

BASAVESHWAR ENGINEERING COLLEGE (A), BAGALKOTE
DEPARTMENT OF BIOTECHNOLOGY

Syllabus

III-Semester -2022-23

21UBT301C: MICROBIOLOGY

3 Credits (3-0-0)

Course Objectives:

- To know the basic concepts of Microbiology, scope and organization of organisms in the taxonomy.
- Ability to understand the techniques to study microorganisms through microscopy.
- Capable to analyse the structure of different microbes and their applications.
- To know the metabolic reactions within the organisms for fermentation process.

UNIT- 1

Introduction:

10 Hours

Scope of microbiology, History of microbiology-Evolution of microbes. Contributions of Scientist for the development of microbiology. Microbial diversity & taxonomy, Prokaryotes & Eukaryotes. Microscopy: Principles and applications of Bright field microscopy, Dark-Field Microscopy, Phase contrast microscopy, Fluorescence Microscopy and Electron microscopy (SEM & TEM).

UNIT- 2

Microorganisms:

10 Hours

Bacteria- Morphology and ultra structure of Bacteria, Culturing of bacteria, reproduction and growth (continuous and batch). Viruses, fungi, algae, protozoa, actinomycetes- structure and modes of reproduction. Fastidious microorganisms. Microbial toxins. Microbial Techniques: Pure culture techniques- Aerobic and Anaerobic culture techniques. Fermentation(acid & alcohol).

UNIT- 3

Control of Microorganisms:

10 Hours

Control of microorganisms by Physical methods and chemical methods, antibiotics, chemotherapeutic agents and Phage biotics. Medical Microbiology: Normal microflora, common diseases caused by microbes-pathogenesis, symptoms, diagnosis, treatment, prevention .

UNIT- 4

Agricultural and Environmental Microbiology:

12 Hours

Microbiology of soil, Air and Aquatic Microbiology, Biofertilizer, Plant endophytes, Microbes in bioremediation and biocontrol agents.

Industrial Microbiology: Microbial processes using yeasts and bacteria (production of alcohol, vinegar, cheese), Microbes as source of protein (SCP), gelatin agents (alginate, xanthin, agar agar) Microbial insecticides, Enzymes from Microbes (amylase, protease), Useful products from microorganisms using recombinant DNA technology (vaccines and antibiotics).

Total: 42 Hours

TEXT BOOKS:

1. Pelczar, Chan and Noel Kreig, “Microbiology”- 5th Edition Tata Macgraw Hill, 2010.
2. Tortora, Funke and Case, “Microbiology an Introduction” -8th Edition, Pearson Education, 2006.

REFERENCE BOOKS:

1. Stainer R.Y., Ingraham J.L., “General Microbiology”- 5th Edition Mc.Millan Press, 2010.
2. Madigan, Martinko, Parker, Brock’s, “Biology of Microorganisms” - 10th Edition, Prentice Hall, Pearson Education, 2003.
3. Prescott and Dunn, “Industrial Microbiology”-Agribios India, 2002.
4. J. Salle, “Fundamental Principles of Bacteriology” – 7th Edition, Tata Macgraw Hill, 2007.
5. E Alcamo I “Fundamentals of Microbiology”6th Ed, Jones & Bartlet, Pub. 2001.
6. Prescott, Harley & Klein, “Microbiology” -7th Edition, WCB/McGraw Hill, Int. Edition, 2008.

COURSE OUTCOMES:

1. Ability to know the basic concepts of Microbiology, scope and organization of organisms in the taxonomy
2. Ability to understand the techniques to study microorganisms through microscopy
3. Capable to analyze the structure of different microbes and their applications
4. Capable to interpret the techniques used to grow and identify the microbes
5. Ability to analyse the different techniques to control the growth of microbes in different areas.
6. Ability to discuss the causative organisms of the disease and their effect on society
7. Ability to analyse the applied techniques in the environment and create awareness to society
8. Ability to comprehend the applications in the industry and their use in society

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	2	2	2			2	2	2					1	1	1
CO 2	2	2	2	3	2	3	2	1					2	1	
CO 3	3	3	2		2	2	2	1				1	1	1	2
CO 4	3	3	3		2	3	3	2				1	2	1	3
CO 5	2	2	2		2	2	3	1				1	2	1	2
CO 6	2	2	2	3	2	2	1	1				1	1	1	2
CO 7	2	3	2	3	2	3	1	3				2	2	1	1
CO8	2	3	3	3	2	3	1	3				2	1	2	2

21UBT303C: BIOCHEMISTRY

3 Credits (3-0-0)

Prerequisites

Course Objectives:

- To understand the principles of bioenergetics.
- To study metabolic pathway reactions and analysis of metabolic disorders.
- To study the experimental identification of biomolecules.

UNIT- 1

Principles of Bioenergetics:

12 Hours

Energy Flow cycle, energy conversion. Structure and properties of ATP, Bioenergetics of metabolic pathway

Carbohydrate Metabolism:

Glycolysis, TCA cycle, Electron transport chain and oxidative phosphorylation and respiration energetics. Calvin Cycle, Glyoxylate cycle, Pentose Phosphate Pathway, Gluconeogenesis and regulation of gluconeogenesis.

Disorders of carbohydrate metabolism- Galactosemia, Lactose intolerance, Glycogen storage disorder etc. (Defective enzyme lead to disorder during metabolism).

Osazone formation to identify the carbohydrates.

UNIT- 2

Lipid Metabolism:

10 Hours

Biosynthesis of fatty acids. cholesterol, phospholipids and glycolipids, Regulation of fatty acid biosynthesis, biodegradation of fatty acid, ketone bodies production during starving and diabetes. Disorders of lipid metabolism- Sphingolipidoses etc.

UNIT- 3

Nucleic acid Metabolism:

10 Hours

Biosynthesis of purines - origin of ring atoms, formation of IMP, conversion of IMP to AMP and GMP. De novo synthesis of pyrimidine nucleotides - biosynthesis of UTP & CTP. Biodegradation of purines & pyrimidines. Recycling of Purine and Pyrimidine nucleotides by salvage pathways. Disorders of nucleic acid metabolism-Lesch-Nyhan Syndrome and Gout.

UNIT- 4

Amino Acid Metabolism:

10 Hours

Biosynthesis of amino acids starting from acetyl CoA (with reference to oxaloacetate family)- Aspartate, Asparagine, Methionine, Lysine, Threonine. Biodegradation of amino acids- deamination, transamination and urea cycle. Disorders of amino acid metabolism- Phenylketonuria, Albinism, Maple Syrup Urine Disease, Tyrosinemia.

Total: 42 Hours

TEXT BOOK:

1. David L. Nelson and Michael Cox, "Lehninger Principles of Biochemistry" –6th Edition

REFERENCE BOOKS:

1. Lubert Stryer, "Biochemistry" -Freeman & Co., Pub, 2010.
2. Voet & Voet, "Biochemistry"- 3rd Edition, John Wiley,New York Pub., 2004.
3. Thomas M. Davlins " Biochemistry with clinical correlations" Wiley-Liss; 5 edition, 2001.
4. Mathews, Vanholde & Arhen "Biochemistry" -3rd Edition, Pearson Education Pub., 3 edition 2010.
5. K. Trehan, "Biochemistry" -New Age International Pub, 2nd edition, 2003
6. Elliot & William H, "Biochemistry & Molecular Biology" Oxford Pub., 2005.
7. Helmreich JEM, "Biochemistry of cell signaling" -Oxford Pub. 2005.
8. U. Sathyanarayana, "Biochemistry" -Books and Allied Pub, 2007
9. Berg J.M., Stryer, Tymoczko J.L. "Biochemistry" Freeman & co 2010.
10. Freifelder D. "Molecular Biology" -Narosa Publications, 2nd Edition 2003.

COURSE OUTCOMES:

1. Ability to interpret principles of bioenergetics of high energy compounds
2. Ability to understand Carbohydrate metabolism along with disorders.
3. Ability to recognize the importance of Lipid metabolism & the enzymes responsible to homoestasis of biochemical reaction.
4. Ability to understand the origin of atom in the formation of purine and pyrimidine.
5. Ability to comprehend Nucleic acid metabolism and its metabolic disorders.
6. Ability to explain Amino acid metabolism and its metabolic disorders.

