SETHU INSTITUTE OF TECHNOLOGY

PULLOOR, KARIAPATTI – 626115

(An Autonomous Institution
Affiliated to Anna University Chennai)

B.TECH. BIOTECHNOLOGY

DRAFT CURRICULUM

REGULATIONS 2021

CHOICE BASED CREDIT SYSTEM

(Applicable to candidates admitted in the Academic Year 2021 - 2022)

SETHU INSTITUTE OF TECHNOLOGY

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(An Autonomous Institution)

B.Tech. Degree Programme

CHOICE BASED CREDIT SYSTEM

CURRICULUM

Regulation 2021

Bachelor of Technology in Biotechnology

OVERALL COURSE STRUCTURE

S.No.	Course Category	Total No. of Courses	Credits	Percentage
1	Humanities and Social Sciences (HS)	6	10	6.25%
2	Basic Science courses (BS)	9	27	16.87%
3	Engineering Science courses (ES)	10	24	15%
4	Professional Core courses (PC)	21	56	35%
5	Professional Elective (PE)	6	18	11.25%
6	Open Elective (OE)	4	12	7.5%
7	Project work (P)	3	13	8.13%
8	Mandatory Courses (MC)	6	--	--
TOTAL		65	160	100

COURSE CREDITS - SEMESTER WISE

Branch	I	II	III	IV	V	VI	VII	VIII	TOTAL
BT	22	17	19	19	23	24	22	14	160

SEMESTER I

S.No.	Course Code	Course Title	Course Category	L	T	P	C
THEORY							
1.	21UEN101	English for Technical Communication	HS	2	0	0	2
2.	21UMA102	Engineering Mathematics – I	BS	3	1	0	4
3.	21UPH103	Engineering Physics	BS	3	0	0	3
4.	21UCY105	Applied Chemistry	BS	3	0	0	3
5.	21UCS108	Problem Solving and PYTHON Programming	ES	3	0	0	3
6.	21UME109	Engineering Graphics	ES	3	1	0	4
PRACTICAL							
7.	21UCS110	Problem Solving and PYTHON Programming Laboratory	ES	0	0	2	1
8.	21UCS112	Engineering Fundamentals Lab	ES	0	0	2	1
9.	21UGS113	Basic Sciences Laboratory-I	BS	0	0	2	1
MANDATORY							
10.	21UGM131	Induction Program	MC	0	0	2	P/F
Total				17	2	8	22
Total Credits : 22							

SEMESTER II

S.No.	Course Code	Course Title	Course Category	L	T	P	C
THEORY							
1.	21UEN201	Communication Skills for Professionals	HS	1	0	1	1.5
2.	21UMA207	Calculus, Complex Analysis and Transform Techniques	BS	3	1	0	4
3.	21UPH204	Biomaterial Physics	BS	3	0	0	3
4.	21UBT204	Microbiology	ES	3	0	0	3
5.	21UBT205	Principles of Biochemistry	ES	3	0	0	3
PRACTICAL							
6.	21UGS210	Basic Sciences Laboratory - II	BS	0	0	2	1
7.	21UBT211	Biochemistry Laboratory	ES	0	0	3	1.5
MANDATORY							
8.	21UGM231	Environmental Science	MC	1	0	0	P/F
Total				14	1	6	17
Total Credits : 17							

SEMESTER III

S.No.	Course Code	Course Title	Course Category	L	T	P	C
THEORY							
1.	21UMA326	Transform Techniques and Partial Differential Equations	BS	3	1	0	4
2.	21UBT302	Stoichiometry and Fluid Mechanics	ES	3	0	0	3
3.	21UBT303	Applied Thermodynamics for Biotechnologists	PC	3	0	0	3
4.	21UBT304	Cell Biology	PC	3	0	0	3
5.	21UBT305	Biochemical Metabolism	PC	3	0	0	3
PRACTICAL							
6.	21UBT306	Microbiology Laboratory	PC	0	0	3	1.5
7.	21UBT307	Cell Biology Laboratory	PC	0	0	3	1.5
Total				15	1	6	19
Total Credits : 19							

SEMESTER IV

S.No.	Course Code	Course Title	Course Category	L	T	P	C
THEORY							
1.	21UMA424	Probability and Inferential Statistics	BS	3	1	0	4
2.	21UBT402	Bioprocess Principles	PC	3	0	0	3
3.	21UBT403	Basic Industrial Biotechnology	PC	3	0	0	3
4.	21UBT404	Protein Engineering	PC	3	0	0	3
5.	21UBT405	Principles of Genetics	PC	3	0	0	3
PRACTICAL							
6.	21UBT406	Chemical Engineering Laboratory	ES	0	0	3	1.5
7.	21UBT407	Instrumental Methods of Analysis Laboratory	PC	0	0	3	1.5
MANDATORY							
8.	21UGM431	Gender Equality	MC	1	0	0	P/F
Total				16	1	6	19
Total Credits : 19							

SEMESTER V

S.No.	Course Code	Course Title	Course Category	L	T	P	C
THEORY							
1.	21UBT501	Molecular Biology	PC	3	0	0	3
2.	21UBT502	Bioprocess Engineering	PC	3	0	0	3
3.	21UBT503	Enzyme Engineering and Technology	PC	3	0	0	3
4.	21UBT504	Heat Transfer and Mass Transfer Operations	ES	3	0	0	3
5.	PE - I	Professional Elective – I	PE	3	0	0	3
6.	OE - I	Open Elective – I	OE	3	0	0	3
PRACTICAL							
7.	21UBT505	Molecular Biology Laboratory	PC	0	0	3	1.5
8.	21UBT506	Enzyme Engineering and Technology Laboratory	PC	0	0	3	1.5
SPECIAL COURSE							
9.	21UGM507	Creative Thinking and Innovation	P	0	0	2	1
10.	21UGS533	Interpersonal Skills Laboratory	HS	0	0`	2	1
MANDATORY							
11.	21UGM531	Tamil Literature, culture and civilization through archeology	MC	1	0	0	P/F
			Total	19	0	10	23
Total Credits : 23							

