FIFTH SEMESTER (C.B.S.) Biotechnology

Sr. No.	Code (Board) Theo./Pract	Subject	Workload				Credit				MARKS				Total Marks
											Theory		Practical		
			L	P	T	Total	L	P	T	Total	Sessional	University	Sessional	University	
1.	BT BIT 501T (BBT)	Fluid Mechanics & Solid Handling	3	-	1	4	3	-	1	4	20	80	-	-	100
2.	BT BIT 502T (BBT)	Biochemical Reaction Engineering I	3	-	1	4	3	-	1	4	20	80	-	-	100
3.	BT BIT 503T (BBT)	Heat Transfer in Biotechnology	3	-	1	4	3	-	1	4	20	80	-	-	100
4.	BT BIT 504T (BBT)	Molecular Biology	3	-	1	4	3	-	1	4	20	80	-	-	100
5.	BT BIT 505T (BBT)	Immunology	3	-	1	4	3	-	1	4	20	80	-	-	100
6.	BT BIT 506P (BBT)	Fluid Mechanics & Solid Handling Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
7.	BT BIT 507P (BBT)	Heat Transfer in Biotechnology Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
8.	BT BIT 508P (BBT)	Molecular Biology Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
Total			**15**	**12**	**5**	**32**	**20**	**6**	**-**	**26**	**100**	**400**	**75**	**75**	**650**

SIXTH SEMESTER (C.B.S.) Biotechnology

Sr. No.	Code (Board) Theo./Pract.	Subject	Workload				Credit				MARKS				Total Marks
											Theory		Practical		
			L	P	T	Total	L	P	T	Total	Sessional	University	Sessional	University	
1.	BT BIT 601T (BBT)	Genetic Engineering	3	-	1	4	3	-	1	4	20	80	-	-	100
2.	BT BIT 602T (BBT)	Mass Transfer in Biotechnology	3	-	1	4	3	-	1	4	20	80	-	-	100
3.	BT BIT 603T (BBT)	Biochemical Reaction Engineering II	3	-	1	4	3	-	1	4	20	80	-	-	100
4.	BT BIT 604T (BBT)	Process Control in Biotechnology	3	-	1	4	3	-	1	4	20	80	-	-	100
5.	BT BIT 605T (BBT)	Industrial Biotechnology	3	-	1	4	3	-	1	4	20	80	-	-	100
6	BT BIT 606T (BGE)	Communication English	3	-	-	3	3	-	-	3	10	40	-	-	50
7.	BT BIT 607P (BBT)	Mass Transfer in Biotechnology Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
8.	BT BIT 608P (BBT)	Process Control in Biotechnology Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
9.	BT BIT 609P (BBT)	Industrial Biotechnology Laboratory	-	4	-	4	-	2	-	2	-	-	25	25	50
Total			**18**	**12**	**5**	**31**	**23**	**6**	**-**	**29**	**110**	**440**	**75**	**75**	**700**

Teaching Scheme B.Tech (Biotechnology)

FIFTH SEMESTER

Lectures: 03 **Tutorials: 01** **No.of Credits: 04**

Papers: 80 Marks **College Assessment- 20Marks**

Duration of Paper: 3Hrs

BT BIT 501T (BBT) **Fluid Mechanics and Mechanical Operations**

Unit 1: Hydraulics- Nature of Fluid and Fluid Flow. Manometers. Mechanism of noncompressible fluid flow, Reynold's number, Distribution of velocities, Reynold's theorem, frictional losses in pipe line, losses in various fittings, transportation of fluids.

Unit 2: Measurement of Fluid flow, orificemeter and venturimeters, pitot tube, rotameter, notches and weirs, and other miscellaneous meters.

Unit 3: Design and operating characteristics of reciprocating and centrifugal pumps, diaphragm pump, rotary and positive displacement pump.

Unit 4: Size reduction and Separation- Properties of solids, size reduction, types of equipments, power requirements, laws of crushing and grinding, open and closed circuit grinding, critical speed of the ball mill.

Unit 5: Sedimentation - Free and hindered settling, design of thickeners etc. Filtration: - Theories of filtration and washing, constant rate and constant pressure filtration, optimum cycle, handling of compressible cake and use of filter aids.