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	1	2	3				3	3				3	2	3	
CO 2	2	3	3	2			2	3				3	2	3	
CO 3	2	3	3	3		3	2	2				2	2	1	2
CO 4	3	3	3	2		2	2	2				2	3	1	
CO 5	2	2	2	2		1	2	2				3	3	2	
CO 6	2	2	3	3		3		3				2	3	2	

21UBT304C: BIOPROCESS PRINCIPLES AND CALCULATIONS

3 Credits (3-0-0)

Prerequisites: Chemistry and Mathematics

The Course objectives are:

- 1 To Understand the material balance of different processes and operations
- 2 To apply and convert the various unit systems
- 3 To solve the material balance problems
- 4 To identify the various principles and variables for solving the problems
- 5 To Calculate the material balance with chemical reaction problems
- 6 Develop the mathematical equations and reactions to solve the engineering problems

UNIT-I

Introduction & Basic Chemical Calculations:

10 Hours

Development and overview of traditional and modern applications of biotechnological processes. Process flow sheet and unit operations in chemical and bioprocess industries. Fundamental and derived quantities, Inter-conversion of units from one system to another (FPS, CGS, MKS, SI). Concept of mole and molecule, Composition of mixtures and solutions- Percentage by weight, mole and volume; Normality, Molarity, Molality; average molecular weight; ppm, pH and pK Buffer calculations. Numerical problems

UNIT-II

Material balance without chemical reactions:

10 Hours

General material balance equation for steady and unsteady states. Material balances in Distillation, Absorption, Extraction, Crystallization, Drying, Mixing, and Evaporation Operations. Numerical problems Numerical problems

UNIT-III Material balance involving chemical reactions:

10 Hours

Principles of Stoichiometry. Definitions of limiting and excess reactants, fractions and percentage conversion, yield and percentage yield, selectivity and related problems. Material balances involving bypass & recycle; Fuels and Combustion: calculations involving Excess air and Air-fuel ratio. Numerical problems

UNIT-IV

Energy Balance:

10 Hours

General energy balance equation for steady state. Thermo physics and Thermo chemistry: Heat capacity, estimation of heat capacity for solids, liquids, gases and their mixtures. Enthalpy, Standard Heat of formation, standard heat of reaction, Standard heat of combustion and calorific value, Calculation of $\Delta(HR)$ at elevated temperature. Heat effects of biochemical reactions. Numerical problems

Total: 40 Hours

TEXTBOOKS:

1. Hougen OA, Wats (2018) Chemical Process Principles: Part I, 2nd Edn., John Wiley, USA.
2. P.M.Doran (2012) Bioprocess Engineering Principles, 2nd Edition, Elsevier India Pvt Ltd.
3. Gavhane K A (2009) Process Calculations Stoichiometry, 22nd Edn, Nirali Prakashan, India.
4. M.L.Shuler and F.Kargi (2008) Bioprocess Engineering--basic Concepts, 2nd Edn. Prentice-hall of India Pvt Ltd.
5. Narayanan K V, Lakshmikutty B (2016) Stoichiometry and Process Calculations, 2nd Edition, PHI India.

REFERENCE BOOKS:

1. D.M.Himmelblau (2014) Basic Principles and Calculations in Chemical Engineering, 8th Edn, PHI LEARNING PVT LTD.
2. Segel IH (2010) Biochemical Calculations 2nd Edn., John Wiley & Sons, New York.
3. Bailey JE and Ollis DF (1993) Biochemical Engg. Fundamentals, McGraw Hill, New York, USA.

COURSE OUTCOMES:

At the end of the course the student should be able to:

- 1 Define the process operations and terms of calculations
- 2 Apply various types of unit systems and convert units from one system to another.
- 3 Develop strategy for solving problems involving gases, vapours etc.
- 4 Adopt the tools learned from the course to solve numerical problems which contain one or more unit operations.
- 5 Able to solve material balance problems involving reactions.
- 6 Develop mathematical relations for both mass and energy balances for different processes.

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	3	3	2	1	1						3	3	2		
CO 2	2	3	3	2	1						2	3	2		
CO 3	2	3	2	1	1						2	3	2		
CO 4	3	3	3	1	1						3	3	2		
CO 5	3	2	3	1	1						3	2	2		
CO 6	3	1	2	1	1						3	1	2		

21UBT305C: UNIT OPERATIONS

3 Credits (3-0-0)

Prerequisites: Chemistry and Mathematics

The Course objectives are:

- 1 To Understand the basic concept of fluid mechanics and fluid Properties
- 2 To evaluate problems in fluid mechanics using the Dimensional analysis
- 3 To calculate the pressure drop in fluid flow and pressure drop problems
- 4 To determine the flow rate , discharge through transportation fluid
- 5 To solve the engineering problems in mechanical operation
- 6 To apply and solve the problems in Heat and Mass Transfer problems

Unit-I

Introduction to Fluid Mechanics:

10 Hours

Units and Dimensions, Basic and Derived units, Dimensional homogeneity, Dimensionless numbers, Rayleigh method, Buckingham's pi theorem, Similitude. Fluid definition and classification (Types of fluids – Newtonian and Non Newtonian); Rheological behaviour of fluids. Fluid statics and its applications Hydrostatic equilibrium, Pressure measurement - Manometers.

Unit-II

Flow Past Immersed Bodies:

10 Hours

Types of flow - laminar and Turbulent; Reynolds number; Basic equations of fluid flow - Continuity equation and Bernoulli equation; Correction for Bernoulli's equation, Pump work in Bernoulli's equation; Flow through circular and non circular conduits – Friction factor relations for smooth and commercial pipes,.

Unit-III

Flow measurements: Flow measurements:

10 Hours

Orifice meter, Venturimeter, Rota meter. Pumps, principle, construction numerical. Major and minor losses ,Centrifugal & Reciprocating pumps, Characteristics of centrifugal pumps. Pipes, fittings and valves. Dimensional Analysis.

Unit-IV

Mechanical Operations- Filtration:

10 Hours

Types of filtration, Filter media and filter aids, calculation of resistances and rate of filtration, filtration equipment. Settling, Free and Hindered, Stoke's law, Newton's law, Terminal settling velocity, Batch sedimentation Agitation: Theory of mixing, Power number calculations, mixing equipment. Flow patterns in agitated tanks, mechanism of mixing, scale up of mixing systems. Size Separation: Particle shape, size, screen analysis, screening equipment. Size Reduction: Characteristics of comminute products, crushing laws and work index; Size reduction equipment.

Total: 40 Hours

TEXTBOOKS:

1. McCabe WL, Smith JC and Harriott (2005) Unit operations of Chemical Engineering, 7th Edn., McGraw-Hill Publications, USA.
2. Gavhane KA (2012) Unit Operations I & II, 22nd Edn., Nirali Prakashan, India.

REFERENCE BOOKS:

1. Alan S Foust, Wenzel LA, Clump CW, Maus L, and Anderson LB (2008) Principles of Unit Operations. 3rd Edn., John Wiley & Sons, USA.
2. R.P.Chhabra V. Shankar (2017) Coulson and Richardson's Chemical Engineering Volume 1A: Fluid Flow: Fundamentals and Applications. 7th Edition, Elsevier, USA.
3. R.P.Chhabra Basavaraj Gurappa (2019) Coulson and Richardson's Chemical Engineering Volume 2A: Particulate Systems and Particle Technology. 6th Edition, Elsevier,USA.

COURSE OUTCOMES:

At the end of the course the student should be able to:

- 1 Understand the basic concept of fluid mechanics and flow measurements.
- 2 Predict the dimensional analysis and solution for fluid flow problems.
- 3 Predict the pressure drop in fluid flow and flow through packed beds.
- 4 Estimate the flow rate of fluids and design the pumps for transportation of fluids.
- 5 Analyse and solve the problems on filtration and settling.
- 6 Analyse the forces involved in flow through solids and its operations

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	2	2	2	1	1								3		
CO 2	3	2	3	2	1								3		
CO 3	2	3	2	2	1								3		
CO 4	3	2	1	1	1								3		
CO 5	2	3	3	1	1								2		
CO 6	2	2	2	2	1								2		

21UBT307L: MICROBIOLOGY LABORATORY
1.5 Credits (0-0-3)

LIST OF EXPERIMENTS IN MICROBIOLOGY LABORATORY

1. Study of microscopes: Types, working principle, parts of the microscope, handling (operating) & caring.
2. Media preparation: NA, Peptone broth, PDA, Macconkeys agar.
3. Isolation of bacteria by serial dilution, pour plate ,spread plate and streak plate techniques
4. Isolation and identification of bacteria and fungi from different sources.
5. Study of colony characteristics and Morphology of bacteria, yeasts and fungi.
6. Study of different staining techniques. (Simple staining differential staining)
7. Enumeration of microorganisms using colony counter
8. Fermentation of Carbohydrates (gas production)
9. Growth curve of bacteria and yeast.
10. Antibiotic susceptibility testing of bacteria & Observation of motility by hanging drop technique.

