SYLLABUS

Date/ Revision : 30 January 2017/0
Faculty : Life Sciences
Approval : Dean, The Faculty of Life Sciences

SUBJECT : PHARMACEUTICAL ENGINEERING UNIT PROCESS

1. Identification of Subject:

Name of Subject : **Pharmaceutical Engineering Unit Process**
Code of Subject : PEUP-3800
SKS : 2
Semester : 6
Study Program : Chemical Engineering
Lecturer : Tutun Nugraha, Ph.D

2. Competency

The course will provide students some aspects of the production process unique to Pharmaceutical Engineering Industries. Various Unit process that are involved in the production of medicines are discussed. Various fundamentals that were given during the first two years of chemical Engineering programs will be used in this course.

3. Description of Subject:

The course provides an introduction to the essential operations used in the manufacture of pharmaceutical products. The course will be a complement to the Chemical Engineering Unit Process Class that is also given and cover the more traditional chemical engineering unit process topics. This course specfically focuses on the manufacturing steps used in production of the Pharmaceutical Product or Dosage Form. Unit operations including blending, granulation, fluidized bed operations, milling, capsule filling, compaction, tablet coating and other processes will be addressed. Students learn to recognize how the output of one process is the input to the next process, and how deviations can cascade along the production sequence until they cause process failures. The course emphasizes design, scale-up, trouble-shooting, and optimization

4. Learning Approach

Approach : Expository, inquiry, collaborative
Method : Lecture presentation, Focus group discussion, team work

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Student Task : Appraisal, group presentation about biomaterial innovation
Media : Power Point presentation, print out of journals

5. Evaluation

a) Absence maximum : 25%
b) Discussion and semester appraisal : 40 points
c) Final Examination (Project + Final test) : 60 points

Total : 100 points

6. Contents/ Topics of Lecturing:

Week	Topics	Content	Remark
1	Powders	• Particles Properties and Structures • Particles interactions • Measurements of cohesion and adhesion • Powder flow • Packing Powder • Granulation • Fluidization • Mixing and Blending	Anthoyn J Hickey, and David Ganderton, "Pharmaceutical Process Engineering" Chapter 4 1 x 2 x 50 minutes
2	Air Conditioning and Humidification	• Vapor and Gas Mixtures • Hygrometry (themeasurement of humidity) • Humidification and Dehumidification	Anthoyn J Hickey, and David Ganderton, "Pharmaceutical Process Engineering" Chapter 5 1 x 2 x 50 minutes
3	Drying	• Theory of Drying • Evaporation of water into an air stream • Static beds of non-porous solids • The internal mechanisms of drying • Static beds of porous solids • Methods of drying • Batch Dryers: Hot air ovens, Vacuum tray dryers, tumblig dryers, fluidized bed dryers, agitated batch dryers, Freeze dryer • Continuous dryers: Spray Dryers, Drum Dryers	Anthoyn J Hickey, and David Ganderton, "Pharmaceutical Process Engineering" Chapetr 6 1 x 2 x 50 minutes

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4	Solid Liquid Extraction	• Methods of Leaching: Leaching by immersion, leaching by percolation • The Choice of Extraction methods • The Choice of Solvent • Factors affecting the rate of Leaching: Size and size distribution of particles, Physical Properties of the solvent	Anthoyn J Hickey, and David Ganderton, "Pharmaceutical Process Engineering" Chapter 7 1 x 2 x 50 minutes
5, 6	Crystalization	• Crystalization in melts • Nucleation • Crystal Growth • Crystalization from Solutions • Operation of a crystalizer • Production of very fine or very large crystals • Evaporative Crystalizers, Cooling crystalizers, Vacuum crystalizers	Anthoyn J Hickey, and David Ganderton, "Pharmaceutical Process Engineering" Chapter 8 2 x 2 x 50 minutes
7	Evaporation and Distillation 1	• The phenomena of evaporation • Heat transfer to noiling liquid • Physical Properties of solution and liquids: Correlation between boiling temperature and composition, correlation to external pressure, Viscosity effect due to concentrations • Effect of temperature on solubility • Effect of heat on active constituents • Evaporators: (i) Natural circulation evaporators, (ii) Forced convection circulators, (iii) film evaporators • Efficiency of an evaporator • Vapor removal and liquid entrainment • Evaporation without boiling	Anthoyn J Hickey, and David Ganderton, "Pharmaceutical Process Engineering" Chapter 9 1 x 2 x 50 minutes
8	Midterm break	•	
9, 10	Evaporation and Distillation 2	• Distillation: Binary mixtures of Immiscible liquids: Steam distillation • Binary mixtures of miscible liquids • Relation of Vapor Pressure and Mixture Composition	Anthoyn J Hickey, and David Ganderton, "Pharmaceutical Process Engineering" Chapter 9

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		• The Relation of Boiling Point and Mixture Composition • Vapor-Liquid Equilibrium Diagrams • Simple or differential distillation • Rectification or fractionation • Plate columns • Principles of Continuous and Batch Fractionation • Separation of liquids with Azeotropy and liquid of similar volatility • Molecular distillation	2 x 2 x 50 minutes
10	Filtration and Centrifugation	• Clarification and cake filtration • Filtration theories • Fluid Flow through porous media • Factors affecting filtration rates: Pressure, viscosity, filter area, permeability coefficient, Particle retention in a depth filter • Conditioning of slurry, compressibility of cake • Cake washing and dewatering • Filters: Gravity filters, Vacuum filters, pressure filters • Filter media: rigid media and flexible media • Air Filtration: mechanisms and operation • Centrifugation: Centrifugal filtration, centrifugal sedimentation	Anthoyn J Hickey, and David Ganderton, "Pharmaceutical Process Engineering" Chapter 10 1 x 2 x 50 minutes
11	Size reduction and Classifications	• Fine particles in Pharmaceutical Industries • Crushing and Grinding • Grinding efficiency • Operations of Mills: wet and dry milling • Other Effects of millings: contaminations, temperature sensitivity, stuctural changes, dust hazards • Milling equipment: edge and runner mill, pin mill, ball mill, hammer mill, vibratory mill,	Anthoyn J Hickey, and David Ganderton, "Pharmaceutical Process Engineering" Chapter 11 1 x 2 x 50 minutes

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		fluid energy mill, colloid mill, roller mill • Classification (size separations): Sieving and screening, elutriation and sedimentation	
12	Mixing	A. Mixing of solids • Properties of random mixtures • Degree of mixing • Mechanisms of mixing and demixing • Mixing rates • Mixing machines: Trough, Ribbon, and Paddle Mixers, tumbler mixers B. Mixing of liquids: • Paddle mixers, propeller mixers, turbine mixers C. Mixing of liquid and solids:	Anthoyn J Hickey, and David Ganderton, "Pharmaceutical Process Engineering" Chapter 12 1 x 2 x 50 minutes
14	Solid dosage forms	• From drug discovery to dosage forms • Granulations • Hard Capsules • Tablets • Inhalation products	Anthoyn J Hickey, and David Ganderton, "Pharmaceutical Process Engineering" Chapter 13 1 x 2 x 50 minutes
15	Sterilization	• Thermal Sterilization • Dry heat and Moist heat • Radiation: dosage and resitance to damage, product development onsiderations • Sterile Filtration: Adsorption and screening, Filter integrity, and product development considerations	Anthoyn J Hickey, and David Ganderton, "Pharmaceutical Process Engineering" Chapter 14 1 x 2 x 50 minutes
16, 17	Final Exam		

7. Book Reference:

Anthoyn J Hickey, and David Ganderton, "Pharmaceutical Process Engineering" Marcel Dekker Inc., USA

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