M. Sc. Part II
Biotechnology Paper I

Engineering Principles

1. Introduction to Engineering calculations, SI units, Dimensional analysis, presentation and analysis of data, Fluid statics, Bernaullis equations, Frictions factor, Pressure drop, Power requirement for pumping and mixing.
2. Fluid flow and mixing : Classification of fluids, fluids in motion, stream lines, Reynolds number, hydrodynamic boundary layers, momentum transfer, viscosity, non-newtonian fluids, Rheological properties of fermentation broths, mixing equipments, flow patterns in agitated tanks, Radial and axial flow impellsers, Mechanism of mixing, scale up of mixing systems, Power requirement for mixing, ungassed newtonian fluids, Gassed fluids, improving mixing in fermentors, Effect of rheological properties on mixing, Role of shear in stirred fermentors, interaction between cells and turbulent eddies, operating conditions for turbulent shear damage, bubble shear.
3. Material balances : Thermodynamic preliminaries, system and process, steady state and equilibrium, law of conservation of mass, types of material balance problem, material balances with recycle, bypass and purge streams, stoichiometry of growth and product formation, growth stoichiometry of growth and product formation, growth stoichiometry and elemental balances, electron balances, biomass yield, unsteady state material balance equations.
4. Energy Balances : Basic energy concepts – Intensive and extensive properties, enthalpy, general energy balance equations, Enthalpy change in non-reactive processes, enthalpy change due to reactions, heat of combustion, heat of reactional non-standard conditions, Thermodynamics of microbial growth, energy balance equation for cell culture, unsteady state energy balance equations.

5. Heat transfer : Heat transfer equipments – Bioreactors, general equipments for heat transfer, double pipe heat exchanger, shell and tube heat exchanger, mechanisms of heat transfer-conductions for heat transfer systems, logarithmic and arithametic mean temperature differences, calculation of heat transfer coefficients, relationship between heat transfer, cell concentration and stirring.
6. Boiling and evaporation : Mechanisms of boiling, films and nucleate boiling, single and multiple effect evaporators, economy and evaporators performance with various feeding patterns viz. forward, backward and parallel.
7. Mass transfer : Molecular diffusion, diffusion theory, Role of diffusion in bioprocessing, film theory, liquid solid mass transfer, liquid liquid mass transfer, gas-liquid mass transfer, mass transfer correlations .
8. Unit operations : Filteration –filter aids, filteration equipments, centrifugation, cell disruption, the ideal stage concept, adsorption.

Biochemical Engineering

Growth and History ; microbial growth, closed, semi-open and open cultivation systems, Maintenance energy and yield concept, Parameters of growth and analysis of growth data, estimation of biomass, Microbial kinetics of growth, substrate utilization and product formation in batch plug flow and cnemostate cultures.

Transport phenomena in bioprocesses – Oxygen transfer in bioreactors, measurement of K_La, oxygen transfer in large vessels.

Scale up of bio processesses – General aspect, scale up methods, sterilization of media and air.

Design and analysis of bioreacttors.

Classification of bioreactors, viz. stirred tank, bubble column, Airlift, Packed bed, Fluidized bed, Trickel bed.

Practical considerations for bioreactor construction.

Modelling of bioreactors

Ideal discontinues stirred tank reactor (DCSTR), Ideal continuous stirred tank reactor (CSTR) with constant volume, The ideal semi-continues stirred tank reactor (SCSTR) with variable volume, The ideal continuous plug flow reactor (CPFR) or tubular reactor, The real plug flow reactor CPFR with disponstion. residence time distribution.

Control of Bioreactors : Control of physical, chemical and biological environment of the bioreactor, advanced control strategies.

Kinetics of immobilized systems :

Heterogenous reactions in biuoprocessing, interaction between mass transfer and reaction, The Thiele modulus and Effectiveness factor, External mass transfer, Liquid solid mass transfer correlations.

M. Sc. Part II
Biotechnology Paper II
Immunology and Immunotechnology

Introduction, origin and background of immunology, innate and acquired immunity, major components of immune system and their functions, primary and secondary lymphoidsystems, cells involved in immune response.

Structure and function of different immunoglobulin classes, idiotypes, isotypes, allotypic determinants, immunoglobulin fold, different theories of antibody formation and generation of antibody diversity.

Major histocompatibility complex, nomneclature and genetic organization of the system, class I and II antigens, tissue distribution of MHC.

T cell receptors, structure, TcR gene generation of diversity and nature of T cell receptor binding site accessory molecules on T cells. Immunoglobulin supergene family.

Antigens, antigenic dterminants, specificity, hapten, antigenicity, its production. B cell, T cell epitopes, MHC restriction, antigen processing and presentation regualtions mautration of B and T cell subsets.

The complements system, mechanism of action, classical and alternative pathways, regulation.

Antigen antibody interactions, precipitin and agglutination reactions, radioimmunoassay, ELISA, immunofluorescence, FACS, complement fixation. immunoelectrophoresis.

Tumor Immunology

Hybridoma technology and monocloanl antibody prodction.

Applications o f monoclonal antibodies in biomedical research and in clinical diagnosis and treatment. AIDS –principles and strategies for developing vaccines.

New methods of vaccine preparation - T subunit vaccines, vaccine and immunodiagnostic development in animal Biotechnology area.

Recombinant vaccines, anti-idiotype vaccines, deleted mutant vaccines, synthetic peptides- chimeric vaccines.

Diagnostic tests : Immunoblot assays.

M. Sc. Part II
Biotechnology Paper III

Genetic Engineering

Isolation, purification and quantitation nucleic acids.

General chanracteistics of the vectors used in genetic engineering viz.pBR 322, pUC plasmids, M13 vectors, lambda vectors etc.

Expression vectors : promoter fusion and high level expression of cloned genes.

Preparation of gene/cDNA library, Screening of the libraries, Restriction endonucleases –Restriction enzyms analysis.

Enzymes used in genetic engineering viz. reverse transcriptase, DNA polymerase, polynucleotide kinase, Terminal deoxynucleotidyl transferase, alkaline phosphatase, Sl nuclease, BAL 31, DNA ligase etc.

Western southern and northern blotting, dot blot hybridization

Agarose gel and polyacrylamide gel electrophoresis for the separation of nucleic and fragments.

High voltage polyacrylamide gel electrophoresis for sequencing gels.

Chemical modification method of Maxa & Gilbert for DNA sequencing, Dideoxy sequencing method of Sanger.

RNA sequencing, Antisense RNA technology, Recombinant DNA technology.

Zoller and Smith's oligonucloetide siter directed mutagenesis Kunkel's and other's methods of site directed mutagenesis.

Biosafety guidelines – Recombinant DNA safety guidelines, biosafety policies.

Intellectual property rights- International as well as national.