Unit 6: Mixing and conveying – Fundamentals of mixing and characteristics of mixing equipments, power consumption and efficiencies, design of conveyor belts. Flow through packed column and fluidization, methods of the dust collection, cyclones, electrostatic precipitators, bag filters.

Books Recommended

1 Introduction to Chemical Engineering by Badger and Banchero, McGraw Hills International Students Edition.
2 Unit Operations in Chemical Engineering by McCabe and Smith, McGraw Hill
3 Unit Operations by Brown, John Wiley and Sons Inc. New York.
4 Chemical Engineering by Coulson and Richardson, Vol I and II, Pergamon Press, New York

Lectures: 03 **Tutorials: 01** **No.of Credits: 04**

Papers: 80 Marks **College Assessment- 20Marks**

Duration of Paper: 3Hrs

BT BIT 502T (BBT) **Biochemical Reaction Engineering – I**

Unit 1- Kinetics of Homogeneous Reactions, Interpretation of Batch Reactor Data

Unit 2- Review of reactors, mass and energy balance equations in reactor system, Design of Single Ideal Reactors

Units 3- Design of single reactions- Comparison of volumes of plug flow reactor and Chemostat. Multiple reactors-Methods to show how total volume and conversion is affected in multiple reactors, Recycle reactor, Autocatalytic reactors.

Unit 4- Animal and plant cell cultivation, Phases of cell growth, kinetic model for cell growth, Evaluation of Monod kinetic parameters, Growth of filamentous organism, Substrate and product inhibition on cell growth, multiple fermenters in series, cell recycling in various fermenters.

Unit 5- Design of multiple reactions- parallel Reactions, Irreversible First-Order Reactions in Series, First-Order Followed by Zero-Order Reaction, Zero-Order Followed by First-Order Reaction, Quantitative treatment of reactors, Kinetics of irreversible series-parallel reactions.

Unit 6 – Heat of reaction from thermodynamics, adiabatic and non adiabatic operations, performance of adiabatic flow reactors

Books Recommended

1) Chemical Reaction Engineering,3rd Edition – O.Levenspiel, Willey Eastern 1999

2) Chemical Kinetics and Reactor Calculations- Scott Fogler, Prentice Hall
3) Biochemical Engineering -James M. Lee, Prentice-Hall Inc. in 1992
4) Elements of Chemical Reaction Engineering-S.D.Dawande, Central Techno Publications, Nagpur.
5) Introduction to Biochemical Engineering by D. G. Rao, McGraw-Hill Publications

Lectures: 03 **Tutorials: 01** **No.of Credits: 04**

Papers: 80 Marks **College Assessment- 20Marks**

Duration of Paper: 3Hrs

BT BIT 503T (BBT) **Heat Transfer in Biotechnology**

Unit 1 Modes of heat transfer, steady state heat conduction equation, heat conduction in slabs, cylinders, spheres, heat generation inside solids, unsteady state heat conduction, Biot Number, Fourier Number and Heisler Charts.

Unit 2- Thermal insulation and their selection, optimum and economic thickness of insulation. Principles of heat flow in fluids, individual and overall heat transfer coefficients.

Unit 3- Free and Forced convection, dimensionless number in heat transfer, expressions for calculating heat transfer coefficients. Laminar and turbulent transfer inside and outside tubes, annuli, finned tubes. Natural convection and its applications. Film wise condensation and drop wise condensation, heat transfer to boiling liquids, pool boiling, forced convection boiling.

Unit 4- Unsteady state heat transfer in batch vessels. Heat exchangers, classification, applications, mode of operations, effectiveness, flow arrangement, design procedures.

Unit 5- Heat transfer in agitated vessels, coils. Heat recovery methods, recuperative, regenerative heat transfer in packed and fluidized beds. Heat transfer in evaporators, vaporizers, reboilers, reaction kettles, classification, operations and design.

Unit 6- Heat transfer by radiation, green house effect, heat flux by radiation. Heating fluids and reagents. Application of heat in sterilization of media, batch and continuous sterilization, in situ sterilization, chilling, freezing and refrigeration.