REFERENCE BOOKS:

1. Stainer, Ingraham and Wheeler, “General Microbiology” -5th Edition, Mac-Millan Pub, 1987.
2. Pelczar, Chan and Krig, “Microbiology” -5th Edition, Tata McGraw Hill, 1993.
3. Prescott and Dunn, “Industrial Microbiology”-2nd Edition, Agrobios, 2002.
4. K. R. Aneja, “Experiments in Microbiology, Plant Pathology and Biotechnology” – 4th Edition, New age International Pub. 2004.

COURSE OUTCOMES;

1. To analyse the principle and procedures of different experiments
2. To perform simple and differential staining techniques
3. To prepare the media for culturing microbes
4. To observe the motility of organisms
5. To interpret the instruments and different components used in lab
6. To interpret the subject orally

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	2	2	3	3	2	2	3	1				3	2	1	3
CO 2	2	3	3	2	3	3	3	3				2	2	2	3
CO 3	3	3	2	3	2	3	2	2				3	2	3	2
CO 4	2	3	3	3	2	3	3	3				3	2	3	3
CO 5	2	3	3	3	3	2	3	3				3	2	2	3
CO 6	2	2	2	2	1	2	3	2				3	2	3	2

21UBT308L: BIOCHEMISTRY LABORATORY
1.5Credits (0-0-3)

LIST OF EXPERIMENTS IN BIOCHEMISTRY LABORATORY

1. pH measurements, volume / weight measurements, concentration units, Specificity, precision, Accuracy.
2. Classes of carbohydrates, lipids and proteins.
3. Reagent preparation and preparation of buffers of constant strength.
4. Qualitative tests for carbohydrate and lipids.
5. Qualitative tests for amino acids and proteins.
6. Estimation of sugar by Folin and O-toluene method.
7. Estimation of amino acid and protein by ninhydrin method
8. Determination of Saponification value of lipids.
9. Determination of Iodine value of lipid.
10. Determination of acetyl value of a lipid.
11. Estimation of urea by diacetyl monooxime method.

REFERENCE BOOKS:

1. Rodney Boyer, "Modern Experimental Biochemistry"-Pearson Education Pub, (2000).
2. Keith Wilson, "Practical Biochemistry" Cambridge University Pub, (2003).
3. Pattabhiraman, "Practical Biochemistry"
4. Beedu Sashidhar Rao and Vijay Deshpande, "Experimental Biochemistry" -I.K.Intl
5. Plummer D. T "Practical Biochemistry" -TMH Pub., 1988

COURSE OUTCOMES:

1. Ability to understand the basic aspects of standard reagent & buffer preparations.
2. Ability to identify various biomolecules qualitatively.
3. Ability to estimate the concentration of carbohydrates in a given sample
4. Ability to evaluate the concentration of amino acid quantitatively.
5. Ability to analyze the types of lipids.
6. Ability to apply knowledge of acid & iodine value to determine the quality of lipids.

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	1	2	3	2			3	3				3	2	3	1
CO 2	2	3	3	2			2	3				3	2	3	1
CO 3	2	3	3	3		3	2	2				2	2	1	2
CO 4	3	3	3	2		2	2	2				2	3	1	1
CO 5	2	2	2	2		1	2	2				3	3	2	1
CO 6	2	2	3	3		3		3				2	3	2	1

V-Semester -2022-23

UBT516C: BIOPROCESS & REACTION ENGINEERING

3 Credits (3-0-0)

Prerequisites: Chemistry, Process calculations and unit operations

The Course objectives are:

- 1 To Understand the basic concept of reaction engineering
- 2 To calculate the order and rate of reaction
- 3 To categorize the batch reactor data for different reactions
- 4 To decide the suitable bioreactor for different reactor
- 5 To Demonstrate the RTD to calculate the conversion
- 6 To Evaluate the bioreactor for various purposes

UNIT-I

Kinetics of Homogeneous reactions:

10 Hours

Basic Concepts of Bioreactor and bioprocess engineering, Concentration dependent term of a rate equation. Rate Constant. Representation of elementary reaction and Non elementary reactions, Kinetic Models of Non elementary Reactions, Testing Kinetic Models. Temperature-dependent term of a rate equation: Temperature dependency from Arrhenius law, Collision theory, Transition state theory, Thermodynamic approach, Activation Energy.

UNIT-II

Interpretation of Batch Bioreactor Data:

10 Hours

Constant volume batch reactor, Integral method of analysis of data -first order, second order, zero order reactions, fractional life, homogenous catalyzed reactions, irreversible reaction in series, irreversible reactions in parallel, reactions of shifting order, autocatalytic reactions, reversible reactions, differential method of analysis of data and numerical.

UNIT-III

Introduction to Reaction Design:

10 Hours

Introduction. Factors to be consider for designing a reactor, Types of reactors, Basic design equation, relation between Concentration and conversion, Performance equation for ideal batch reactor, MFR/CSTR and PFR, space time and space velocity for flow reactors, design of flow reactors and numerical.

UNIT IV

Design for single reactions:

10 Hours

introduction .Size comparison of single reactors, multiple reactors CSTR in series /MFR in series, CSTR in parallel .PFR in series, in parallel, Reactors of different types in series, and numerical.

Total: 40 Hours

TEXTBOOKS:

1. Scott Fogler, H (2016) Elements of Chemical Reaction Engineering, 6th edn., Prentice Hall India Pvt. Ltd.
2. Levenspiel O (2006) Chemical Reaction Engineering, Wiley Eastern, 3rd edn, New Delhi.
3. Kargi and Shuler (2015) Bioprocess Engineering. 3rd edn., Prentice Hall PTR.

REFERENCE BOOKS:

1. BaileyJE and Ollis DF (2010) Biochemical Engineering Fundamentals, 2nd edn. Mc Graw-Hill.
2. Charles D. Holland (1990) Fundamentals of Chemical Reaction Engineering, John Wiley and Sons.
3. Pauline M Doran., Bioprocess Engineering Principles, 2nd Edition, Academic Press, USA, 2013.
4. Tapobrata Panda., Bioreactors: Analysis and Design, 1st Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2011.

COURSE OUTCOMES:

At the end of the course the student should be able to:

- 1 Understand the basic concept of reaction engineering.
- 2 Predict the order and rate of the different reactions.
- 3 Analyze the batch bioreactor data for different reactions.
- 4 Design the suitable bioreactor for different biochemical reactions.
- 5 Predict the residence time distribution to determine the conversion in non ideal flow reactors
- 6 Analyze bioreactors for various cell cultures.

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	3	3	2	2	2							1	2		
CO 2	3	2	2	2	1							1	2		
CO 3	2	3	2	1	2							1	2		
CO 4	2	3	3	2	1							1	2		
CO 5	3	1	2	1	2							1	2		
CO 6	2	2	2	2	1							1	2		

UBT519C: GENETIC ENGINEERING & APPLICATIONS
3 Credits (3-0-0)

Prerequisites: Molecular Biology

UNIT- 1

Introduction:

10 Hours

Tools of genetic engineering- vectors in recombinant DNA technology, biology and salient features of vectors, Types of vectors - plasmids, cosmids, bacteriophage lambda vectors.

Enzymes in genetic engineering:

Introduction- Restriction Endonucleases-classification, mode of action, applications. Enzymes used in nucleic acid modification – Alkaline phosphatase , polynucleotide Kinase, Ligases, terminal deoxy nucleotidyl transferase.

UNIT- 2

Nucleic acid hybridization and amplification:

10 Hours

Methods of nucleic acid detection, Fluorescent In situ hybridization (FISH), colony hybridization, polymerase chain reaction (PCR), its types and applications, methods of nucleic acid hybridization, Southern, Western and Northern hybridization techniques.

Construction of cDNA libraries:

Construction of Complementary DNA (cDNA), genomic DNA libraries and cDNA libraries.

UNIT- 3

Gene transfer techniques:

12 Hours

Gene transfer techniques in plants, animals and microbes –Transformation, microinjection, electroporation, microprojectile system, and liposome mediated transfer, embryonic stem cell method. Agrobacterium-mediated gene transfer in plants – Ti & Ri Plasmid: structure and functions, Ti based vectors- Binary vectors and Cointegrate vectors.

Transgenic science and genetic improvement:

Transgenic science in plant improvement, Antisense RNA technology (Flavr savr tomatoes). Application of plant transformation for productivity and performance – Herbicide resistance - glyphosate. insect resistance - Bt genes(*Bacillus thuringiensis* and its mode of action), Cry proteins – mechanism of action.

UNIT- 4

Gene therapy:

10 Hours

Introduction, Methods of Gene therapy-gene targeting, gene augmentation, assisted killing, prodrug therapy and gene silencing. Gene therapy in the treatment of cancer, SCID, muscular dystrophy. Use of thrombolytic agents in blood clotting. Challenges in gene therapy.

Applications:

Engineering microbes for the production of Insulin, growth hormones, monoclonal antibodies.

