## BP304T. PHARMACEUTICAL ENGINEERING (Theory)

**45 Hours**

**Course content:**

**Unit-I** **10 Hours**

**Flow of Fluids:** Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturi meter, Pitot tube and Rotameter.

**Size Reduction:** Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill.

**Size Separation:** Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.

**Unit-II** **10 Hours**

**Heat Transfer:** Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers.

**Evaporation:** Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator& Economy of multiple effect evaporator.

**Distillation:** Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation.

**Unit-III** **10 Hours**

**Drying:** Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer.

**Mixing:** Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles & Silverson Emulsifier.

**Unit-IV** **08 Hours**

**Filtration:** Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seitz filter.

**Centrifugation:** Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & super centrifuge.

**Unit-V** **07 Hours**

**Materials of pharmaceutical plant construction, corrosion and its prevention:** Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and their prevention. Ferrous and non-ferrous metals, inorganic and organic non-metals, basic of material handling systems.

## BP308P. PHARMACEUTICAL ENGINEERING (Practical)

**4 Hours/week**

1. Determination of radiation constant of brass, iron, unpainted and painted glass.
2. Steam distillation – To calculate the efficiency of steam distillation.
3. To determine the overall heat transfer coefficient by heat exchanger.
4. Construction of drying curves (for calcium carbonate and starch).
5. Determination of moisture content and loss on drying.
6. Determination of humidity of air – From wet and dry bulb temperatures- use of Dew point method.
7. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier.
8. Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic and logarithmic probability plots.
9. Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond coefficients, power requirement and critical speed of Ball Mill.
10. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment.
11. Factors affecting rate of filtration and evaporation (Surface area, Concentration and Thickness/viscosity).
12. To study the effect of time on the rate of crystallization.
13. To calculate the uniformity Index for given sample by using Double Cone Blender.

**Recommended Books: (Latest Editions):**


- Introduction to Chemical Engineering b y Walter L. Badger & Julius Banchero, Tata McGraw Hills, New Delhi.
- Solid Phase Extraction, Principles, Techniques and Applications by Nigel J.K. Simpson- Latest edition.
- Pharmaceutical Engineering by K. Sambamurthy, New Age International (P) Ltd., New Delhi.
- Unit Operation of Chemical Engineering by McCabe Smith, McGraw Hills, New Delhi.
- Pharmaceutical Engineering Principles and Practices by C.V.S Subrahmanyam et al., Vallabh Prakashan, Delhi.
- Remington Practice of Pharmacy by Martin, Latest edition.
- Lachman/Lieberman's Theory and Practice of Industrial Pharmacy by Roop K. Khar, S.P. Vyas, F.J. Ahmad and G.K. Jain, CBS Publishers & Distributers Pvt. Ltd., New Delhi.

- Cooper and Gunn's Tutorial Pharmacy edited by S.J. Carter, CBS Publishers & Distributers Pvt. Ltd., New Delhi.
- Unit Operations by G.G. Brown, CBS Publishers & Distributers Pvt. Ltd., New Delhi.
- Perry's Chemical Engineers' Handbook by R.H. Perry and D.W. Green, McGraw-Hill, USA.
- Aulton's Pharmaceutics: The Design and Manufacture of Medicines; 3rd edition, Churchill Livingstone, UK.
- Bentley's Textbook of Pharmaceutics edited by E.A. Rawlins, Reed Elsevier India Pvt. Ltd., New Delhi.
- Pharmaceutical Process Engineering by Anthony J. Hickey and David Ganderton, Vol-112, Drugs and Pharmaceutical Sciences, Marcel Dekker, Inc., USA.