Book Recommended:

1. Principles of Heat Transfer and Mass Transfer by SD Dawande, Central Techno Publications, Nagpur.
2. Process Heat transfer by Dr. Kern Tata McGraw-Hill Education, 1950.
3. Fluid Mechanics and Heat Transfer by Kay JM, Cambridge University Press.
4. Heat Transmission by McAdams WH, McGraw Hill book Co, New York.
5. Heat Transfer by P.S.Ghoshdastidar, Oxford University Press
6. Heat Transfer by Y.Cengel, McGraw-Hill, 2003
7. Fundamentals of Heat and Mass Transfer, Frank P. Incropera, David P. DeWitt John Wiley & Sons, 2011

Lectures: 03 **Tutorials: 01** **No.of Credits: 04**

Papers: 80 Marks **College Assessment- 20Marks**

Duration of Paper: 3Hrs

BT BIT 504T (BBT) **Molecular Biology**

Unit 1- Basics of Molecular Biology- Introduction to Replication (Prokaryotic and Eukaryotic), Transcription (Initiation, elongation and termination, post transcriptional modification, splisosome), Translation (mechanism of translation and protein folding).

Unit 2- Mutation and DNA repair- Genetic Code. Mutations: types of mutations, mutagens, mutagenesis. DNA damage and repair mechanism: Types of DNA damage, mechanisms of DNA repair. Selection of mutants by replica plate method.

Unit 3- Prokaryotic gene regulation- Prokaryotic genome organization and structure. Prokaryotic gene expression, operons (lac, tryptophan, arabinose and galactose), positive and negative gene regulations, factors involved in gene regulation.

Unit 4- Eukaryotic Gene Regulation- Eukaryotic genome organization and structure, regulatory sequences (Intron, exon, spacers, amplifiers, and inhibitors) DNA binding protein, ALU sequences, telomerase, transposones. Gene silencing by modification of histones and DNA. RNA in gene regulation.

Unit 5- DNA fingerprinting techniques- Restriction Enzymes. Polymerase Chain Reaction (PCR). Hybridization based fingerprinting and PCR based fingerprinting. DNA probes, chromosome walking.

Unit 6- Molecular biological techniques- microarray, SNP, SSR, Real Time PCR, Southern, Western and Northern blotting. Concept of genomics, proteomics and gene silencing (RNAi technique), Micro RNA

Books Recommended:

1. Gene VII, Lewin . B. 2002, Oxford University, Press, New York.
2. Russel , V.E.A 1992, Molecular Genetic Approach, Springer Verlag.Berlin
3. Freifelder D, " Molecular Biology ", Jones and Bartlett Publishers Inc. 1987.
4. Molecular Biology by Watson. Benjamin-Cummings Publishing Company; 4 edition
5. Basics molecular biology by Avinash Upadhya and Kakoli Upadhya, Himalaya Publication.

Lectures: 03 **Tutorials: 01** **No.of Credits: 04**

Papers: 80 Marks **College Assessment- 20Marks**

Duration of Paper: 3Hrs

BT BIT 505T (BBT) **Immunology**

Unit 1- Introduction, innate and acquired immunity, active and passive immunity. Introduction to cells (T & B lymphocytes, NK cells, mast cells, dendritic cells) and organs of immune system – Primary and secondary (bone morrow, thymus, lymph nodes, CALT and MALT).

Unit 2- Structure of antigens and antibody- Antigens – classification, isotypes, functions and diversity. Antibody – structure, functions, types, monoclonal and polyclonal antibody,

Immunoglobullin gene. Generation of antibody diversity and specificity. Concept of Mitogen, hapten, immunogen, adjuvants. MHC and its significance.

Unit 3- B and T cell receptors- cytokines and their biological role . A brief idea about antigen processing and presentation. Humoral and cell mediated immune response. Complement system:- concept of activation, classical and alternative pathway.

Unit 4- Immunology Techniques- Antigen-antibody interaction, precipitin reaction, agglutination, immuno-diffusion. Immunoassay techniques-- Immuno-electrophoresis, ELISA, RIA, Immunochemistry , immunofluroscence. Blood group determination.

Unit 5- Vaccines- Active and passive immunization; Live, killed, attenuated, sub unit vaccines; Vaccinetechnology- recombinant vector vaccines, synthetic peptide vaccines and subunit vaccines, DNA vaccines. antibody engineering- Production of monoclonal antibodies. Chimeric antibody, humanized antibody. Methods of preparation, their clinical applications and applications in Research and development.