Total: 42 Hours

TEXT BOOKS:

1. Molecular Biotechnology, Principles and applications of Recombinant DNA by Bernard R Glick and Jack J Pasternak, second edition, CBS Publishers, 2012.
2. Recombinant DNA by Watson, et al., second edition, Freeman Publishers 2010.

REFERENCE BOOKS:

1. Principles of gene manipulation, Primrose S.B., Blackwell Scientific Publications, 2010.
2. From Genetics to Gene Therapy – the molecular pathology of human disease by David S Latchman, BIOS scientific publishers, 2010.
3. Biotechnology Expanding Horizon, B.D.Singh, 3rd revised edition, Kalyani Publishers,2010
4. NPTEL Source material

COURSE OUTCOMES:

1. Emphasize on the basic aspects of genetic engineering; the key areas and apply the knowledge in vectors used in genetic engineering experiments.
2. Apply the properties of various enzymes and vectors in gene and genome manipulation.
3. Acquire working knowledge on the mechanism of methods of nucleic acid detection, hybridization and amplification and their applications in the research.
4. Acquire working knowledge on the construction of genomic and cDNA libraries their applications in the research and biology of *Bacillus thuringiensis*.
5. Identify the various gene transfer techniques in plants, animals and microbes that are essential for controlled protein production in the industry and acquire knowledge on various strategies of Gene therapy and its application in therapeutics.
6. Identify and apply the current applications and advances of biotechnology and describe the steps involved in the production of biopharmaceuticals in microbial systems and industrial utilization.

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	1	1	1	2						1		2	1	2	3
CO 2	1			2	3							2	1	2	3
CO 3		1		2								2	1	2	1
CO 4		1		2								2	1	2	1
CO 5		1	1	2	3	3		3				2	1	2	1
CO 6		1	1	2	3	2	2	3				2	1	2	1

UBT520C: FUNDAMENTALS OF BIOINFORMATICS

3 Credits (3-0-0)

Prerequisites: Biochemistry Molecular biology, Bio-statistics, Cell biology & Genetics, Computer Applications.

UNIT 1

Introduction to Bioinformatics and Biological Database: 12 Hours

Introduction to bioinformatics, Components of bioinformatics and interdisciplinary nature of bioinformatics, Classification of biological databases; Primary database: NCBI, GenBank, DDBJ and EMBL, PIR, Uniprot; Secondary databases: PROSITE, PRINTS, BLOCKS and Pfam; Structure databases: Protein Data Bank (PDB), MMDB, CATH, SCOP; Specialized databases: PubMed, OMIM, Metabolic Pathway-KEGG; ExPasy and PubChem databases, File format: GenBank flat file, PDB flat file.

Tutorials: Practices on other primary and secondary databases

UNIT 2

Sequence alignment and database searches: 10 Hours

Introduction, Types of sequence alignment, Comparison between global and local alignment, Pairwise sequence alignment: Dot matrix analysis, Dynamic programming, Global alignment-Needleman-Wunch algorithm, Local Alignment-Smith & Waterman algorithm, Substitution matrix- BLOSUM and PAM; GAP Penalty; Low complexity regions; Word/k-tuple method- BLAST, FASTA.

Multiple Sequence Alignment: Introduction, applications of MSA; Types of MSA: Progressive method of MSA-Clustal W; Iterative method of MSA; Motifs and Patterns; Statistical models of MSA-Position Specific Scoring Matrix (PSSM) and Profiles.

Tutorials: Solving problems on pairwise sequence alignment

UNIT 3

Phylogenetic analysis and predictive methods using sequences: 10 Hours

Introduction, concepts of trees, types of evolutionary trees, Rooted and unrooted trees, Steps in constructing phylogenetic trees, Tree building methods - Distance based methods: Neighbor Joining (NJ) method, Fitch-Margoliash (FM) method; Character based method: Maximum parsimony; Tree Evaluation methods, Phylogenetic Softwares.

Predictive Methods using sequences: Structure of Prokaryote and Eukaryote genes; Algorithms for Prokaryotic and Eukaryotic gene prediction, Web based tools for gene prediction (ORF finder, GenScan). Protein Secondary Structure Prediction, Tertiary Structure Predictions: Homology modelling.

Tutorials: Practices on prediction of phylogenetic trees

UNIT 4

Plasmid mapping and primer designing & molecular modelling techniques: 10 Hours

Restriction mapping, Web based tools: Restriction Mapper and REBASE. Utilities of Mac Vector and Vector NTI; Basics of Primer designing, Primer design softwares (PRIME3). Rational Approaches in Drug Design, molecular docking, deriving the Pharmacophoric Pattern, quantitative structure-activity relationship (QSAR), deriving bioactive conformations, Calculation of Molecular Properties, Docking softwares (AUTODOCK, HEX)

Tutorials: Solving problems related to Restriction mapping and Primer designing

Total: 42 hours

TEXT BOOKS

1. Bioinformatics – Andreas D Baxevanis. Wiley Interscience, 4 th Edition, 2020.
2. Bioinformatics –David W Mount, cold spring harbor, 2 nd Edition, 2005.

REFERENCE BOOKS

1. Introduction to Bioinformatics – Arthur Lesk, Oxford, 2nd Edition,2006.
2. Bioinformatics – Stuart M Brown, NYU Medical Center, NY USA. 2000.
3. Fundamental Concepts of Bioinformatics – D E Krane & M L Raymer, Pearson, 2006.
4. Computational methods for macromolecular sequence analysis – R F Doolittle. academic Press, 1996.

COURSE OUTCOMES

1. Importance of databases involved in bioinformatics along with their file formats
2. Will have idea on searching similar sequences in databases and find similarity between given set of sequences
3. Derive evolutionary relationship between genes and proteins by phylo-genetic analysis
4. Explain various statistical tools involved in predicting the structure of genes and proteins
5. The principle behind restriction mapping and primer designing
6. Different approaches involved in silico drug design

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	3	2	-	-	2	1	2	2				3	2	2	3
CO 2	3	2	2	2	2	1	2	-				3	2	2	3
CO 3	3	2	-	1	-	-	2	-				3	2	2	3
CO 4	2	2	-	1	-	2	-	-				3	1	-	2
CO 5	2	2	2	1	-	2	-	2				1	2	-	2
CO 6	2	1	2	2	2	2	1	1				1	1	1	1

UBT506H: INDUSTRIAL SAFETY & BIOETHICS
3 Credits (3-0-0)

Prerequisites: Basic and applied aspects of life science

UNIT 1

Introduction to Bioethics & Biosafety:

10 Hours

Definition and scope of bioethics and biosafety, Ethical implications and need for biosafety, Legal and Socio-Economic impacts of Biotechnology. Convention on biological weapons. Bioterrorism-classification of biological agents with examples.

Biosafety regulation guidelines

Recombinant DNA Advisory Committee (RDAC), Institutional Biosafety committee(IBC), Review Committee on Genetic Modification (RCGM), Genetic Engineering Approval Committee(GEAC), Biosafety guidelines- national guidelines, Cartagena Protocol on Biosafety.

UNIT 2

Biosafety Regulation:

12 Hours

Genetically modified organisms and their release in environment, Laboratory associated infections and other hazards, Good Lab Practices and Good Manufacturing Process (GLP &GMP). Biosafety levels for microorganism(BL1,BL2,BL3,BL4) plants (BL1-P,BL2-P,BL3-P,BL4-P) animals (BL1-N,BL2-N,BL3-N,BL4-N).

Risk assessment during laboratory research and risk groups. Recombinant organisms and transgenic crops. Guideline for labeling GM crops. Containments; Physical, Biological. Field trial methods using transgenic plants.

UNIT 3

Food and Pharma safety:

10 Hours

Biosafety assessment procedures for biotech foods and Pharma products. Procedure to apply patent, Copy right, Plant Breeder's Right, Environmental aspects of biotech applications. Special application of patent laws in biotechnology and case studies. Flavr Savr Tomato as model case, case studies of relevance (Eg. Bt cotton, Bt brinjal). Licensing and cross licensing.

UNIT 4

Industrial safety:

10 Hours

Need for safety, importance of occupational safety, Health and safety programs, Safe and unsafe conditions.

Accidents: Accident preventive measure, Measurement and control of safety performance, 5E's for accident prevention Safety policy.

Fire: Fire extinguishers and fire exits, extinguishing agents.Importance of safety in food and Pharma industry. Food safety, Biological, chemical and Physical Hazards-HAACP system, Pharma safety. Food and safety act. Injuries by industrial sector.

Total: 42 Hours

TEXTBOOKS:

1. Bioethics and Biosafety by Sateesh M.K., I.K.International pub, 2012.
2. Biotechnology Expanding Horizon, B.D.Singh, 3rd revised edition, Kalyani Publishers, 2010.