SEMESTER VI

S. No.	Course Code	Course Title	Course Category	L	T	P	C
THEORY							
1.	21UBT601	Genetic Engineering	PC	3	0	0	3
2.	21UBT602	Immunology	PC	3	0	0	3
3.	PE – II	Professional Elective – II	PE	3	0	0	3
4.	PE – III	Professional Elective – III	PE	3	0	0	3
5.	OE – II	Open Elective – II	OE	3	0	0	3
PRACTICAL							
6.	21UBT606	Genetic Engineering Laboratory	PC	0	0	3	1.5
7.	21UBT607	Bioprocess Engineering Laboratory	PC	0	0	3	1.5
SPECIAL COURSE							
8.	21UBT608	Product Development Project	P	0	0	8	4
9.	21UGS631	Logical Reasoning and Aptitude	HS	1	0	0	1
10.	21UGS632	Soft skills and Communication Laboratory	HS	0	0	2	1
MANDATORY							
11.	21UGM632	Indian Constitution	MC	1	0	0	P/F
Total				17	0	16	24
Total Credits : 24							

SEMESTER VII

S.No.	Course Code	Course Title	Course Category	L	T	P	C
THEORY							
1.	21UBT701	Downstream Processing	PC	3	0	2	4
2.	21UBT702	Bioinformatics	PC	3	0	2	4
3.	21UME	Project Management and Finance	HS	3	0	0	3
4.	PE – IV	Professional Elective – IV	PE	3	0	0	3
5.	PE – V	Professional Elective – V	PE	3	0	0	3
6.	OE – III	Open Elective – III	OE	3	0	0	3
PRACTICAL							
7.	21UBT707	Immunology Laboratory	PC	0	0	4	2
Total				18	0	8	22
Total Credits : 22							

SEMESTER VIII

S.No.	Course Code	Course Title	Course Category	L	T	P	C
THEORY							
1.	PE - VI	Professional Elective – VI	PE	3	0	0	3
2.	OE - IV	Open Elective – IV	OE	3	0	0	3
PRACTICAL							
3.	21UBT803	Project work	P	0	0	16	8
MANDATORY							
4.	21UGM731	Professional Ethics and Human Values	MC	1	0	0	P/F
Total				7	0	16	14
Total Credits : 14							

LIST OF ELECTIVES

S.No.	Course Code	Course Title	L	T	P	C
1.	21UBT901	Artificial Intelligence in Biotechnology	3	0	0	3
2.	21UBT902	Bioremediation Technology	3	0	0	3
3.	21UBT903	Genomics and Proteomics	2	0	2	3
4.	21UBT904	Principles of food processing	3	0	0	3
5.	21UBT905	Process Economics and Plant Design	3	0	0	3
6.	21UBT906	Molecular Pathogenesis of Infectious Diseases	3	0	0	3
7.	21UBT907	Stem Cell Technology	3	0	0	3
8.	21UBT908	Molecular Farming	3	0	0	3
9.	21UBT909	Marine Biotechnology	3	0	0	3
10.	21UBT910	Fundamentals of Nanotechnology	3	0	0	3
11.	21UBT911	Biofuel	3	0	0	3
12.	21UBT912	Nano Medicine for cancer theranostics	3	0	0	3
13.	21UBT913	Therapeutic nutrition	3	0	0	3
14.	21UBT914	Cancer Biology	3	0	0	3
15.	21UBT915	Vaccine Technology	3	0	0	3
16.	21UBT916	Bioreactor Engineering and Design	3	0	0	3
17.	21UBT917	Molecular Diagnostics	3	0	0	3
18.	21UBT918	Preclinical and Clinical Regulatory affairs	3	0	0	3
19.	21UBT919	Bioethics, Biosafety and IPR	3	0	0	3
20.	21UBT920	Systems Biology	3	0	0	3
21.	21UBT921	Neurobiology and Cognitive Sciences	3	0	0	3
22.	21UBT922	Biochemical Toxicology and Degenerative Diseases	3	0	0	3
23.	21UBT923	Metabolic Engineering	3	0	0	3
24.	21UBT924	Environmental Biotechnology	3	0	0	3
25.	21UBT925	Biopharmaceutical Technology	3	0	0	3
26.	21UBT926	Biopolymers	3	0	0	3
27.	21UBT927	Animal and Plant Biotechnology	3	0	0	3

LIST OF OPEN ELECTIVES

S.No.	Course Code	Course Title	Course Category	L	T	P	C
1.	21UBT971	Herbal Medicines	OE	3	0	0	3
2.	21UBT972	Nanomedicine for Cancer Treatment	OE	3	0	0	3
3.	21UBT973	Quality Assurance and Control In Food Industry	OE	3	0	0	3
4.	21UBT975	Bionanotechnology	OE	3	0	0	3
5.	21UBT976	Bioentrepreneurship	OE	3	0	0	3

LIST OF INDUSTRY DESIGNED COURSES

S.No.	Course Code	Course Title	L	T	P	C
1.	21UBT861	Food microbiology and Fermentation laboratory	0	0	2	1
2.	21UBT862	Computational Reckoning of Bioprocess	0	0	2	1
3.	21UBT863	Automated Interactive Tools for Conformational Studies	0	0	2	1
4.	21UBT865	3D Bio-printing of Living tissues	0	0	2	1
5.	21UBT866	Introduction to PERL Programming & Bio-Perl	0	0	2	1
6.	21UBT867	Regulation Perspective of Clinical Research	0	0	2	1
7.	21UBT868	Introduction to Fuzzy Logic and Genetic Algorithms	0	0	2	1
8.	21UBT869	Numerical methods for Biotechnologists	0	0	2	1

SEMESTER - II

21UBT204	MICROBIOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the microbial world and their nutritional requirements for growth and metabolism
- Conceptualize the principle, classifications and the characteristics of microbial species and study its applications in industrial and environmental sector.

UNIT – 1	INTRODUCTION TO MICROBIOLOGY AND MICROSCOPY	9

Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms - Microscopic examination of microorganisms: Bright field light Microscopy, Compound, Phase Contrast, Fluorescence and Electron microscopy - Principles of different staining techniques like gram staining, acid fast, negative staining, capsular staining, flagellar staining, endospore staining.