Unit 6- Hypersensitivity- Types, mechanisms and disorders; Autoimmunity:- Mechanism and therapeutic approaches, immunodeficiency syndrome and their diagnosis, Immunotherapy Transplantation Immunology:- Types of graft, mechanism of graft rejection, prevention of graft rejection, Tumor immunology:- Tumor Associated antigens and Tumor Specific Antigens;

Books Recommended

1. Immunology Kuby, R.A. Goldsby, T.J. Kind 1997, 4th Edition B.A. Osborne.
2. Essential of immunology Ivan Riot-Blakswel 1997, 4th Edition B.A. Osborne
3. Fundamentals of Immunology Paul W.E. (Eds.) 1998 Raven press, New York.
4. William, R. Clark The Experimental Foundations of Modern Immunology (1991) (4th Edition) John Wiley and Sons, New York.
5. Principles of Immunology by Dr.N.V.Shastri, Himalaya Publication.
6. Immunology Introduction text book by Nandini Shetty, New age international limited publishers.

PRACTICALS

BT BIT 506P (BBT) **Fluid Mechanics and Solid Handling Laboratory**

1. To calibrate Venturi meter and obtain its coefficient of discharge.
2. To calibrate an Orifice meter and obtain its coefficient of discharge.
3. To calibrate Rotameter and obtain its coefficient of discharge.
4. To calibrate Notched Weir and to determine its coefficient of discharge (Rectangular and Triangular Notch)
5. To Study Losses in pipes apparatus.
6. To investigate the flow of air alone through a packed column.
7. To verify Bernoulli's theorem.
8. To study Mouth Pieces Apparatus.
9. To study Losses across fittings
10. To study Centrifugal pump test ring
11. To determine Coefficient of discharge of Pitot tube apparatus.

BT BIT 507P (BBT) **Heat Transfer in Biotechnology Laboratory**

1. Study of heat transfer in natural convection.
2. Study of heat transfer in forced convection.
3. To determine emissivity of test plate.
4. Study of heat transfer in a double pipe heat exchange both in co-current flow and counter-flow conditions.
5. Study of heat transfer in shell and tube heat exchanger.
6. Study of heat transfer in open pan evaporator.
7. Study of heat transfer in lagged pipe.
8. Study of unsteady state heat transfer.
9. To determine the thermal conductivity of insulating material by guarded hot plate method.
10. To study heat pipe apparatus.

BT BIT 508P (BBT) **Immunology & Molecular Biology**

Part A: Immunology:

1. Experiments based on Ouchternlony Double Diffusion (ODD) for antigen-antibody pattern.
2. Radial Immunodiffusion (RID).
3. Immunoelectrophoresis.
4. Rocket Immunoelectrophoresis (RIEP).
5. Latex Agglutination.
6. Western blotting technique of proteins

Part B: Molecular Biology:

1. Extraction techniques of DNA
2. Identification and Isolation of PCR products.
3. Isolation and visualization of plasmid by electrophoresis.
4. DNA fingerprinting/Restriction mapping.
5. Southern hybridization.

Teaching Scheme B.Tech (Biotechnology)

SIXTH SEMESTER

Lectures: 03 **Tutorials: 01** **No.of Credits: 04**

Papers: 80 Marks **College Assessment- 20Marks**

Duration of Paper: 3Hrs

BT BIT 601T (BBT) **Genetic Engineering**

Unit 1- Introduction, milestones in genetic engineering. Modification enzymes (all enzymes necessacery for genetic engineering). DNA markers, Marker Assisted Selection (Developmet of NIL, identification of different markers-RAPD,AFLP,SSR,SNP etc, calculation of cM distance of marker from gene, linkage of marker with gene.)

Unit 2- r-DNA technology:- Concept of recombinant DNA Technology, vectors – plasmids, bacteriophages, phagenmids, cosmids,. Vectors for plants and animal host. Yeast artificial chromosomes. Mammalian Artificial Chromosomes.

Unit 3- Gene Cloning:- concept of gene cloning and cDNA synthesis. cDNA and Genomic Library construction and screening. DNA primers, linkers, adaptors. Alternative strategies of gene cloning. T-DNA and transposone tagging

Unit 4- Protein Engineering:- Concept of Site-directed Mutagenesis and Protein Engineering. Ame's mutagenicity test.