REFERENCE BOOKS:

1. Biotechnology and Safety Assessment by Thomas, J.A., Fuch, R.L. Academic Press. 2002.
2. Biological safety Principles and practices)by Fleming, D.A., Hunt, D.L., ASM Press, 2000.
3. IPR-Biosafety and Bioethics Deepa Goel, Shomini Parashar, 2nd edition, Pearson Education India Publishers, 2010

COURSE OUTCOMES:

1. Emphasize on the basic aspects of Biosafety and ethics; the key areas and apply the knowledge in the social, legal & ethical issues connected with BT, BWC and Bioterrorism
2. Interpret & describe biosafety regulation guidelines committees, Cartagena protocol & their relevant applications in BT
3. Identify biosafety levels as relevant to Biotechnology & apply this knowledge in maintenance of biosafety, GLP, GMP in research lab, field & industry.
4. Acquire working knowledge on the risk assessment, containment, GMO labeling and transgenic field trials in the research.
5. Identify the various forms of IPR and understand the importance of patents in modern scientific and industrial research and discuss special application of patent laws in biotechnology with case studies.
6. Identify & discuss the potential dangers in Biotechnology and gain knowledge on safety aspects in food and Pharma industry and apply precautionary measures to avoid /overcome it.

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1							2	3				1	1	1	1
CO 2			1	1	2		2	3				1	1	2	1
CO 3			2	1	2	2	2	3					1	1	1
CO 4				1				3				1	1	2	2
CO 5				1				3				1	1	3	2
CO 6						2		3		1		1	1	1	1

UBT527E: NUTRACEUTICALS

3- Credits (3-0-0)

UNIT 1

Introduction to Nutraceutical and dietetics:

10 Hours

Organizational elements, classification of nutraceuticals, dietary supplements, fortified foods, functional foods and phytonutraceuticals. Scope involved in the industry, Indian and global scenario. Recommended dietary intake (RDA), acceptable dietary intake, nitrogen balance, protein efficiency ratio, net protein utilisation. Basics of energy balance - Basal Metabolic Rate (BMR), Body Mass Index (BMI) and Standard Dynamic Action (SDA) with special reference to nutraceutical industry.

UNIT 2

Nutrition related diseases and disorders:

10 hours

Carbohydrates, Protein, amino acids, Fat, vitamins and minerals - Excess and deficiency, symptoms, prevention and management. Role of nutraceuticals with special reference to diabetes mellitus, hypertension, hypercholesterolemia, cancer, glands in the prevention and treatment. Concept of antioxidants - use of antioxidants as dietary supplements in prevention and treatment of cancer, obesity and stress. Role of nutraceuticals and functional foods in pediatrics, geriatrics, sports, pregnancy and lactation.

UNIT 3

Nutraceuticals of microbial, plant and animal origin:

10 hours

Concept of prebiotics and probiotics - principle, mechanism, production and technology involved, applications - examples of bacteria used as probiotics, use of prebiotics in maintaining the useful microflora - extraction from plant sources. Synbiotics for maintaining good health. Algae as source of omega - 3 fatty acids, antioxidants and minerals - extraction and enrichment. Plant secondary metabolites, classification and sub-classification - Alkaloids, phenols, Terpenoids. Animal metabolites - Sources and extraction of nutraceuticals of animal origin. Examples: chitin, chitosan, glucosamine, chondroitin sulphate and other polysaccharides

UNIT 4

Biotechnology in Phytonutraceuticals:

10 hours

Role of medicinal and aromatic plants in nutraceutical industry – propagation - conventional and tissue culture, cultivation, post harvest technology and strategies for crop improvement, development of high yielding lines and yield enhancement, plant genomics and metabolomics. Biofortification and nutritional enhancement. GM foods with enhanced nutraceutical properties. Golden rice, GM Tomatoes.

Total: 40 Hours

TEXT BOOKS:

1. Israel Goldberg (Ed.) (1999) Functional foods, designer foods, pharma foods, Nutraceuticals, Aspen publishers Inc., USA.
2. L. Rapport and B. Lockwood, Nutraceuticals, Pharmaceutical Press., 2nd Edition, 2002.

REFERENCE BOOK:

1. M. Maffei ,Dietary Supplements of Plant Origin, Taylor & Francis,1 st Edition,2003.
2. Shahidi and Weerasinghe, Nutraceutical beverages Chemistry, Nutrition and health Effects, American Chemical Society,1 st Edition, 2004.
3. Richard Neeser& J. Bruce German (2004) Bioprocesses and Biotechnology for Functional Foods and Nutraceuticals, Jean, Marcel Dekker, Inc.
4. TimothtS. Tracy, Richard L. Kingston, Herbal Products 2nd Edition, 2007.

COURSE OUTCOMES:

1. To be aware of basic concepts of nutraceuticals and nutrition.
2. To have a general idea of scope of nutraceuticals and functional foods.
3. To have brief idea about nutrition related health disorders and the role of Nutraceuticals.
4. To classify nutraceuticals and the role of nutraceuticals among different age groups.
5. To learn about the basic aspects of nutraceuticals derived from microbial, plant and animal origin.
6. To know about the role of biotechnology in production of plant secondary metabolites.

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	3	2	-	-	2	1	2	2				3	2	2	3
CO 2	3	2	2	2	2	1	2	-				3	2	2	3
CO 3	3	2	-	1	-	-	2	-				3	2	2	3
CO 4	2	2	-	1	-	2	-	-				3	1	-	2
CO 5	2	2	2	1	-	2	-	2				1	2	-	2
CO 6	2	1	2	2	2	2	1	1				1	1	1	1

UBT514L: BIOINFORMATICS LAB
1 Credit (0-0-2)

LIST OF EXPERIMENTS IN BIOINFORMATICS LABORATORY

1. Bibliographic search from PUBMED, SCIRUS and MEDMINER
2. Sequence retrieval from Nucleic acid and Protein databases.
3. Sequence searches using BLAST – Retrieval of homologs, paralogs, orthologs, and Xenologs
4. Pair wise comparison of sequences – Analysis of parameters affecting alignment.
5. Multiple alignments of sequences and pattern determination using PROSITE
6. Evolutionary studies / Phylogenetic analysis – Analysis of parameters affecting trees.
7. Identification of functional sites in Genes / Genomes.
8. Secondary structure prediction of proteins and comparison with PDB.
9. Restriction mapping: Analysis of maps for suitable molecular biology experiment.
10. Primer Design: Factors affecting primer design.
11. PDB structure retrieval and visualization: Analysis of homologous structures.
12. Determination of ligand-protein interactions using SPDBV/ LIGPLOT
13. Superposition of structures – Calculation of RMSD.
14. Docking studies – Analysis of substrate / ligand binding using homologous structures.

REFERENCE BOOKS:

1. Bioinformatics – Andreas D Boxevanis. Wiley Interscience, 1998.
2. Bioinformatics – David W Mount, cold spring harbor, 2001.
3. Bioinformatics – A biologist's guide to biocomputing and the internet. Stuart M brown,
4. Fundamental Concepts of Bioinformatics – D E Krane & M L Raymer, Pearson, 2006.
5. Computational methods in Molecular Biology – S.L.Salzberg, D B Searls, S Kasif, Elsevier, 1998.
6. Bioinformatics – methods and applications: Genomics, proteomics and drug Discovery – s c Rastogi, N. mendiratta & prastogi, phi, 2006.

COURSE OUTCOMES:

1. Ability to Search literature and sequence databases
2. Ability to retrieve and search sequences from databases
3. Ability to align pair wise and multiple sequences
4. Ability to identify evolutionary relationships and functional sites in genomes
5. Ability to evaluate primer designing and restriction mapping
6. Ability to docking and superimpose the structures

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	3	3	3	-	3	1	-	3				3	3	3	1
CO 2	3	3	3	-	3	1	-	-				3	2	3	1
CO 3	3	3	2	2	3	1	1	-				3	3	3	1
CO 4	3	3	2	-	3	-	1	-				3	2	3	2
CO 5	3	3	2	1	3	1	-	2				3	3	3	2
CO 6	3	3	3	2	3	1	-	1				3	2	3	1

UBT515L: GENETIC ENGINEERING LABORATORY

1 Credit (0-0-2)

List of Experiments in Genetic Engineering Laboratory

1. Transformation.-
2. Blue white colony screening.
3. Thermal denaturation of DNA.
4. Restriction Digestion.
5. Ligation Experiment.
6. Southern Blotting – Agarose Gel Electrophoresis
7. Electroblotting and analysis.
8. SOP for PCR
9. SOP for Gel Documentation
10. SOP for UV-Spectrophotometer
11. SOP for Lyophilizer
12. PCR (Amplification with specific primers)

REFERENCE BOOKS:

1. Sadashiva and Manickam, “Biochemical Methods”, 2nd Edition, New age international Publishers, 2017.
2. Sambrook & Russell, “Molecular Cloning”, Cold Spring Harbor Lab, 3rd Edition, 2002.
3. Current protocols in molecular biology-Greena Publishing Associates, NY, 1988

Course Outcomes

1. To demonstrate proficiency in Transformation and screening of transformants.
2. To apply the knowledge of thermal denaturation to calculate T_m value.
3. To evaluate the functions of restriction digestion and Ligation on DNA.
4. To demonstrate proficiency in Electro-blotting and detection.
5. To demonstrate understanding of SOP and PCR.
6. To gain knowledge in common and advanced laboratory practices in Genetic engineering lab.

