**Reference Books:**


1. Nanomaterials: Synthesis, Properties and Application,A.S. Edelstein, R. C. Cammarata, 1996, IOP publication.
2. Nanotechnology: Principles and Practices,Sulabha K. Kulkarni, 2007, Capital PublishingCo.
3. Industrial Chemistry, B. K. Sharma, 1998, Goel Publishing House.
4. Dryden's outlines of Chemical Technology,M. Gopala Rao and Marshall Sitting, 1973, East-West Press.
5. Shreve's Chemical Process Industries, George T. Austin, 1984, Mograw Hill Intl. Edn.
6. Carbon Capture and Storage, 2nd Edn., Stephen A. Rackley, 2017, Butterworth-Heinemann/Elsevier
7. Carbon Capture, Storage and Utilization,MaltiGoel, Baleshwar Kumar, S. NirmalCharan, 2008, Narosa Publishing House.
8. Green Chemistry: Theory and Practice,P.T. Anastas and J.C. Warner, 1998, Oxford University Press.


**Books for further reading:**


1. Introduction to Nanotechnology, C.P. Poole (Jr.) and F.J. Owens, 2003, Wiley-Interscience.
2. Nanotechnology, S. Shanmugam, 2016, MJP Publisher.
3. Introduction to Nanotechnology,Charles P. Poole, Jr., Frank J. Owens,2003, John Wiley & Sons.
4. Reigel's Industrial Chemistry, James. A, Kent, 1997, CBS Publishers.
5. Inclusion Compounds, Ed. J. L. Atwood, J. E. D. Davies and D.D. McNicol, 1991, Oxford University Press.
6. The Chemistry of Waste Minimization,J.H. Clark, 1995, Blackie Academic.
7. Carbon Capture, Storage and Use, Jürgen-Friedrich Hake, W. Kuckshinrichs, 2015, Springer
8. Handbook of Green Chemistry and Technology,James Clark and Duncan MacQuarrie, 2002, Blackwell Science.

## PT04EACH23 Organic Semiconductors

**Unit- IStructure of Organic Semiconductors**

Introduction, History different organic semiconductor materials, Transitions between molecular states, Spectroscopic methods: Photoluminescence spectra, Lifetimes and quantum yields, Excited state absorption spectra, Fluorescence excitation spectroscopy.

**Unit- II Charges and Excited States in Organic Semiconductors**

Introduction, Excited molecules from the gas phase to the amorphous film, Excited molecules in crystalline phases –Frenkel exciton, Excited states in $\pi$ -conjugated polymers, Comparison between inorganic and organic semiconductors.

**Unit- IIIAdvanced Materials for Organic Electronics and its application**

High-performance pentacene transistors, Engineered pentacenes, Organic semiconductors based on polythiophene and indolo[3,2-b]carbazole, Polymer thin-film transistors, Gate dielectrics, Advanced flexible polymeric substrates.

**Unit- IV Devices, Applications and Products**

From transistors to large-scale integrated circuits, Roll-up active-matrix displays, Active-matrix light-emitting displays, Large-area detectors and sensors, Organic semiconductor-based chemical sensors.

**Reference Books:**


1. Electronic Processes in Organic Semiconductors: An Introduction,Anna Köhler and Heinz Bässler, 2015, Wiley-VCH Verlag GmbH & Co. KGaA.
2. Organic Electronics: Materials, Manufacturing and Applications, Hagen Klauk, 2006, Wiley-VCH Verlag GmbH & Co. KGaA.