Unit 5- Recombinant protein and IPR:- Classification of recombinant proteins. Processing of recombinant proteins (purification and refolding), Characterization of recombinant proteins. Bioethics: The legal and socioeconomic impacts of Biotechnology. Intellectual property rights.

Unit 6- Application of genetically modified organisms in various fields:- Agriculture, health, fermentation industry, chemical industry (dyes, textiles and leather), bioremediation, effluent treatment plant. Environmental release of GMOs- risk analysis and assessment.

Books Recommended:

1. Gene Cloning :-T.A. Brown 4th Ed Print 2001.
2. Gene VII:- Benzamin Lewin Oxford University Press.1st Ed.Print 2003
3. From genes to Clones:-Winacker 1st Ed.. Panima Publishing Corp. Print 2003
4. From genes to Genomes:- Dale and Schantz JhonWiley and Sons. Print 2002
5. Gene manipulation:-Old and Primrose. Blackwell Science prints 2001.
6. Molecular Biotechnology: Glick and Pasternak ASM Press 2nd edition
7. Saleesha A.Stanely, "Bioethics", Wisdom educational service, 2008.
8. Genetic Engineering by S.Rastogi and N.Pathak. Oxford University Press 2009.

Lectures: 03 **Tutorials: 01** **No. of Credits: 04**

Papers: 80 Marks **College Assessment- 20Marks**

Duration of Paper: 3Hrs

BT BIT 602T (BBT) **Mass Transfer in Biotechnology**

Unit 1: Molecular diffusion in fluids, Diffusion in solids. Interphase Mass Transfer, coefficient and their correlations/HTU and NTU, concept of Jd factor. Mass transfer in packed and fluidized beds. Concept of effective diffusivity. Diffusion through membranes and applications. Measurment of k_La. Oxygen transfer methodology in fermenters.

Unit 2: Distillation: Vapour liquid equilibrium, T-x,y and P-x,y diagrams, estimation of VLE using vapour pressure data and relative volatility. Vapour liquid equilibrium for multicomponent mixtures. Differential distillation, Equilibrium distillation, Rectification.

Unit 3: Gas Absorption: Equilibrium relationship, mass transfer theories, concept of driving force, individual and over all mass transfer coefficient. Plate column for absorption, analytical and graphical calculation of number of plates. Humidity and air conditioning, wet and dry bulb hygrometry, Humidity charts. Method of humidification and dehumidification, air conditioning.

Unit 4: Liquid Liquid Extraction–Equilibrium for immiscible and partially miscible systems. Supercritical fluid extraction. Concept of number of stages for cocurrent and countercurrent contacting, solid liquid extraction.

Unit 5: Drying characteristics of the biological materials. Theory and mechanism of drying. Free and bound moisture and water activity. Evaluation of drying rates. Material and enthalpy balance equations in continuous drying operations. Equipments for dehydration of biological materials.

Crystallization, Miers theory, nuclei formation, crystal growth. Theory of crystallization, batch and continuous cyrstalliztion.Fractional crystallization.

Unit 6: Adsorption - Gas solid isotherms for one and more sorbates, chemisoption, liquid solid isotherms. Adsorption unit – fixed bed equation, isothermal operations, non isothermal operation.

Books Recommended:

1. Chemical Engineering by Coulson and Richardson,Vol I & II. Pergamon Press, New York.

2. Mass Transfer operations by R.E.Treyball, MGH International.

3. Unit Operation by G.G.Brown, CBS publications.

4. Transport Processes and Separation Process Principles by Christie John Geankoplis, Phi Learning.

5. Unit Operations of Chemical Engineering by W.L. Mccabe, J.C. Smith, Peter Harriott, McGraw-Hill Publications.

6. Introduction to Biochemical Engineering by D. G. Rao, McGraw-Hill Publications

Lectures: 03 **Tutorials: 01** **No. of Credits: 04**

Papers: 80 Marks **College Assessment- 20Marks**

Duration of Paper: 3Hrs

BT BIT 603T (BBT) **Biochemical Reaction Engineering – II**

Unit I -Non-Ideal Behavior in Reaction Systems- Reasons for non-ideality, concept of macro using – RTD analysis (E-C-F functions), diagnosing the ills of non-ideal bioreactors.

