**SRM UNIVERSITY**
**SCHOOL OF BIOENGINEERING**
**DEPARTMENT OF BIOTECHNOLOGY**
**BT2106-BIOPROCESS PLANT DESIGN**
**I SEMESTER-M.Tech Biotechnology**
**June 2015 -Dec 20145** **Lesson plan** **LabHour -45**

**PURPOSE**

To understand the fundamentals of engineering economics, drafting a project budget to develop and apply problem solving and bioprocess plant design techniques.

**INSTRUCTIONAL OBJECTIVES**

1. To learn about the mass and energy balance of bioprocess
2. To develop and optimize the process parameters for the industries
3. To apply design factors for scale up in the industry
4. To evaluate the process plant design for regulatory compliance
5. To design a plant layout for processing of biological materials

| Unit | Hours | Lecture Topics | Learning Outcomes |
|---|---|---|---|
| **UNIT I-MASS AND ENERGY BALANCE-9Hrs** | | | |
| **1** | 1 | Introduction: | Can understand the Mass and Energy flow in a process |
| | 2-3 | General design information | |
| | 4-5 | Material Balance | |
| | 6-7 | Energy balance | |
| | 8-9 | Calculations - Process Flow sheeting | |
| **UNIT II-SCALE UP AND SCALE DOWN OF EQUIPMENTS (10 hours)** | | | |
| II | 10-11 | Heat and Mass Transfer studies | Can acquire knowledge on mixing and mass transfer and Scaleup and scale down |
| | 12-14 | Effect of scale on oxygenation, mixing, sterilization, pH, temperature, inoculum development, nutrient availability and supply. | |
| | 15-16 | Bioreactor scale-up - constant power consumption per volume,mixing time, impeller tip speed (shear) - mass transfer coefficients. | |
| | 17-19 | Scale up of downstream processes - Adsorption (LUB method), Chromatography (constant resolution etc.), Filtration (constant resistance etc.) – Centrifugation (equivalent times etc.) - Extractors (geometry based rules) - Scale-down related aspects. | |
| **UNIT III-DESIGN OF EQUIPMENTS (8 Hrs)** | | | |

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| III | 20-21 | Selection of bioprocess equipment (upstream and downstream) | Can understand the Heat and Mass transfer, Sterility maintenance and Materials of construction |
| | 22-23 | Specifications of bioprocess equipment - Mechanical design of reactors, heat transfer and mass transfer equipment. | |
| | 24-25 | Design considerations for maintaining sterility of process streams and process equipment | |
| | 26-27 | Piping and instrumentation - Materials of construction for bioprocess plants. | |
| **UNIT IV-FACILITY DESIGN (9 hours)** | | | |
| **IV** | 28-29 | Facility design aspects | Can understand the utilities,cleaning aspects,Cell culture and safety guidelines |
| | 30-31 | Utility supply aspects | |
| | 32-33 | Equipment cleaning aspects | |
| | 34-35 | Culture cell banks | |
| | 36 | cGMP guidelines – Validation - Safety. | |
| **UNIT V-ECONOMICS AND CASE STUDY (9 hours)** | | | |
| V | 37 | Process economics | |
| | 38-45 | Case studies. Commodity chemicals and Production of pharmaceutical products. | |

**REFERENCES**


1. Robert H. Perry and Don W. Green (eds.). *"Perry's Chemical Engineers'Handbook"*, 7th Edition, McGraw Hill Book Co., 1997.
2. Michael Shuler and FikretKargi. *"Bioprocess Engineering: BasicConcepts"*, 2nd Edition, Prentice Hall, Englewood Cliffs, NJ, 2002.
3. Roger Harrison et al., *"Bioseparations Science and Engineering"*,Oxford University Press, 2003.
4. Coulson J.M. and J. F. Richardson (Eds.) R.K.Sinnott. "*ChemicalEngineering*, Volume 6: *An Introduction to Chemical Engineering Design"*, 2nd Edition, Butterworth-Heinemann Ltd., UK. (Indian Edition: Asian Books Private Limited, New Delhi)
5. Max S. Peters and Klaus, D. Timmerhaus. *"Plant Design and Economics for Chemical Engineers"*, 4th Edition, McGrawHill Book Co., 1991.
6. Joshi M. V. and V.V.Mahajani. *"Process Equipment Design"*, 3rd Edition, Macmillan India Ltd., 2000.
7. Michael R. Ladisch. *"Bioseparations Engineering: Principles, Practice and Economics"*, 1st Edition, Wiley,2001.
8. Relevant articles from Bioprocess journals.


Course Co-Ordinator

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