FACULTY OF PHARMACY
Third Semester Bachelor of Pharmacy
In Effect from Academic Year 2017-18

Subject Code: 1PH1010302	**Subject Title:** PHARMACEUTICAL ENGINEERING
Pre-requisite Subject	**- NONE -**

Objectives of course:
To learn the fundamentals of pharmaceutical engineering with an emphasis on understanding the unit operation, unit process, conversion of unit, different flow meters, heat transfer, mass transfer, handling of material, material used in pharmaceutical plant construction and engineering drawing.

Learning outcomes:
On the completion of the course, students will be able to:

1. Understand the fundamental concepts of engineering in pharmacy.
2. Understand the principle of various flow meters, conversion of unit involve in unit process, tie substance and unit operation, principle of transfer of heat and mass.
3. Understand the transfer of solid, liquid and gas material.
4. Identify the material used in pharmaceutical plant construction.

Teaching Scheme (Hours per week)				**Evaluation Scheme (Marks)**					
				Theory(T)		**Practical(P)**		**Total Marks**	
Lecture	**Tutorial**	**Practical**	**Credit**	**University Assessment**	**Continuous Assessment**	**University Assessment**	**Continuous Assessment**	**Theory**	**Practical**
3	NA	3	6	80	20	80	20	100	100

Subject Contents			
Sr. No.	**Topic**	**Total Hours**	**Weight (%)**
1	**Introduction:** Pharma engineering and its significance, unit operations and unit processes. Unit systems, SI unit, CgS unit, gas constant and conversion of units. Physical quantities, dimensions and units, dimensional equations, dimensional analysis and dimensionless groups. Different types of graphical representation.	2	6
2	**Stoichiometry:** General principles, material balance-tie substances, chemical reactions and molal units, rate process, steady, unsteady and equilibrium state, laws of combining weights, applications of gas laws, energy balance, fuels and combustion, etc., Mathematical problems.	9	20
3	**Fluid flow:** Types of steady flow, Reynold number & its significance, types of pressure, viscosity, concept of boundary layers, total energy balance and total mechanical energy balance, losses in mechanical energy of fluids, basic equations of fluid flow, valves, flow meters, manometers. Mathematical problems.	10	22
4	**Material handling systems:** Solid handling- storage, conveyers, vacuum & pneumatic conveying. Liquid handling-storage, pumps Gases- Fans, blowers and compressors. Colour coding of Pipelines, use of forklifts and pallets, store design in pharmaceutical industries.	8	18
5	**Heat transfer:** Modes of heat transfer. Conduction- Fourier's law, resistances in series and parallel, use of mean area and mean temperature difference. Convection-Concept of film,	10	22

	overall coefficient, heat transfer by forced convection in laminar and turbulent flow, condensing vapours, evaluation of individual film coefficients. Radiation-Black body, absorptivity & emissivity. Heating of fluids, steam as heating medium, properties and uses of steam, steam traps, study of steam table. Heat exchange equipments-Heat exchangers, condensers, boilers, extended surface scraped and surface equipments etc. applications of heat transfer in industrial processes. Mathematical problems.		
6	**Mass Transfer:** Principle, streams in mass-transfer operations, solid/fluid and fluid/fluid mass transfer, influence of mass transfer on unit operations.	3	6
7	**Materials of Pharmaceutical Plant Construction:** General study of composition, corrosion resistance, properties, factors affecting the selection of material of pharmaceutical plant construction with special reference to stainless steel and glass. Corrosion-types, causes, theories of corrosion and its prevention.	3	6

List of Experiments: (45 hours)

Practical exercises should be based on theoretical topics. The practical should broadly cover the following:

1. To demonstrate unit systems and conversion of units.
2. To demonstrate Stoichiometry and tie substances in chemical reactions.
3. To measure pressure of gas and other fluids using different manometers. (U-tube manometer, inclined manometer etc)
4. Study of various flow meters (orifice meter, venturi meter, rotameter) and ejector pump.
5. Experiment on Reynolds number.
6. Determination of overall heat transfer coefficient.
7. Demonstration of corrosion resistance of various materials.
8. Practical related to topics in pharmaceutical engineering theory should be carried out.
9. Introduction to engineering drawing – Demonstration of orthographic and isometric projections, preparation of sheets based on orthographic projections.

List of References:

Reference Books:

1. Elementary Chemical Engineering - Max S. Peters, Published by McGraw Hill Book Company, New York, 1954.
2. Perry's Chemical Engineer's Handbook - Robert H Perry, Green D.W., Maloney J.O.7th Edition, 1998, McGraw – Hill Inc., New York.
3. Unit Operations of Chemical Engineering, 5th edition - McCabe, Smith & Harriott, McGraw – Hill Inc., New York.
4. Alfonso G. Remington: The Science & Practice of Pharmacy. Vol. I & II. Lippincott, Williams & Wilkins Philadelphia.
5. Engineering Drawing & Graphic Technology, 13th edition by Thomas E. French, Charles J. Vierch, Rebot J. Foster, McGraw Hill International Edition, New Delhi, 1972
6. Introduction to Chemical Engineering by Walter L. Badger & Julius T. Banchero, Mc graw Hill International edition, New Delhi, 1955
7. Pharmaceutics: The Science of Dosage Form Design - M.E. Aulton.
8. The Theory & Practice of Industrial Pharmacy – Lachman L., Lieberman H.A. & Kanjig J.L., 3rd edition, 1990 Varghese Publishing House, Bombay.

Text Books:

1. Tutorial Pharmacy by Cooper & Gunn, ed. S.J.Carter, CBS Publishers & Distributors, Delhi, 6th Edition, 2000.
2. Pharmaceutical Engineering – K.Sambamurthy, 2002 NAI (P) Ltd., Delhi.
3. Pharmaceutics I (Pharmaceutical Engineering), Jani G. K., B. S. Shah Prakashan, Ahmedabad.

4. Pharmaceutical Engineering: Principles and Practice, Subramanyam C.V.S., Thimma J, Suresh S.S. et. al., 2002, Vallabh Prakashan, Delhi.
5. A Textbook of Engineering Drawing Vol. I and II, P.J.Shah,6th Edition, 2003, Ahmedabad
6. Engineering Drawing, 34th edition, N.D.Bhatt Charutar Publishing House, 1994

e-Resources:

1. https://www.khanacademy.org/science/chemistry/chemical-reactions-stoichiome
2. http://byjus.com/physics/fluid-flow/
3. http://www.efunda.com/formulae/heat_transfer/home/overview.cfm
4. http://webserver.dmt.upm.es/~isidoro/bk3/c11/Mass%20Transfer.pdf
5. https://www.comsol.co.in/multiphysics/what-is-mass-transfer