Unit II-Solid Catalyzed Reactions-Surface Kinetics, Pore Diffusion Resistance Combined with Surface Kinetics, Heat Effects during Reaction, Performance Equations for Reactors Containing Porous Catalyst Particles.

Unit III- Non-Catalytic Systems-Fluid-Fluid Reaction Kinetics, Fluid-Fluid Reactors: Design, Fluid-Particle Reaction Kinetics.

Unit IV-Enzyme catalyzed Reaction**-** Briggs Haldane approach, Michaelis-Menten Kinetics, Factors affecting enzyme reactions, Substrate-Limiting Microbial Fermentation, Product-Limiting Microbial Fermentation.

Unit V-Protein Ligand Interaction**-** Hill equation and Hill plot, Model for Hemoglobin Oxygen Interaction, Various Immobilization techniques of enzyme, Inhibition of enzyme reactions- competitive, non competitive and uncompetitive inhibition.

Unit VI-Mechanism of catalyst deactivation-fouling poisoning and sintering, rate and performance equation, methods of catalyst regeneration

Books Recommended:

1) Chemical Reaction Engineering,3rd Edition – O.Levenspiel, Willey Eastern 1999
2) Chemical Kinetics and Reactor Calculations- Scott Fogler, Prentice Hall
3) Biochemical Engineering -James M. Lee, Prentice-Hall Inc. in 1992
4) Elements of Chemical Reaction Engineering-S.D.Dawande, Central Techno Publications, Nagpur.
5) Principals of Biochemistry by A.Lehninger
6) Introduction to Biochemical Engineering by D. G. Rao, McGraw-Hill Publications

Lectures: 03 **Tutorials: 01** **No. of Credits: 04**

Papers: 80 Marks **College Assessment- 20Marks**

Duration of Paper: 3Hrs

BT BIT 604T (BBT) **Process Control in Biotechnology**

Unit 1: Transient response of the first and second order systems. Time constant, damping coefficient. Transfer function for liquid level and mixing processes. Linearization. Response of the first order systems in series. Transfer function and transient response of interacting and non-interacting systems. Transportation lag.

Unit 2: Linear closed loop systems. Bio-chemical reactor control system. Block diagram, pneumatic and electronic controllers and final control elements. Choice of controllers, stabilization time, characteristics of proportional integral and derivative control modes. Transident response of simple control systems. Combination of controllers.

Unit 3: Concept of stability for linear systems. Routh criteria, root locus diagram for positive and negative feedback systems.

Unit 4: Control systems design by frequency response method. Bode stability criterion. Gain and phase margins. Ziegler-Nichols controller settings.

Unit 5: Instrumentation : Measurement of temperature: Expansion Thermometer- solid and liquid expansion thermometer, Electrical sensors for temperature measurement- resistance temperature detectors (RTD), Thermistor, Thermocouple, Pyrometer- radiation pyrometer, optical pyrometer. Measurement of pressure and vacuum: Elastic pressure transducer- Bourdon pressure gauge, Diaphragm pressure gauge, capsule and bellow pressure gauge.

Unit 6: Measurement of head and level: Direct level measurement- point contact method, buoyancy method Indirect level measurement- hydrostatic method radiation method, ultrasonic level detector. Composition Analysis: absorption spectroscopic method- X-ray, UV and IR absorption spectroscopy, Emission spectroscopic method- electric arc method, flame method, fluorescence method, Oxygen analyzer. Composition analysis by density, viscosity, pH measurement, biosensors.

Book Recommended:

1. Process Systems analysis and control coughanowr and Koppel.
2. Process Control: Peter Harriot, Tata Mc-Graw Hill Publication.
3. Process Dyanamics and Control, D.Edgar, 2nd Edition Wiley Publication.
4. Chemical Process Control-George Stephanopoulos, PTR Prentice hall
5. Process Control and Instrumentation- R.P.Vyas, Dennet & Co.2010

Lectures: 03 **Tutorials: 01** **No.of Credits: 04**

Papers: 80 Marks **College Assesment- 20Marks**

Duration of Paper: 3Hrs

BT BIT 605T (BBT) **Industrial Bio-Technology**

Unit 1: Introduction fermentation technology- Isolation, preservation and improvement of industrially important microorganism. Sterilization process (heat, radiation and filtration method), media for industrial fermentation, development of inoculum for industrial fermentations.