UNIT – 2	MICROBES- STRUCTURE AND MULTIPLICATION	9

Microbial morphology: Structure and Functional anatomy of Prokaryotic and Eukaryotic Cells - Multiplication of bacteria, viruses, algae and fungi, with special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophages

UNIT – 3	MICROBIAL NUTRITION, GROWTH AND METABOLISM	9

Common nutritional requirements of bacteria - major, minor, trace selements and supplements, Nutritional types : Autotroph, Heterotroph, Chemotroph and Lithotroph - Different media used for bacterial culture based on physical state, chemical composition and functional type, Batch growth - Growth curve, kinetics – doubling time, growth rate, quantification of growth - direct and indirect methods – Introduction to continuous culture - Microbial metabolism: Entner–Doudoroff pathway, Aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.

UNIT – 4	CONTROL OF MICROORGANISMS	9

Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, antifungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms such as *Staphylococcus aureus* and Pseudomonas species. Case Study- Antibiotic sensitivity assay (*Staphylococcus aureus*)

UNIT – 5	INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY	9

Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, vitamin B-12; biogas; bioremediation; bioleaching; biofertilizers and biopesticides; microorganisms and pollution control; biosensors and biofilters

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1	Understand and explain the fundamentals of microbial species, their taxonomical classification, cell structure and metabolism.	Understand
CO2	Apply and evaluate the antibiotics and antifungal agents to control the	Apply

	microbial species	
CO3	Analyze fundamental concepts in the structure and functioning of a microbial cell	Analyze
CO4	Investigate biochemical aspects of various microbes	Evaluate
CO5	Conduct experiments in laboratories and participate in solving societal issues with the help of microbes.	Create

TEXT BOOKS:

1. Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C. Brown Publishers, 2005.
2. Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.
3. Prescott L.M., Harley J.P., Klein DA, Microbiology, McGraw Hill , USA, 2005.

REFERENCES:

1. Talaro, K. P., & Chess, B. (2018). Foundations in microbiology. McGraw-Hill.
2. Lim D, "Microbiology", Second Edition, WCB-McGraw Hill, 2001.
3. Remaut, H., & Waksman, G. (2004). Structural biology of bacterial pathogenesis. Current opinion in structural biology, 14(2), 161-170.

21UBT205	PRINCIPLES OF BIOCHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the scientific essentials of basic structure and functions of biomolecules
- Explore the principle, classifications and the characteristics of different biomolecules and study its biotechnology applications in healthcare sector.

UNIT – 1	BIOCHEMICAL ORGANIZATION	9

Living systems - basics, chemical composition, structure and reactivity of simple biological molecules, chemistry of water and its relevance to living systems, acids, bases, pH and buffers in biological systems - Scope of clinical biochemistry, component of the cell - structure and biochemical functions - membrane structure and functions, transport through biological cell membrane

UNIT – 2	STRUCTURE AND FUNCTION OF CARBOHYDRATES AND LIPIDS	9

Carbohydrates: mono, di, oligo & polysaccharides - Proteoglycans - Glucosaminoglycans – Mutarotation, Functions of carbohydrates - Reactions of monosaccharides - Lipids: fattyacids, glycerol- Simple lipids: fats, oils and waxes- Complex lipids: phospholipids, glycolipids, sphingolipids - Derived lipids: steroids, terpenoids and carotenoids - Functions of lipids - saponification, iodination and hydrogenation

UNIT – 3	STRUCTURE AND FUNCTION OF PROTEINS AND NUCLEIC ACIDS	9

Proteins: Amino acids, peptides - hierarchy of organization: primary, secondary, tertiary and quaternary structures - conjugated proteins: glycoproteins, proteoglycans and lipoproteins - Functions of Proteins - Nucleic acids: purines, pyrimidines, nucleoside, nucleotide, structure and function of RNA and DNA, nucleoprotein complexes.

UNIT – 4	MACROMOLECULES, VITAMINS AND ENZYMES	9

Structure and properties of haemoglobin, immunoglobin and its types, Functions, requirements, deficiency manifestations and role of vitamins as co-enzyme, Nomenclature- classification of enzymes, mechanism of actions, activation energy, specificity, factors influencing enzyme activity, types of enzyme inhibition, Enzymes of clinical importance.

UNIT – 5	INTERMEDIARY METABOLISM AND REGULATION	9

Overview of metabolism - Glycolysis- TCA cycle- gluconeogenesis- pentose phosphate shunt- glyoxalate shunt - amino acid metabolism: deamination, transamination and decarboxylation, urea cycle- interconnection of pathways and metabolic regulation – Bioenergetics and ATP

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1	Understand the principles of chemistry and biology, fundamentals of living organisms, their classification, cell structure, biochemical composition and its functions.	Understand
CO2	Apply the principle and synthesis of biomolecules- carbohydrates, lipids, proteins, amino acids and their characteristics in biochemical processes	Apply
CO3	Analyze the mechanism of enzyme action and its kinetics, identify the classes of enzymes and factors affecting them.	Analysis
CO4	Evaluate the type of biochemical processes and its molecular connections with living organisms and biological system.	Evaluate
CO5	Design scientific processes to conduct experiments, critically analyze results, interpret data and bring their expertise in solving clinical problems.	Modern Tool Usage

TEXT BOOKS:

1. Nelson D. L. and Cox M. M., "Lehninger's Principles of Biochemistry", 7th Edition. Macmillan Publisher, 2017.
2. Moran L. A., Horton R.A., Scrimgeour G., Perry M., Rawn D., "Principles of Biochemistry" 5th Edition, Pearson New international Edition,2014.
3. McKee T. and McKee J. R., "Biochemistry- The Molecular Basis of Life", Oxford University Press, London, 2008.
4. Devlin, T. M. (2011). Textbook of Biochemistry. 6th edition. John Wiley & Sons

REFERENCES:

1. Berg J. M., Tymoczko J. L. and Lubert Stryer, "Biochemistry", W H Freeman and Company, New York, 2002.
2. Rodwell V., Bender D., Botham K., Kennelly P., Anthony Weil P., "Harpers Illustrated Biochemistry" McGraw Hill, 31th Edition 2018.