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	3	3	3	-	3	1	-	3				3	3	3	1
CO 2	3	3	3	-	3	1	-	-				3	2	3	1
CO 3	3	3	2	2	3	1	1	-				3	3	3	1
CO 4	3	3	2	-	3	-	1	-				3	2	3	2
CO 5	3	3	2	1	3	1	-	2				3	3	3	2
CO 6	3	3	3	2	3	1	-	1				3	2	3	1

VII-Semester -2021-22

UBT704C: ECONOMICS & PLANT DESIGN

3 Credits (3-0-0)

Prerequisites: Mathematics, Process calculations, Unit Operations, Reaction Engg and Equipment Design

The Course objectives are:

- 1 To understand the process design of plant
- 2 To study the feasibility survey for the plant design
- 3 To Identify the cost analysis involved in the design of plant
- 4 To Calculate the project profitability and alternative investment
- 5 To recommend for entrepreneurs with good engineering knowledge
- 6 To evaluate the knowledge of plant design and cost estimation

UNIT- 1

Process design development:

10 Hours

Design project procedure, design information from the literature and other sources of information, flow diagrams, preliminary design and equipment design and specialization, safety factors specifications, and materials of construction.

General design considerations:

Marketability of the product, availability of technology, raw materials, human resources, land and utilities, site characteristics, plant location, plant layout, plant operation and control, utilities, storage, materials handling, materials and fabrication selection,. Waste disposal community factors. Safety and hazard control measures.

UNIT- 2

Capital investments:

10Hours

Fixed capital investments including land, building, equipment and utilities, installation costs,(including equipment, instrumentation, piping, electrical installation and other utilities),working capital investments.

Manufacturing costs and plant overheads:

10 Hours

Manufacturing Costs: Direct Production costs (including raw materials, human resources, maintenance and repair, operating supplies, power and other utilities, royalties, etc.), fixed charges Plant Overheads: Administration, safety and other auxiliary services, Conceptual numerical.

UNIT- 3

Cost analysis:

10 Hours

Cost Analysis: Factors involved in project cost estimation, methods employed for the estimation of the capital investment. Estimation of working capital

Depreciation: different type of depreciation methods of and calculations, Conceptual numerical.

UNIT- 4

Profitability analysis:

10 Hours

Methods for the evaluation of profitability. Return on original investment, interest rate of return, Cash flow diagrams. Break-even analysis. Conceptual numericals.

Total:40 Hours

TEXT BOOKS:

1. Peters and Timmerhaus (1989) Plant Design and Economics for Chemical Engineers, 4th edn.McGraw Hill.
2. Rudd and Watson (1987) Strategy of Process Engineering, Wiley.
3. Poornima M C (2006) Entrepreneurship Development and Small Business Enterprises”, Pearson education.

REFERENCE BOOKS:

1. Vasanth Desai (2007) Dynamics of Entrepreneurial Development & Management”,H imalaya Publishing House.
2. Khanka SS (2004) Entrepreneurship Development, S Chand & Co.
3. Thomas W. Zimmer, Norman M. Scarborough.(2007), Essentials of Entrepreneurship and small Business Management

COURSE OUTCOMES:

At the end of the course the student should be able to:

- 1 Acquire knowledge in the design of a plant.
- 2 Conduct preliminary feasibility study of the plant design assigned.
- 3 Estimate the cost analysis involved in the design of a chemical plant.
- 4 Analyze the project profitability and alternative investments for the selection of good investment projects
- 5 Develop entrepreneurs with substantial knowledge in engineering concepts.
- 6 Apply the knowledge of plant design and cost estimation in actual engineering problems.

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	2	2	1	1			1	1	1		2		2		
CO 2	2	1	2	1			1	1	1		3		2		
CO 3	1	2	1	2			1	1	1		2		1		
CO 4	2	1	2	2			1	1	1		3		2		
CO 5	1	1	2	1			1	1	1		2		1		
CO 6	2	2	2	1			1	1	1		2		2		

UBT715C: DOWNSTREAM PROCESSING TECHNOLOGY
3 Credits (2-2hrs)

Prerequisites: Bioprocess & Reactions Engineering, Unit operations
Plant & Animal cell culture techniques

UNIT- 1

Introduction:

10 Hours

Role and importance of downstream processing in biotechnological processes. Range and characteristics of bioproducts. Purification process of bio-product. Cell disruption methods for intracellular products; physical, chemical and mechanical methods. Basic principles of distillation, crystallization, centrifugation, ultracentrifugation (preparative and analytical). Types of centrifuges and rotors, centrifugation-differential, density gradient (zonal and isopycnic).

UNIT- 2

Primary Recovery Operations:

10 Hours

Process involved in liquid-liquid extraction, solid-liquid extraction, ammonium sulphate precipitation, Precipitation of proteins and nucleic acids by solvents and polyethylene glycol, dialysis, electrodialysis, ultrafiltration (Removal of insolubles by filtration), reverse osmosis, drying and lyophilization. Membrane based separations theory, design and configuration of membrane separation equipment.

UNIT- 3

Chromatography:

10 Hou

Principles of chromatographic separations, Classification of chromatography- plain and column chromatography, Paper chromatography - Single dimensional (Ascending and Descending, radial and two dimensional) chromatography, partition coefficient, retention factor, Thin layer chromatography, Gas liquid Chromatography, Adsorption Chromatography: Adsorption column chromatography, Ion Exchange Chromatography: cation Exchange and anion Exchange chromatography. Gel Filtration Chromatography, Affinity Chromatography, High Performance liquid chromatography, NP-HPLC and RP-HPLC.

UNIT- 4

Electrophoresis:

10 Hours

Electrophoresis principles, factors affecting electrophoresis mobility, Moving boundary electrophoresis, Zone Electrophoresis, Gel Electrophoresis, Continuous Gel electrophoresis, Disc Gel electrophoresis, Agarose Gel Electrophoresis, Capillary Electrophoresis, Cellulose Acetate, Starch Gel , Native and SDS-PAGE, High voltage electrophoresis, Isoelectric focusing, Immunoelectrophoresis, ELISA, Flow cytometry.

Downstream Processes:

Case studies (production)-DSP flowsheets for penicillin, insulin, amino acid, monoclonal antibody.

Total-40 Hours

TEXT BOOKS:

1. Bioseparations Principles and techniques, by B. Sivasankar, Kindle edition, PHI Publishers, 2010
2. Biophysical chemistry principles and Techniques by Upadhay and Nath, Himalaya Publishing House, 3rd edition, 2010

REFERENCE BOOKS:

1. NPTEL Source material.
2. Bioseparations - Downstream processing for biotechnology by Belter P.A., Cussier E. and Wei Shan Hu., Wiley Inter science Pub, 1988.
3. Separation Processes in Biotechnology by Asenjo J. and Dekker M, 1993.
4. Product Recovery in Bioprocess Technology – BIOTOL Series, VCH, 1990
5. Rate controlled separations by Wankat P.c., Elsevier, 1990
6. Fermentation & Enzyme Technology by D.I.C. Wang, Wiley Eastern 1979.

COURSE OUTCOMES:

1. Identify the basic separation unit operation in DSP like membrane separation, enrichment operation, product recovery and various resolutions and fractionation techniques.
2. Interpret and analyze the industrial fermentation processes.
3. Apply the knowledge in identifying various pharma and R&D sections.
4. Analyse the details of experimentation pertaining to chromatography and electrophoresis.
5. Understand analyse and apply the techniques in various tests involved in finding out purity of biological components.
6. Apply the knowledge in identifying various biochemicals using advanced purifications like HPLC and to demonstrate DSP flowsheets.

