

Subject Code: 1PH1010101	Subject Title: UNIT OPERATION-I
Pre-requisite Subject	- NONE -

Objectives of course:

Some basic operations such as size reduction and separation, mixing, crystallization etc., become day to day work in a pharmaceutical industry. The course enables the student to study fundamentals of various unit operations applied in manufacturing of bulk drugs and dosage forms in pharmaceutical industry along with commonly used equipments in depth.

Learning outcomes:

At the end of semester student will be able to:

1. Understand the theoretical concepts and principles used in unit operations and correlate them with various practical applications in pharmaceutical industries in the formulations of various pharmaceutical products like tablets, capsule, liquid preparations etc.
2. Students will learn insights of basic operations in a pharmaceutical industry and by the end of the semester; students will feel easy to select appropriate equipment for different operations.
3. Identify industrial hazards and safety precaution measures for it.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)					
Lecture	Tutorial	Practical	Credit	Theory(T)		Practical(P)		Total Marks	
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	Theory	Practical
3	0	3	6	80	20	80	20	100	100

Subject Contents			
Sr. No.	Topic	Total Hours	Weight (%)
1	Size reduction Objectives, importance and theory of size reduction. Factors affecting, energy requirements, mechanisms and methods (dry/wet grinding) of size reductions. Principle, material of construction, applications, advantages and disadvantages of various mills like cutter mill, hammer mill, roller mill, ball mill, fluid energy mill, colloid mill. Study of latest industrial mills used in manufacturing of various dosage forms and their application.	09	20
2	Size separation Principles of size separation, screen and its standards as per pharmacopoeia, screening equipments including shaking & vibrating screens, gyratory screens, sedimentation type industrial separators etc. Methods of determining size distribution. Fluid classification methods like sedimentation and elutriation, Principle, material of construction, applications, advantages and disadvantages of cyclone separator, sedimentation tank, etc.	07	15
3	Mixing Definition, objectives, mechanism and theory of mixing. Type of mixtures: liquid mixing, powder mixing, semi solids mixing. Principle, material of construction, applications, advantages and disadvantages of shaker mixer, propeller mixer, turbine mixer, paddle mixer, planetary mixer, double cone mixer, V mixer, sigma	06	15

	mixer and colloid mill, ultrasonic mixer, etc.		
4	Crystallization Objectives, crystal lattice, types of crystal, crystal form, size and habit, formation of crystals, super saturation theory, factors affecting crystallization process and crystal growth. Study of various types of crystallizers including Swenson walker, tanks, agitated & batch, circulating magma, vacuum and crystal crystallizer etc. Methods for prevention of caking of crystals. Numerical problems on crystal yield.	06	15
5	Extraction and leaching Principle, theory and types of extraction. Solvents used for extraction, leaching and extraction equipments, small scale and large scale extraction methods, special extraction techniques-supercritical fluid extraction, applications in pharmaceutical industry.	07	15
6	Automated process control system Process variables - temperature, pressure, vacuum, flow level and their measurements. Elements of automatic process control systems. Elements of computer aided manufacturing. Introduction to latest process control systems used in pharmaceutical industry.	05	10
7	Industrial hazards and safety precautions Industrial hazards: mechanical, chemical, electrical, fire and dust hazards. Measures to prevent and combat the hazards. Introduction to waste water system in industry.	05	10

List of References:

Reference Books:

1. Max S. Peters, Elementary Chemical Engineering - Published by McGraw Hill Book Company, New York, 1954
2. Robert H Perry, Green D. W., Maloney J. O., Perry's Chemical Engineer's Handbook - 7th Edition, 1998, McGraw – Hill Inc., New York.
3. McCabe, Smith & Harriott, Unit Operations of Chemical Engineering, 5th edition - McGraw – Hill Inc., New York.
4. Aulton M.E., Pharmaceutics: The Science of Dosage Form Design, 2nd edition, 2002, Churchill Livingstone, London.
5. Lachman L., Lieberman H.A. & Kanjig J.L., The Theory & Practice of Industrial Pharmacy, 3rd edition, 1990 Varghese Publishing House, Bombay.
6. Alfonso G. Remington: The Science & Practice of Pharmacy. Vol. I & II. Lippincott, Williams & Wilkins Philadelphia.
7. Cooper & Gunn, Tutorial Pharmacy ed. S. J. Carter, CBS Publishers & Distributors, Delhi, 6th Edition, 2000.

Text Books:

1. Dr G K Jani, Pharmaceutical Engineering -1 (Unit-operations-1,Pharmaceutics-1) by B.S. Shah Prakashan, Ahmedabad
2. Dr G K Jani, Pharmaceutics-2 B S Shah Prakashan, Ahmedabad
3. K.Sambamurthy, Pharmaceutical Engineering –2002 NAI (P) Ltd., Delhi
4. Subramanyam C.V.S., Thimma J, Suresh S.S., Pharmaceutical Engineering: Principles and Practice, 2002, Vallabh Prakashan, Delhi.

e-Resources:

1. <http://www.sciencedirect.com/science/book/9780433111009>
2. <http://www.pharmainfo.net/pharmacy-books>

List of Experiments:

Sr. Practical exercises should be based on theoretical topics. The practical should broadly cover No. the following:

- 1 To determine the average particle size & to study particle size distribution using standard sieve method for given powder substance/ granular mixture.
- 2 To determine the average particle size & to study particle size distribution using microscopy method.
- 3 To carry out particle size reduction by Ball mill.
- 4 To determine mixing index for blending given powder using laboratory mixer.
- 5 To study the effect of time and speed on solid-liquid mixing.
- 6 Study the effect of various factors (rate of cooling, rate of agitation, seeding, solvent, etc.) on crystallization of different salts.
- 7 To generate Mier's super-solubility curve for given substance (2 salts).
- 8 To study the effect of temperature on % yield of crystallization (2 salts).
- 9 To determine the percentage of acetic acid recovered from mixture of Benzene and Acetic acid using water as an extracting agent.
- 10 To study the extraction by Percolation method.
- 11 Demonstration of handling hazardous chemicals and safety precautions.
- 12 Any other practical's covering syllabus aspect.