21UBT211	BIOCHEMISTRY LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to:

- Learn and understand the principles behind the qualitative and quantitative analysis of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,) and laboratory analysis of the same in the body fluids.
- Demonstrate various methods to quantity the biomolecules and measuring enzymatic activity using spectroscopic methods

LIST OF EXPERIMENTS:

1. General guidelines for working in biochemistry lab (theory)
2. Demonstration of use of volume and weight measurements devices
3. Accuracy, precision, sensitivity and specificity (theory)
4. Preparation of buffer – titration of a weak acid and a weak base.
5. Qualitative tests for carbohydrates – distinguishing reducing from non-reducing sugars and keto from aldo sugars.
6. Estimation of starch by Anthrone method.
7. Quantitative method for amino acid estimation using ninhydrin – distinguishing amino from imino acid
8. Qualitative analysis for Proteins
9. Protein estimation by Biuret and Lowry's methods.
10. Determination of cholesterol by Zak's method.
11. Estimation of nucleic acids by absorbance at 260 nm and hyperchromic effect.
12. Enzymatic assay: phosphatase from potato.
13. Enzymatic assay: estimation of glucose by GOD-POD method after hydrolysis of starch with acid and specificity of the enzymatic method.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1	Demonstrate various qualitative analysis of biomolecules in given samples	Apply
CO2	Examine biochemical normal and abnormal reactions in human body and estimate the glucose and cholesterol.	Analyze
CO3	Evaluate the total amount of carbohydrates, proteins and lipids in the given samples by conducting suitable experiments.	Evaluate

EQUIPMENTS REQUIREMENT:

Sl. No.	Name of the equipment	Quantity required
1	Spectrophotometer	1
2	Colorimeter	2
3	Autoclave	1
4	Hot air Oven	1
5	Incubators	2
6	Light Microscopes	4
7	Laminar Flow Chamber	2

Glassware, Chemicals, Media as required

TEXT BOOKS

1. Practical Biochemistry by R.C. Gupta and S. Bhargavan.

2. Introduction of Practical Biochemistry by David T. Phummer. (II Edition)

REFERENCES

1. Harpers Biochemistry Ed. R.K. Murray , D.K. Granner, P.A. Mayes and V.W.Rodwell, Appleton and Lange ,Stanford ,Connecticut.

2. Textbook of Biochemistry with clinical correlations. Ed. Thomas M. Devlin. Wiley Liss Publishers.

SEMESTER - III

21UBT302	STOICHIOMETRY AND FLUID MECHANICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- To make the students to understand the various systems of units and dimensions pertaining to unit operations and unit processes.
- To make the students to understand the importance of material balance and energy balance to perform material balance and energy balance calculation for various unit operations and unit processes.
- To understand and apply fluid mechanics principles, various flow measuring devices and flow through packed bed and fluidized bed.

UNIT – 1	BASIC CHEMICAL CALCULATIONS	9

Introduction to chemical Process - Basic laws used in unit operations and unit process, Units, dimensions – Systems of units - Engineering FPS, Engineering MKS & SI systems, Basic and derived units – Conversion from one system to other system - Moles, density and composition – composition of mixtures and solutions – mass fraction, mass %, mole fraction, mole %, mass ratios, molarity, molality, normality, ppm - composition by density.

UNIT – 2	CONCEPTS IN ENERGY BALANCES AND HUMIDITY CALCULATIONS	9

Energy balances - Heat capacity of solids, liquids, gases and solutions - use of mean heat capacity in heat calculations - Standard heat of reaction: heats of formation, combustion - Calculation of standard heat of reaction - Humidity definition and Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Humidity chart.– Wet, Dry bulb, Dew point temperatures.

UNIT – 3	CONCEPTS IN MATERIAL BALANCES	9

The concept material balance – overall & component – material balance applications for evaporator, gas absorber without reaction, Distillation (Binary system), Liquid extraction, solid-liquid extraction, crystallization, drying, Reverse Osmosis separation, Recycle and Bypass systems and calculations.

UNIT – 4	FLUID PROPERTIES AND FLUID MECHANICS	9

Fluid definition - compressible, incompressible fluids – coefficient of isothermal compressibility – Density - specific gravity - specific weight - surface tension - vapour pressure – viscosity - Newtonian and Non-newtonian fluids - Fluid statics – Barometric equation - Pressure changes in atmospheric air – Gauge and absolute pressure – pressure measurement with Bourdon gauge & manometers - Fluid Dynamics – equation of continuity – Bernoulli's equation and Navier - Stokes equation – press loss in straight pipes – in fittings – expansion and contraction losses - Fluid flow measurement - Orifice, venture & Rota meter.

UNIT – 5	FLOW OF FLUID THROUGH PACKINGS	9

Fluidization and its types - Fluid transport Industrial application of fluid flow through packing - characteristics of packed bed - Bed surface area-void fraction - Laminar flow through packed bed and turbulent flow pressure drop experienced by the fluid-equations and application problems. Fluidization phenomena - Industrial application - minimum fluidization velocities. Industrial pipes and fittings Fluid moving machinery-pumps centrifugal, Reciprocating - gear, Peristaltic pumps, Introduction to gas moving machinery - Fans, blowers, compressors.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1	Understand fundamental concepts in chemical, energy and material balances and also the basics of fluids and flow patterns	Understand
CO2	Apply concepts of chemical, energy and material balances and also the basics of fluids and flow patterns in the field of bioprocess engineering	Apply
CO3	Solve the calculations involved energy and material balance and fluid flow studies to elucidate the product production and to avoid the loss of energy and matter	Analyse
CO4	Interpret problems related to chemical, energy and material balances of various unit operation and fluid flowing pathways for developing an efficient biochemical processes.	Evaluate
CO5	Design unit operation equipments and fluid flowing pathways for biochemical processes with the knowledge obtained by basics concepts	Implement

TEXT BOOKS

1. Narayanan, K.V., Lakshmikutty B., "Stoichiometry and Process Calculations", Prentice Hall International, 1st Edition, 2011.
2. D.C.Sikdar,"Chemical process calculations "Prentice Hall India Learning Private Limited, 2013.

REFERENCES:

1. McCabe W.L &J.C.Sonith&P.Harriot "Unit operations of chemical Engineering" 6thEdn McGraw Hill 2001.
2. Himmelblau, D.M. "Basic principles and calculations in Chemical Engineering", 8thEdition, PHI, 2011.
3. Robert W.Fox, Alan T.McDonald& Philip J.Pritchard "Introduction to Fluid Mechanics" 7th edn John Wiley & Sons 2009.
4. Bhatt B.I & SB Thakore, Stoichiometry - Fifth edition Tata McGraw Hill 2012.