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1			2			3	2	2				1	2	1	1
CO 2			2			3	2	3				1	2	1	1
CO 3			1			3	2	2				1	2	1	1
CO 4			2			3	2	2				1	2	1	1
CO 5			1			3	3	3				1	2	1	1
CO 6			1			3	2	2				2	2	1	1

UBT716H: INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP
3 Credits (3hrs)

UNIT 1

DEVELOPMENT OF MANAGEMENT THOUGHTS AND ITS FUNCTIONS: 10 hours

Concept & definition of Management, Social Responsibilities of Management, and Pioneers in Management: Contributions of Taylor, Henry Taylor, Gilberth & Mayo, Schools of Management thought: Management process school, Empirical School, Human Behavior School, Social system school, Systems approach school and decision theory school. Selection of site for the plant and plant layout, plant operation and control, utilities, structural design, storage, material handling, Sources of capital. Definition and functions of administration. Planning, organizing, staffing, directing and controlling. Concept of authority and responsibility.

UNIT 2

QUANTITATIVE TECHNIQUES IN MANAGERIAL DECISIONS: 10 hours

Concept of productivity, measuring productivity, concept of budget, effective budgetary control, ABC analysis, break even analysis, product life cycle, promotion of sales, pricing, "EOQ" model. Production costs (including raw materials, and repair, operating supplies, power and other utilities, royalties, etc.), fixed charges (including depreciation, taxes, insurance, rental costs etc.).

UNIT 3

PRODUCTION AND MATERIAL MANAGEMENT: 10 hours

Types of production, types of planning, manufacturing planning, factory planning, production planning, method study, systems of wage payments, bonus, automation, organization of production, planning. Functions of purchasing & materials management, quality, quality standard & inspection, sources of supply, pricing, principles & practices, Inventory management.

UNIT 4

ENTREPRENEURSHIP & PERSONNEL MANAGEMENT: 10 hours

Meaning of entrepreneur, evaluation of the concept, function of entrepreneur, evolution of entrepreneurship, development of entrepreneurship, stages in entrepreneurial process, role of entrepreneurs in economic development entrepreneurship- its barriers. Recruitment and selection. Training of personnel. Employer - Employee relationship. Settlement of disputes.

Total: 40 hours

TEXTBOOKS:

1. O.P. Khanna - "Industrial Engineering & Management", Dhanpat Rai & Sons, 1992.

REFERENCE BOOKS:

1. T. R. Banga & S. C. Sharma - "Industrial Engineering & Management Science", 6th. Edn, Khanna Publications, 2003
2. C.B.Mamoria and S.V.Gankar- Personnel Management, Himalaya Pub, 21 st edn,2010
3. Veerabhadra Havinal -Management and Entrepreneurship- New Age International,2009
4. Ramesh Burbure – Management &Entrepreneurship- Rohan Pub.2008
5. Poornima M. Charanthimath – Entrepreneurship Development, Pearson Education-2005

COURSE OUTCOMES:

1. Ability to recall and recollect the history theories and definition of management and its importance in society
2. To analyze and apply the basic concepts of Quantitative techniques of management
3. Ability to know the difference between production and productivity, measurement and cost analysis
4. Explore the knowledge of production costs, planning and material management
5. Able to make basic economic analysis of project
6. To be aware of making business ideas and prepare project planning
7. Ability to understand the role and importance of entrepreneurship in economic development
8. Ability to know the importance of personnel management

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	2	2		3	2		1					1	2	1	1
CO 2	2	1	2	3	2		1						2	1	2
CO 3	1	2	1	2	2		1					1	2	1	2
CO 4	2	1	2	3	1		1						2	1	3
CO 5	1	1	2		2		1					1	2	1	3
CO 6	2	3	2	1		2							2	1	3
CO 7	2	1	3	1								1	2	1	2
CO 8	1	2	1										2	1	2

UBT724E: FOOD PROCESSING TECHNOLOGY

3 Credits (3-0-0)

Prerequisite: Biochemistry, Microbiology, Molecular biology.

UNIT 1

Introduction:

10 Hours

Constituents of food, soluble fibres, protein rich foods, popular fats and oils in foods, Food flavours, Browning reactions and its effects . Intrinsic and extrinsic parameters of foods, effect of inhibitors, pH and temperature. Minerals in foods. Aroma compounds in foods .Food additives, Vitamins, amino acids, Sweeteners, Food colours. Toxic-trace elements in food.

UNIT 2

Detection of Microorganisms:

12 Hours

Culture, Microscopic and Sampling Methods, Conventional; SPC, Membrane Filters, Microscope colony Counts, Agar Droplets, Dry Films, Most probable Numbers (MPN), Dyereduction, Roll Tubes, Direct, Microscopic Count (DMC), Microbiological Examination of surfaces, Air Sampling, Metabolically Injured Organisms, Enumeration and Detection of Food-borne Organisms. Dairy products: Composition of milk, Sterilization of milk (Pasteurization and UHT), Cheese production, Acidophilus milk Yoghurt, Kumiss and Kefir. Marketing scope of dairy & food products Fruit and vegetable processing: Jam, jelly, Juice, squash, wine, pickles and sauerkraut.

UNIT 3

Food Spoilage & Preservation:

10 Hours

The Role and Significance of Microorganisms, Primary Sources of Microorganisms found in Foods Synopsis of common borne bacteria, Molds& Yeasts. Microbial Spoilage of Vegetables, Fruits, Fresh and Processed Meats, Poultry, and Seafood. Spoilage of Miscellaneous Foods, Food Preservation: Principles Underlying in spoilage and preservation, Application, Effect and Legal Status of Food Irradiation, Food Preservation with Low Temperatures, High Temperatures and Drying. Food Industry: Characteristics of Food Industry.:. nutritional food supplements. Food packaging, New trends in packing, edible films. Factors influencing food product development, marketing, and promotional strategies, risks and benefits of food industry.

UNIT 4

Food Engineering:

10 Hours

Properties of fluid foods, Measurement of rheological parameters .Thermal properties of frozen foods. Food freezing equipment, storage of frozen foods. Food dehydration: Freeze Dehydration Calculation of drying times. Food waste management.

Total: 42 hours

TEXT BOOKS:

1. Food Science & Nutrition, by Sunetra Roady, Oxford University Press, 2007.
2. Food microbiology by William Frazier and Westhoff D.C, 4th Edn, TATA McGraw Hill Pub (2005)

REFERENCE BOOKS:

1. Modern Food Micro-Biology by James M. Jay, CBS Publishers. 2005.
2. Food Microbiology by K.Vijay Ramesh MJP Publishers, 2007.
3. Plant biotechnology In Agriculture by K. Lindsey and M.G.K. Jones, Prentice Hall, USA. 1990.
4. Food Science By Potter N.N. and Joseph Hotchkiss, 5th Edn, CBS Pub, 1996.

COURSE OUTCOMES:

- 1 Able to know about basic constituents of food
- 2 Able to know the techniques involved in detection of microbes in food industry
- 3 To have idea about Dairy , fruits and vegetable processed products and production
- 4 To be aware of different food spoilage and preservation techniques
- 5 To know the Characteristics of food industry and scope
- 6 Able to understand Basic concepts in food Engineering for preservation

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1			2			3	2	2				1	2	1	
CO 2			2			3	2	3				1	2	1	
CO 3			1			3	2	2				1	2	1	
CO 4			2			3	2	2				1	2	1	
CO 5			1			3	3	3				1	2	1	
CO 6			1			3	2	2				2	2	1	

UBT731E: NANOBIO TECHNOLOGY AND BIOMATERIALS

3 credits (3-0-0)

Course Objectives:

To understand the techniques of characterization of nanoparticles.

To study the application of nanoparticles in various fields.

To understand the scope of biopolymers.

UNIT- 1

Introduction to nanotechnology:

10Hours

A Brief History of the Nano particles : Bottom-Up versus Top-Down; What Is Nanobiotechnology. Discussions on nanofabrication, nanolithography, nanotubes, buckyballs, structure-property relationships in materials, materials characterization techniques, scanning electron, scanning tunneling and atomic force microscopy (SEM, STM & AFM), biomolecule-surface interactions, quantum dots,

Applications of nanotechnology in the life sciences:

Buckyballs and Buckytubes, Diagnostics and Sensors, Drug Delivery Revenues Health Risks and Challenge.

UNIT- 2

Biopolymers:

10 Hours

Polymers as biomaterials, microstructure, mechanical properties – effects of environment on elastic moduli, sterilization and disinfections of polymeric materials. Biocompatibility of polymers, chemically modified glycosaminoglycans, heparin like substances from nonglycosaminoglycan polysaccharides and microbial glycosaminoglycan, surface immobilized heparins.

UNIT- 3

Synthetic polymers:

10 Hour

Polymers in biomedical use, polyethylene and polypropylene, perfluorinated polymers, acrylic polymers, hydrogels, polyurethanes, polyamides, biodegradable synthetic polymers, silicone rubber, plasma polymerization, micro-organisms in polymeric implants, polymer sterilization.

UNIT- 4

Biocompatibility:

10Hours

Definition, Wound healing process-bone healing, tendon healing. Material response: Function and Degradation of materials in vivo. Host response: Tissue response to biomaterials . Testing of implants: Methods of test for biological performance-In vitro implant tests, In vivo implant test methods.

