MMC 201 – Industrial Microbiology
Course credits: 4 – Three credits theory and one credit practical

Theory **(Contact Hours)**

1

1.1 History of Industrial Microbiology, fermentation processes, descriptive layout and components of fermentation process for extracellular and intracellular microbial products **(05)**

1.2 Microbial growth kinetics: **(05)**
Batch kinetics – Monod's model (single substrate), deviations from Monod's model, dual substrates – sequential utilization, multiple substrates – simultaneous utilization, substrate inhibition, product synthesis (primary and secondary metabolite), toxic inhibition, death constant

1.3 Microbial growth kinetics: **(07)**
Fed-batch kinetics – fixed volume, variable volume and cyclic fed-batch, applications and examples of fed-batch systems,
Continuous cultivation system – relationship between specific growth rate (μ) and dilution rate, multistage systems, feedback systems (internal and external feedback), applications and examples of continuous cultivation system; comparison between various cultivation systems

2

2.1 Optimization and modeling of fermentation process – single variable design, multivariate screening designs, critical factor analysis, optimization designs for two or more factor, singlet method; Metabolic and flux control analysis **(05)**

2.2 Bioreactor design and operation: classification of reactors; Ideal mixed v/s plug flow reactor; designing parameters for reactors (stirred tank reactor, airlift reactor, plug flow reactor), rheology of fermentation broth **(05)**

2.3 Bioreactor design and operation: gas-liquid mass transfer, heat transfer, analysis of dimension less parameters and their application (aeration number, power number and Reynold's number; Scale-up of bioprocesses: parameters used in scale-up and problems associated with scale-up **(05)**

3

3.1 Solid substrate fermentation (SSF): Principles and application; Surface fermentation Comparison between SSF, Surface fermentation and SmF. Problems in fermentation process and handling (foam, contamination, strain degeneration, etc), Immobilized enzymes and cell systems **(05)**

3.2 Fermentation monitor and control: Common measurement and control systems (speed, temperature, gas, pH, Dissolved oxygen, foam, redox, air flow, weight, pressure, biomass), On-line and off-line analysis, Digital controllers, control algorithm, flow charting, incubation control, advanced fermentation control and computer-based automation of process. **(05)**

3.3 Industrial scale Down-stream processing and product recovery: principle and general description of instrumentation, Recovery of particulates (cells and solid particles), recovery of intracellular products, primary isolation (extraction, sorption), precipitation, industrial processes for chromatography and fixed bed adsorption, membrane separations; Type Processes - Antibiotic (Penicillin including semi-synthetic) **(05)**

Practicals **(45)**

1 Fermentation kinetics – growth of *E.coli*/*S.cerevisiae* and determination of μ_{max}, Ks, Yx/s, m
2 Rheology of substrate solutions, culture broth and harvested cell suspension
3 Designing of fermentor – stirred tank reactor
4 Aeration efficiency using dissolved oxygen analysis
5 Immobilization using alginate
6 Baker's yeast – ISI quality assurance

Reference Books

1 Manual of Industrial Microbiology and Biotechnology, Demain et al., Wiley
2 Fermentation and Biochemical Engineering Handbook - Principles, Process Design, and Equipment, Vogel and Tadaro, William Andrew Publishing
3 Biochemical Engineering and Biotechnology Handbook, Atkinson, Grove's Dictionaries
4 Encyclopedia of Bioprocess Technology, Fermentation, Biocatalysis and Bioseparation, Volumes 1 - 5, Flickinger and Drew, Wiley
5 Principles of Fermentation Technology, Stanbury et al., Butterworth-Heinemann