21UBT303	APPLIED THERMODYNAMICS FOR BIOTECHNOLOGISTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to impart knowledge on :

- Basic laws of thermodynamics and property relations
- Partial molar properties and their estimation
- Fundamentals of phase equilibria and chemical reaction equilibria
- Application of thermodynamics

UNIT – 1	THERMODYNAMIC PROPERTIES OF FLUIDS	9

Laws of thermodynamics - Thermodynamic potentials: Internal energy, Enthalpy, Helmholtz free energy, Gibbs free energy - Thermodynamic property relations - Volumetric properties of fluids exhibiting non ideal behavior – Residual properties – Estimation of thermodynamic properties using equations of state – Calculations involving actual property exchanges – Maxwell's relations and applications.

UNIT – 2	SOLUTION THERMODYNAMICS	9

Partial molar properties – Concepts of chemical potential and fugacity – Ideal and non-ideal Solutions – Concepts and applications of excess properties of mixtures – Activity coefficient – Composition models – Gibbs Duhem equation.

UNIT – 3	PHASE EQUILIBRIA	9

Criteria for equilibrium between phases in multi component non-reacting systems in terms of chemical potential and fugacity - Application of phase rule - Vapour-liquid equilibrium - Phase diagrams for homogeneous systems and for systems with a miscibility gap - Effect of temperature and pressure on azeotrope composition - Liquid liquid equilibrium - Ternary liquid-liquid equilibrium.

UNIT – 4	CHEMICAL REACTION EQUILIBRIA	9

Definition of standard state - Standard free energy change and reaction equilibrium constant - Evaluation of reaction equilibrium constant - Prediction of free energy data - Equilibria in chemical reactors - Calculation of equilibrium compositions for homogeneous chemical reactors - Thermodynamic analysis of simultaneous reactions.

UNIT – 5	THERMODYNAMIC DESCRIPTION OF MICROBIAL GROWTH AND PRODUCT FORMATION	9

Thermodynamics of microbial growth stoichiometry thermodynamics of maintenance - Calculation of the Operational Stoichiometry of a growth process at Different growth rates - Including Heat using the Herbert –Pirt Relation for Electron Donor, thermodynamics and stoichiometry of Product Formation

TOTAL : 45 PERIODS

COURSE OUTCOMES:
At the end of the course the student will be able to

CO1	Understand the basic laws of thermodynamics, property relations, Fundamentals of phase equilibria and chemical reaction equilibria	Understand
CO2	Derive the thermodynamics property relations in accordance with laws of thermodynamics and also derive the phase equilibria and chemical reaction equilibria.	Apply
CO3	Analyze the basic concepts of classical and statistical thermodynamics.	Analyze
CO4	Investigate the potential applications of thermodynamics in real life scenario	Evaluate
CO5	Design of modeling energy demands for cell growth based on the understanding of thermodynamics laws and the real gas behaviour.	Implement

TEXT BOOKS:

1. Smith, J.M., Van Ness, H.C., and Abbott, M.M., "Introduction to Chemical Engineering Thermodynamics",6thEdn., McGraw Hill International Edition, Singapore 2001.
2. Narayanan K.V. "A Text Book of Chemical Engineering Thermodynamics", PHI, 2003.

REFERENCES:

1. Sandler S.I., "Chemical and Engineering Thermodynamics", John Wiley, 2nd Edition, 2014.
2. Bevan O.J, Juliana B.G., "Chemical Thermodynamics: Advanced Applications", Academic Press, 2000.
3. Batter J.A., "Chemical Thermodynamics", Nabu Press, 2nd Edition, 2013.

21UBT304	CELL BIOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student gain knowledge and understand

- Structure, function of cell organelles, different receptors and model of signalling.
- Transport mechanisms across membranes, signal transduction and cyclic pathway of cells.
- Different techniques to study cells

UNIT – 1	CELL STRUCTURE AND FUNCTION OF THE ORGANELLES	9

Prokaryotic, Eukaryotic cells, Sub-cellular organelles and functions. Principles of membrane organization - membrane proteins, cytoskeletal proteins. Extra cellular matrix, cell-cell junctions.

UNIT – 2	TRANSPORT ACROSS CELL MEMBRANES	9

Overview of membrane transport - Passive transport: Diffusion, Facilitated diffusion, Ion channels: Gated and Non-gated - Active Transport: ATP Powered Pumps – P, V, F and ABC super family pumps: Ca^{2+} ATPase, Na^{+}/K^{+} ATPase, H^{+} ATPase - Bacterial Permeases - Transporters – Glucose transporters, Na^{+}/Glucose symporters, Ca2+/Na+ antiporter - Movement of water – Osmosis and Tonicity, Endocytosis and exocytosis - Entry of viruses and toxins into cells.

UNIT – 3	CELL CYCLE	9

Cell division – Mitosis, Meiosis - Regulation: check points - Cancer - properties, causes, introduction to types of proteins involved in controlling cell growth and proliferation, role of carcinogens and DNA repair in cancer - Apoptosis - Introduction to cell culture techniques.

UNIT – 4	CELL TRANSDUCTION	9

Steps in signal transduction, Signal amplification, Modes of intercellular signaling, Hormones as signals – Examples for peptide hormones, protein hormones, lipid and phospholipid derived hormones. Signaling at the cell surface: GPCR; Receptors with intrinsic or associated enzymatic activity: Receptor tyrosine kinases – Ras MAP Kinase pathway; cytokine receptor – JAK/STAT pathway; receptors that are ion channels – Ca2+signalling ; receptors activating pathways involving proteolysis - Wnt pathway; intracellular receptor pathways - Nitric oxide pathway; Intracellular signal transduction - second messengers.

UNIT – 5	TECHNIQUES USED TO STUDY CELLS	9

Cell fractionation and flow cytometry, Morphology and identification of cells using microscopic studies like SEM, TEM and Confocal Microscopy. Localization of proteins in cells – Immunostaining.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1	Understand the cell structure, cell signaling and transport process and techniques to study the cells	Understand
CO2	Distinguish between structure of different cells, various cell signaling and transport process and techniques to study the cells	Apply
CO3	Analyze the morphology of various cells and Infer the malfunctioning of signaling pathways	Analysis
CO4	Evaluate the complexities involved in cell structure and signaling and choose suitable techniques for cell studies	Evaluate
CO5	Utilize their knowledge in cell structure and functions to study the changes or alterations in their function as a response to environmental or physiological changes or mutation with the help cell studying techniques	Implement

TEXT BOOKS:

1. Lodish; Arnold Berk; Chris A. Kaiser; Monty Krieger; Anthony Bretscher; HiddePloegh; ''Molecular Cell Biology'', IX edition, 2021.
2. Cooper, G.M., Hansman R.E., "The Cell: A Molecular Approach", Sinauer Associates Inc., 4th edition (revised), 2006.