Medical devices:

Polyurethane elastomers, applications of polymers in medicine and surgery. Skin graft polymers, Properties of implant materials, metals and alloys.

Total: 40Hours

TEXT BOOKS:

1. B.Vishwanath “ Nano Materials” Published by Narosa Publishing House Pvt. Ltd., New Delhi, 2011.

REFERENCE BOOKS:

1. K Eric Drexler “Unbounding the future” Quill,1993.
2. Stephen Lee and Lynn M Savage “Biological molecules in Nanotechnology” 2010.
3. Mark Ratner and Daniel Ratner “Nanotechnology:A Gentle Introduction to Next Gig Idea” Pearson Education Ltd, 2003.

COURSE OUTCOMES:

1. Ability to explain the characterization techniques of nanotechnology.
2. Ability to understand the importance of nano-particles in drug delivery system.
3. Ability to understand the importance of biopolymers.
4. Ability to differentiate biopolymer and synthetic polymer.
5. Ability to understand the importance of biocompatibility.
6. Ability to apply the methods to test the implants and use in medical devices.

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	2	3	3			1	2					2	2	2	1
CO 2	1	2	3			1	2					3	3		
CO 3	2	2	3			2	2	3				3	2	2	1
CO 4	3	3	3			2	2	2				2	2	1	1
CO 5	3	3	3			1	2	3				1	2	3	
CO 6	2	3	3			3	3	3				3	3	3	3

UBT733N: Industrial Safety
3 Credits (3-0-0)

UNIT 1

Industrial safety: 12 Hours
Need for safety, importance of occupational health and safety, Health and safety programs, unsafe conditions, factors contributing to unsafe conditions, Good Lab Practices (GLP).
Accidents: Accident preventive measure, Measurement and control of safety performance, 5E's for accident prevention- Engineering, Education, Enthusiasm, Enforcement and Evaluation. Hierarchy of Controls, Safety policy.
Chemical Hazards- Types of hazards, Classification of chemicals based on their nature, routes to exposure of chemicals, Health effects of harmful chemicals in the work environment, Control of chemical hazards.

UNIT 2

Electrical Hazards and Control measures 10 Hours
Electrical hazards, protection against voltage fluctuations, effects of shock on human body. Fire- Fire formation, Fire extinguishing agents. Evacuation procedures for workers during emergency conditions.
Physical Hazards and Control measures Noise,
noise exposure regulation, properties of sound, Workers exposure to electromagnetic field, Ionizing radiation and non-ionizing radiations, effects of radiations, Classification of dangerous materials with pictorial symbols, Safety in transportation of dangerous materials by road, rail, ships and pipelines.

UNIT 3

Biological and Construction Hazards and their control measures 10 Hours
Classification of Bio hazardous agents –bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases – Hazardous material used in labs, Instructions followed for hazardous waste disposal, Biohazard control program, Biological safety cabinets
Construction Hazards
Hazards in construction and safety measures, Good Manufacturing Practices (GMP).

UNIT 4

Occupational Health and Toxicology 10 Hours
Classification of Occupational hazards, occupational related diseases- silicosis, asbestosis, pneumoconiosis, etc. lead, nickel, chromium and manganese toxicity, effects and prevention –Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects. Industrial Hygiene. Various types of Company policies.

Total: 42 hours

REFERENCE BOOKS

1. Bioethics and Biosafety by Sateesh M.K., I.K.International pub, Kindle edition, 2012
2. Biotechnology Expanding Horizon, B.D.Singh, 3rd revised edition, Kalyani Publishers, 2015
3. Bioethics and Biosafety in Biotechnology V.Krishna, New Age International, first edition, 2007
4. Handbook of Occupational Health and Safety, Danuta Koradecka, CRC press, 2002

COURSE OUTCOMES:

- 1) Emphasize on the basic aspects of Industrial hazards and safety.
- 2) Interpret & describe various types of accidents and chemical hazards.
- 3) Identify physical hazards and apply control measures in work place.
- 4) Acquire knowledge of electrical hazards and apply control measures in work place.
- 5) Identify various types of biological hazards and apply control measures.
- 6) Identify control measures and apply industrial toxicology and hygiene occupational related diseases the same in work place.

Course Outcomes	Programme Outcomes												Programme Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3	
Industrial Safety																
CO 1		1		1	1	3	1	3	-	-	-	1	3	2	3	
CO 2		1		2	1	2	1	2	-	3	-	1	3	1	1	
CO 3	3	1		2	1	2	1	2	-		-	1	3	1	1	
CO 4		1	3	2	3	3	1	2	-	2	-	1	3	2	1	
CO 5		1		3	3	2	1	1	2	-	2	1	2	2	1	
CO 6		1	3	2	1	3	1	1	-	-	-	1	2	2	1	

UBT707L: UPSTREAM PROCESSING LAB

1.5 Credit (0-0-3)

LIST OF EXPERIMENTS IN UPSTREAM PROCESSING LABORATORY

1. Callus Induction Technique- Stock preparation, Media preparation.
2. Explants preparation and inoculation technique.
3. Development of suspension culture from callus
4. Animal cell culture techniques
5. Artificial seed production (Auxiliary buds)
6. Production of secondary metabolite by shake flask studies; Comparison of yield in various media
7. Fed batch culture – Assessment of yield
8. Development of inocula; lag time effect
9. Study of operational functions of the fermentor
10. Production of Ethanol in fermentor – Study of Growth kinetics, product formation, substrate utilization

REFERENCE BOOKS:

1. Plant Cell Culture: A Practical Approach by R.A. Dixon & Gonzales, IRL Press. 2nd Edition, 1995
2. Introduction to plant Biotechnology by H.S. Chawla, , Oxford & IBH Publishers, 3rd Edition, 2018.
3. Culture of Animal cells- 3rd Edition- R. Ian Freshney. Wiley 2010.
4. Principles of fermentation Technology by P.F. Stanbury and A. Whitaker, Butterworth- Heinemann; 3rd Edition, 2016

COURSE OUTCOMES;

- 1 Able to prepare/reproduce the protocols for the experiments
- 2 Able to produce callus using plant tissue culture techniques
- 3 Able to prepare the industrial media and inoculum for the fermentation process
- 4 Able to operate lab fermenter and prepare the fermentation process to study growth kinetics, substrate utilization and product formation
- 5 Able to record/observe the experimental data and interpret them in the graph/table
- 6 Able to calculate the result and to write the conclusion at the end of the experiment

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	3												3		
CO 2		2												3	
CO 3			3										2	2	
CO 4				3	3								2	2	
CO 5		3											2	3	
CO 6		3											3	2	

UBT710L: BIOSEPARATION TECHNIQUES LAB
1Credits (0-0-2)

LIST OF EXPERIMENTS IN BIOSEPARATION TECHNIQUES LABORATORY

1. Cell disruption techniques.
2. Solid-liquid separation methods: Filtration (Cross flow)
3. Solid-liquid separation methods: Sedimentation.
4. Solid-liquid separation methods: Centrifugation.
5. Membrane dialysis
6. Product enrichment operations: Precipitation – (NH₄)₂ SO₄ fractionation of a protein.
7. Product enrichment operations: Two – phase aqueous extraction.
8. Product drying techniques.
9. Estimation of Amino acids / Carbohydrates by TLC.
10. Separation of ethanol from fermented broth.
11. Separation of Citric acid from fermented broth.
12. Separation of proteins by molecular sieving.
13. Analysis of biomolecules by HPLC / GC (using standard spectra).

REFERENCE BOOKS:

1. Protein Purification by Scopes R.K., IRL Press, 1993.
2. Rate controlled separations by Wankat P.C., Elsevier, 1990
3. Bioseparations by Belter P.A. and Cussier E., Wiley, 1985.
4. Bio-separations Science & Engineering By Roger G Harrison, Paul Todd, Scott R Rudge, Demetri.
5. Product Recovery in Bioprocess Technology - BIOTOL Series, VCH, 1990
6. Separation processes in Biotechnology by Asenjo J. and Dekker M. 1993

COURSE OUTCOMES

1. Able to prepare/reproduce the protocols for the experiments.
2. Able to extract the intracellular product using different cell disruption techniques.
3. Able to concentrate, purify the desired product using different chromatography/ filtration techniques.
4. Able to analyze the product both quantitative/qualitatively.
5. Able to record/observe the experimental data and interpret them in the graph/table.
6. Able to calculate the result and to write the conclusion at the end of the experiment.

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	3												3		1
CO 2		2												3	1
CO 3			3										2	2	1
CO 4				3	3								2	2	1
CO 5		3										2	2	3	1
CO 6		3										2	3	2	1

