

# GUJARAT TECHNOLOGICAL UNIVERSITY

M.Pharm

## PHARMACEUTICAL CHEMISTRY

SEMESTER: II

**Subject Name: PHARMACEUTICAL PROCESS CHEMISTRY**

**Subject Code: MPC204T**

**Scope:** Process chemistry is often described as scale up reactions, taking them from small quantities created in the research lab to the larger quantities that are needed for further testing and then to even larger quantities required for commercial production. The goal of a process chemist is to develop synthetic routes that are safe, cost-effective, environmentally friendly, and efficient. The subject is designed to impart knowledge on the development and optimization of a synthetic route/s and the pilot plant procedure for the manufacture of Active Pharmaceutical Ingredients (APIs) and new chemical entities (NCEs) for the drug development phase

**Objectives:** Upon completion of this course the student should be able to

1. The strategies of scale up process of APIs and intermediates
2. The various unit operations and various reactions in process chemistry

Sr No	Course Contents	Total Hrs
1	Process chemistry Introduction, Synthetic strategy Stages of scale up process: Bench, pilot and large scale process. In-process control and validation of large scale process. Case studies of some scale up process of APIs. Impurities in API, types and their sources including genotoxic impurities	12
2	Unit operations A) Extraction: Liquid equilibria, extraction with reflux, extraction with agitation, counter current extraction B) Filtration: Theory of filtration, pressure and vacuum filtration, centrifugal filtration C) Distillation: azeotropic and steam distillation D) Evaporation: Types of evaporators, factors affecting evaporation E) Crystallization: Crystallization from aqueous, non aqueous solutions factors affecting crystallization, nucleation. Principle and general methods of Preparation of polymorphs, hydrates, solvates and amorphous APIs	12
3	Unit Processes - I a) Nitration: Nitrating agents, Aromatic nitration, kinetics and mechanism of aromatic nitration, process equipment for technical nitration, mixed acid for nitration, b) Halogenation: Kinetics of halogenations, types of halogenations, catalytic halogenations. Case study on industrial halogenation process. c) Oxidation: Introduction, types of oxidative reactions, Liquid phase oxidation with oxidizing agents. Nonmetallic Oxidizing agents such as H <sub>2</sub> O <sub>2</sub> , sodium hypochlorite, Oxygen gas, ozonolysis	12
4	Unit Processes - II	12

	<p>a) Reduction: Catalytic hydrogenation, Heterogeneous and homogeneous catalyst; Hydrogen transfer reactions, Metal hydrides. Case study on industrial reduction process.</p> <p>b) Fermentation: Aerobic and anaerobic fermentation. Production of i. Antibiotics; Penicillin and Streptomycin, ii. Vitamins: B2 and B12 iii. Statins: Lovastatin, Simvastatin</p> <p>a) c) Reaction progress kinetic analysis i. Streamlining reaction steps, routes election, ii. Characteristics of expedient routes, characteristics of cost-effective routes, reagent selection, families of reagents useful for scale-up.</p>	
<b>5</b>	<p>Industrial Safety</p> <p>a) MSDS (Material Safety Data Sheet), hazard labels of chemicals and Personal Protection Equipment(PPE)</p> <p>b) b) Fire hazards, types of fire &amp; fire Extinguishers c) Occupational Health &amp; Safety Assessment Series 1800 (OHSAS-1800) and ISO-14001(Environmental Management System), Effluents and its management</p>	12

#### REFERENCES:

1. Process Chemistry in the Pharmaceutical Industry: Challenges in an Ever Changing Climate- An Overview; K. Gadamasetti, CRC Press.
2. Pharmaceutical Manufacturing Encyclopedia, 3rd edition, Volume 2.
3. Medicinal Chemistry by Burger, 6th edition, Volume 1-8.
4. W.L. McCabe, J.C Smith, Peter Harriott. Unit operations of chemical engineering, 7th edition, McGraw Hill
5. Polymorphism in Pharmaceutical Solids .Dekker Series Volume 95 Ed: H G Brittain(1999)
6. Regina M. Murphy: Introduction to Chemical Processes: Principles, Analysis, Synthesis
7. Peter J. Harrington: Pharmaceutical Process Chemistry for Synthesis: Rethinking the Routes to Scale-Up
8. P.H.Groggins: Unit processes inorganic synthesis(MGH)
9. F.A.Henglein: Chemical Technology (Pergamon)
10. M.Gopal: Dryden's Outlines of Chemical Technology, WEP East-West Press
11. Clausen, Mattson: Principle of Industrial Chemistry, Wiley Publishing Co.,
12. Lowenheim & M.K.Moran: Industrial Chemicals
13. S.D. Shukla & G.N. Pandey: A text book of Chemical Technology Vol. II, Vikas Publishing House
14. J.K.Stille: Industrial Organic Chemistry(PH)
15. Shreve: Chemical Process, McGrawhill.
16. B.K.Sharma: Industrial Chemistry, Goel Publishing House
17. ICH Guidelines
18. United States Food and Drug Administration official website [www.fda.gov](http://www.fda.gov)