REFERENCES:

1. De Robertis& De Robertis, "Cell and Molecular Biology" Lippincott Williams & Wilkins; 8th edition, 2010.
2. Gerald, Karp, "Cell and molecular biology Concepts and Experiments", Wiley publications, 7th Edition, 2013.
3. Thomas D. Pollard, William C. Earnshaw and Jennifer Lippincott-Schwartz: Cell Biology: With Student Consult Online Access, Saunders College Publishing, 2nd Edition, 2007.

21UBT305	BIOCHEMICAL METABOLISM	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student will gain knowledge about:

- The individual metabolic pathways and its reaction chemistry
- The integration and the regulation of intermediary metabolism.

UNIT – 1	INTERMEDIARY METABOLISM	9

Introduction to Metabolism – Catabolism – Anabolism – Catabolic - Anabolic and Amphibolic pathways - Bio Energetics - Endergonic and exergonic reactions - Coupled reactions - High energy compounds – Structural features of ATP and its free energy change during hydrolysis - Other high energy compounds - Biological oxidation - Ultra structure of mitochondrion - Electron transport chain - Electron transport complexes Complex I, II, III and IV - Uncouplers and inhibitors of respiration (Rotenone, Antimycin, Cyanide and 2,4 DNP) - Oxidative phosphorylation.

UNIT – 2	CARBOHYDRATE METABOLISM	9

Introduction - Aerobic and anaerobic pathways – Glycolysis – Gluconeogenesis - Fates of pyruvate – Conversion of pyruvate to lactate, alcohol and acetyl Co-A - TCA cycle - Amphibolic&Anaplerotic reactions - Balance sheet of glucose oxidation - Pentose phosphate pathway (HMP shunt) -Entner–Doudoroff pathway(ED Pathway) Photosynthesis – 'light' and 'dark' reactions - Disorders of carbohydrate metabolism.

UNIT – 3	AMINO ACID METABOLISM	9

Protein turnover - General reaction of amino acid degradation – Transamination - Deamination and decarboxylation - Urea cycle - Biosynthesis of amino acids - Inborn errors of amino acid metabolism – Phenylketonuria – Albinism – Alkaptunuria and Maple syrup syndrome.

UNIT – 4	LIPID METABOLISM AND NUCLEIC ACID METABOLISM	9

Oxidation of fatty acid – α, β and ω types – Beta oxidations of saturated & unsaturated fatty acids - Formation of ketone bodies - Biosynthesis of fatty acids – Tri glycerol – Cholesterol - Disorders of lipid metabolism - Biosynthesis of purines and pyrimidine nucleotides - denovo and salvage pathways - Disorders of nucleic acid metabolism.

UNIT – 5	INTRODUCTION TO SYSTEMS BIOLOGY	9

Introduction to Systems Biology - Systems level understanding of biological systems - Basic concepts in Systems modeling - Model Scope, Model Statements, System state, Variables, parameters and constants, Model behavior, classification and steady state - Merits of computational modeling, Purpose and Adequateness of Models, Model Development - Typical Aspects of Biological Systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will able to

CO1	Understand the concepts of metabolism and flow of energy through the pathways in biological system	Understand
CO2	Apply the gained knowledge of Energy synthesis by understanding the biochemical metabolism and its disorders	Apply
CO3	Examine the anabolic and catabolic pathways of amino acids and disorders associated with them.	Analysis
CO4	Describe the role of lipid and nucleic acid metabolism in assimilating energy and disorders associated with them	Evaluate
CO5	Implement system biology concepts in the intricate network of metabolic interactions to study the metabolic profiles and metabolic fuel regulations.	Implement

TEXT BOOKS:

1. Lehninger, Nelson and Cox, Principles of Biochemistry, 4th Edition, W.H.Freeman& Company, 2004.
2. Biochemistry by Jeremy M.Berg, John L.Tymozko, LubertStryer, Fifth edition, W.H.Freeman and Company,1514 pages.

REFERENCES:

1. Voet D., Prat W.C., Voet J., "Principles of Biochemistry", John Wiley and Sons, 4th Edition 2012.
2. Moran L.A., Horton R.A., Scrimgeour G., Perry M., Rawn D., "Principles of Biochemistry" Pearson New international, 5th Edition, 2014.
3. Sathyanarayana. U and Chakrapani U (2013). Biochemistry, 3rd edition, Elsevier

21UBT306	MICROBIOLOGY LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to:

- Handle sterilization techniques and microscopy.
- Gain hands on experience on staining techniques, biochemical characterization of bacteria and culturing microorganisms.
- Familiarize with activity of antibiotics and disinfectant on microbial growth.
- Monitor growth of microorganisms at different physiological conditions

LIST OF EXPERIMENTS

1. Introduction, Laboratory Safety, Equipment usage and Sterilization Techniques
2. Culture Media-Types and Use; Preparation of broth and agar
3. Isolation techniques – serial dilution, pour plate, spread plate, streak plate
4. Culturing and preservation techniques of microorganisms(bacteria)
5. Handling, Working and care of Microscope.
6. Smear preparation and Staining Techniques – simple, gram and acid fast staining
7. Growth Curve studies on Bacteria
8. Quantification of Microbes – TVC
9. Effect of Temperature on Growth of Bacteria
10. Effect of UV radiation on Growth of Bacteria
11. Antibiotic Sensitivity Assay
12. Effect of Disinfectants- Phenol Coefficient

TOTAL : 45 PERIODS

COURSE OUTCOMES

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

CO1	Handle sterilization techniques and follow good laboratory practices in microbiology laboratory	**Understand**
CO2	Illustrate isolation, subculture, identification and preservation of microbe using appropriate basic microbiology technique	**Apply**
CO3	Evaluate the activity of antibiotics and disinfectant on microbial growth by monitoring at different phases	**Evaluate**
CO4	Interpret the effect of pH, temperature and irradiation on microbial growth	**Evaluate**

TEXT BOOKS:

1. Cappuccino, J.G. and N. Sherman "Microbiology: A Laboratory Manual", 4th Edition, Addison-Wesley, 1999.
2. Collee, J.G. et al., "Mackie & McCartney Practical Medical Microbiology" 4th Edition, Churchill Livingstone, 1996.