Unit 2: Types of fermentor- (solid state, submerged fermentation and continuous fermentation), Designing of a fermentor, operation and application, instrumentation and control, fermentation kinetics, optimization of fermentation process, aeration and agitation.

Unit 3: Production of Microbial products- Process technology for production of organic solvents such as industrial alcohol, glycerol, acetone butanol, Production of Vit B12. Brief account of steroid transformation.

Unit 4: Enzyme Biotechnology- Production of industrial enzymes. Bioreactors for enzyme production. Industrial applications of enzymes in detergents, leather, beverage, food and pharmaceutical industries. Recent development in a recovery methods and purification for industrial enzyme.

Unit 5: Food Biotechnology- Fermented Foods – Yoghurt, Buttermilk, Idli, Dosa, Cheese, Tempeh, bread, pickles, soya sauce. Microbial Foods – Single cell proteins (SCP). Technique of mass culture of Algae – spirulina.Alcoholic beverages – Wine and beer. Plant cell suspension culture for the production of food additives – Saffron and Capsaicin.

Unit6: Microbial polysaccharides and polyesters- production of xanthan gum and polyhydroxyalkonoides (PHA). Production of biofertilizers, biopesticides, and biosurfactants.

Books Recommended:-

1. Principles of fermentation technology:- Stanbury, Whittaker and Hall,2nd Ed. 1997.Aditya Books.
2. Fermentation Microbiology and Biotechnology :-El-Mansi and Bryce,2002
3. Process Biotechnology Fundamental :-Mukhopadhaya
4. Biochemical Engineering and Biotechnology :- Atkinson B and Mavituna F.
5. Industrial Microbiology by Prescott and Dunn,Mc-graw Hill publication.

PRACTICALS

BT BIT 607P (BBT) Mass Transfer in Biotechnology

1. Determination of diffusion coefficient of an organic vapor (acetone) in air.
2. Study of the drying characteristics of a given material under constant drying conditions and to report equilibrium and critical moisture content.
3. Determination of the mass transfer coefficient for the absorption of water vapor on silica gel.
4. Study the operation of a batch rectification column under constant reflux condition.
5. Study the variation of mass transfer coefficient as a function of flow rate of air for the vaporization of naphthalene in a packed bed.

6. Estimation of the rate constant for the physical dissolution of benzoic acid in a liquid.
7. Determination of the effective interfacial area as a function of liquid velocity in a packed adsorption column.
8. Determination of the diffusion coefficient for the given liquid-liquid system as a function of concentration.
9. Estimation of Kla for air/oxygen absorption in nature.

BT BIT 608P (BBT) **Process Control in Biotechnology**

1. To determine the valve characteristics of the linear and equal percent valves.
2. To determine the transient response of the first order and second order system.
3. To study the characteristics of flapper nozzle system and to calculate its gain.
4. To study the step response of the first order systems arranged in non interacting and interacting mode and to study its impulse response.
5. To study the advanced control techniques like cascade control, feed forward control, and ratio control using multiprocess trainer.
6. To study the working principle of current to pressure and pressure to current converter using I/P and P/I converter.
7. To study the characteristics of thermistors, thermocouples, and RTD using temperature measurement system.
8. Study of controlling the level using level controller.
9. Study of controlling the temperature using temperature controller.

BT BIT 609P (BBT) **Industrial Bio-Technology**

Part A: Industrial biotechnology

1. Production of critic acid from Aspergillus culture.

2. Enzyme immobilization by enzyme entrapment in polyacrylamide gel.
3. Production and estimation of lactic acid and lactose.
4. Cell immobilization with calcium alginate.
5. Preparation of wine.
6. Production and Estimation of alcohol by specific gravity method.
7. Production of enzymes by submerged and solid state fermentation.

Part B: Genetic Engineering

1. To study the Restriction mapping
2. Preparation of competent cell for transformation
3. $Cacl_2$ method of transformation
4. DNA cloning and blue white screening of recombinant cells.