21UBT307	CELL BIOLOGY LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to

- Develop skills in the basic cell biological techniques
- Gain practice on isolation and identification of cell organelles
- Do hands-on work on basic cytogenetic techniques

LIST OF EXPERIMENTS:

1. Sterile techniques and cell propagation
2. Microscopic observation of eukaryotic cells
3. Isolation of cell organelle: chloroplast
4. Cell organelles staining techniques - nuclear staining
5. Leishman staining
6. Giemsa staining
7. Cell cycle : mitotic cell division in onion root tip
8. Osmosis and tonicity
9. Tryphan blue assay
10. Separation of Peripheral Blood Mononuclear Cells (PBMC) from blood.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1	Describe basic Sterile techniques and cell propagation concepts	**Undersatnd**
CO2	Apply Techniques to learn the morphology, identification and propagation of cells	**Apply**
CO3	Analyze the morphology of cells organelles and effect of osmosis effect on cells	**Ananlyze**

CO4	Evaluate osmosis and tonicity effect of cells, PBMC for antibody analysis	**Evaluate**

TEXT BOOKS

1. Rickwood, D. and J.R. Harris "Cell Biology: Essential Techniques", Johnwiley, 1996.
2. Davis, J.M. "Basic Cell Culture: A Practical Approach", IRL, 1994.

SEMESTER - IV

21UBT402	BIOPROCESS PRINCIPLES	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Develop skills of the students in design operation, medium design, optimization, fermentation process and effluent treatment.
- Understand the modern industrial biotechnological process, sterilization, metabolic stoichiometry and growth kinetics of microorganisms.

UNIT – 1	OVERVIEW OF FERMENTATION	9

Overview of fermentation industry - General requirements of fermentation processes, basic configuration of fermentor and ancillaries, Instrumentation in bioprocess: main parameters to be monitored and controlled in fermentation processes - Role of bioprocess engineer in the biotechnology industry - Unit operations involved in bioprocesses - Modern applications of biotechnological processes

UNIT – 2	RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS	9

Criteria for good medium - Medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements –Medium formulation of optimal growth and product formation, examples of simple and complex media - Design of various commercial media for industrial fermentations - Medium optimization methods, Plackett-Burman and Response Surface Methodology- Overview of animal and plant cell culture media

UNIT – 3	STERILIZATION KINETICS AND EFFLUENT TREATMENT	9

Modes of media sterilization- FSIP and ESIP, modes of air sterilization, media sterilization by membrane filtration method - Filter sterilization of liquid media - Design of filters – Air sterilization - Types of sterilization process Batch and continuous heat sterilization of liquid media - Thermal death kinetics of microorganisms – Design of sterilization equipment and validation issues - Effluent treatment in bioprocesses, types of treatment methods, containment and effluent disposal.

UNIT – 4	METABOLIC STOICHIOMETRY AND ENERGETICS	9

Stoichiometry of cell growth and product formation - Elemental balances, degrees of reduction of substrate and biomass, available electron balances - Yield coefficients of biomass and product formation, maintenance coefficients, energetic analysis of microbial growth and product formation - Oxygen consumption and heat evolution in aerobic cultures, Thermodynamic efficiency of growth.

UNIT – 5	MICROBIAL GROWTH AND PRODUCT FORMATION KINETICS	9

Biomass estimation – Direct and Indirect methods- Modes of operation - Batch, fed batch and continuous cultivation - environmental conditions affecting the growth kinetics, heat generation by microbial growth; Industrial applications - Chemostat –Turbidostat - Introduction to unstructured models for growth and product formation - Simple unstructured kinetic models for microbial growth - Monod model - Growth of filamentous organisms - Product formation kinetics – Leudeking - Piret models, Substrate and product inhibition on cell growth and product formation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1	Summarize the overall bioprocess principles, Design of fermentor and fermentation media for the production of metabolites	Understand
CO2	Apply Concepts and knowledge from various biotechnological processes	Apply
CO3	Analyze the stoichiometry of cell growth and evaluate parameters in Monod kinetics	Analysis
CO4	Evaluate the microbial growth by developing microbial energetics using various methods	Evaluate
CO5	Use modern statistical tool for the optimization of enhanced production and recovery of product.	Modern Tool Usage

TEXT BOOKS:

1. Pauline, D., “Bioprocess Engineering Principles”, Elsevier, 2nd Edition, 2012.
2. Shuler, M.L., Kargi F., “Bioprocess Engineering”, Prentice Hall, 2nd Edition, 2002.

REFERENCES:

1. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.
2. Stanbury, P.F., Stephen J.H., Whitaker A., “Principles of Fermentation Technology”, Elsevier, 2nd Edition, 2009.
3. James. E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
4. Lydersen, B.K., “Bioprocess Engineering Systems, Equipment and Facilities” Wiley- India, 1st Edition, 2010.

21UBT403	BASIC INDUSTRIAL BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Acquire basic knowledge in fermentation, product recovery, production of biological products and strategies used in the production of primary and secondary metabolites.
- Learn about the strategies used in the production of enzymes, modern recombinant products and other biological products

UNIT – 1	INTRODUCTION TO INDUSTRIAL BIOTECHNOLOGY	9

Traditional and Modern Biotechnology - A brief survey of organisms, processes and products - Stages in Bioprocess cultivation - Upstream processing: Microorganisms, Medium components, Physical parameters - Biological waste as substrate - Types of fermentation – Batch - Fed batch – Continuous – Aerobic and Anaerobic - Downstream processing - Unit operations - Principles - Process flow sheeting - Block diagrams - Pictorial representation

UNIT – 2	PRODUCTION OF PRIMARY METABOLITES	9

Primary Metabolites- Production of commercially important primary metabolites like organic acids - citric acid, lactic acid and acetic acid, Amino acids: glutamic acid, phenylalanine and aspartic acid and alcohols – ethanol and butanol – Related industries.

UNIT – 3	PRODUCTION OF SECONDARY METABOLITES	9

Processes and production of various classes of secondary metabolites – Antibiotics - beta lactams - Penicillin and Cephalosporin, Aminoglycosides – Streptomycin, Macrolides – Erythromycin, Aromatic Antibiotic-chloramphenicol, Quinones Antibiotic – Tetracyclines, Vitamins – Cyanocobalamine, Riboflavin – Related industries.

UNIT – 4	PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS	9

Production of industrial enzymes – Amylases - Lipases and Cellulases - Production of bio-pesticides, bio-fertilizers - Single cell protein - Biopolymers - Xanthan gum and Poly hydroxyalkoanates – Microbes in households products – Cheese, curd, paneer, yoghurt – Related industries.

UNIT – 5	PRODUCTION OF BIOPHARMACEUTICAL PRODUCTS	9

Production of recombinant proteins having therapeutic and diagnostic applications – Streptokinase – Immunoglobulin – Insulin – Interferon - Tissue plasminogen activator – Vaccines - Monoclonal antibodies - Products of plant and animal cell culture – Related industries.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1	Describe principles and strategies used industrial bioprocess and ways to improve it.	Understand
CO2	Employ the knowledge on the production of economically important bio-products.	Apply
CO3	Point out and solve the problems in enzyme and metabolite production.	Analyze
CO4	Examine the results of the bioprocess and enhance their production.	Evaluate
CO5	Plan the strategies for efficient production and recovery of the biopharmaceutical products in industries.	Implement

TEXT BOOKS

1. Cruger,W., Crueger A., "Biotechnology: A Textbook of Industrial Microbiology", Panima Publishing, 2nd Edition, 2000.
2. A.H.Patel., Industrial microbiology, Laxmi Publications Publishers India, 2nd edition (2016).

REFERENCES

1. Rehm, H.J., Reed, G., "Biotechnology-Volume 9", Wiley VCH Publishers (New York), 2nd Edition,1995
2. Young M.M., "Comprehensive Biotechnology", Pergamon, 2nd Edition, 2011.
3. Dubey, R.C. "A Textbook of Biotechnology" S.Chand& Co. Ltd., 4th revised Edition, 2008

21UBT404	PROTEIN ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- To identify the importance of protein biomolecules.
- To realize the structure-function relationships in proteins

UNIT – 1	BONDS, ENERGIES, BUILDING BLOCKS OF PROTEINS	9

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure. Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups).

UNIT – 2	PROTEIN ARCHITECTURE	9

Concept of motifs and domains, Alpha-turn-alpha, beta-turn-beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, prediction of substrate binding sites. Tertiary structure: Domains, folding, denaturation and renaturation, Quaternary structure: Modular nature, formation of complexes.

UNIT – 3	PROTEIN STRUCTURE ANALYSIS	9

Primary structure: peptide mapping, peptide sequencing - automated Edman method & mass spec. Secondary structure: Ramachandran plot, Alpha, beta and loop structures and methods to determine Super-secondary structure - High-throughput protein sequencing setup - overview of methods to determine 3D structures - Computer exercise on the above aspects

UNIT – 4	STRUCTURE-FUNCTION RELATIONSHIP	9

DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp Repressor, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers. Membrane proteins: General characteristics, Trans-membrane segments, prediction, bacterio rhodopsin and Photosynthetic reaction center, Immunoglobulins: IgG Light chain and heavy chain architecture, abzymes and Enzymes: Serine proteases, understanding catalytic design by engineering trypsin, chymotrypsin and elastase, substrate-assisted catalysis other commercial applications. Computer exercise on the above aspects

UNIT – 5	INTRODUCTION TO PROTEOMICS	9

Introduction to the concept of proteome, components of proteomics, proteomic analysis, importance of proteomics in biological functions, protein-protein interactions and methods to study it: protein arrays, cross linking methods, affinity methods, yeast hybrid systems and protein arrays. Computer exercise on the above aspects

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1	Understand the role of functional proteins in various field of study	Understand
CO2	Practice the latest application of protein science in their research	Apply
CO3	Discriminate the various interactions in protein makeup	Analyze
CO4	Evaluate the protein-protein interactions.	Evaluate
CO5	Apply the gained knowledge in advanced studies of protein and their nature	Implement

TEXT BOOKS:

1. Branden C. and Tooze J., "Introduction to Protein Structured" 2nd Edition, Garland Publishing, 1999.
2. Creighton T.E. "Proteins" 2nd Edition. W.H. Freeman, 1993.
3. Pennington, S.R and M.J. Dunn, "Proteomics: Protein Sequence to Function". Viva Books, 2002.
4. Liebler, "Introduction to Proteomics" Humana Press, 2002.

REFERENCES:

1. Voet D. and Voet G., "Biochemistry". 3rd Edition. John Wiley and Sons, 2008.
2. Haggerty, Lauren M."Protein Structure: Protein Science and Engineering". Nova Science Publications, 2011.
3. Williamson, Mike "How Proteins Work". Garland Science, 2012

19UBT405	PRINCIPLES OF GENETICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Learn the fundamentals of genetics, Mendelian principle and its derivatives.
- Acquire the knowledge of chromosome structure and their functions.
- Understand the concepts of sex chromosome, links, disorders, gene mapping and regulations.

UNIT – 1	CLASSICAL GENETICS	9

Structure and Functions of DNA – Genomes - Mendel's principles and experiments - Sex Determination and Linkage – Pedigrees - Linkage and Mapping - Extensions of Mendelian genetics - Gene Interaction - Relationship of genotype to phenotype-variation in dominance patterns - Altered dihybrid ratios - Examples of gene interactions to produce variation in coat colour - Complementation test.

UNIT – 2	CHROMOSOME ORGANIZATION, LINKAGE AND CROSSING OVER	9

Chromosome structure and organization in prokaryotes and eukaryotes - Giant chromosomes – Polytene and Lampbrush – Deletion – Inversion – Translocation – Duplication - Variation in chromosomal numbers – Aneuploidy – Euploidy – Polyploidy - Ames test – Karyotyping - Linkage, Crossing over – cytological basis of crossing over, chromosome mapping – two and three factor cross – interference, somatic cell hybridization

UNIT – 3	MECHANISMS OF GENETIC EXCHANGE - PROKARYOTES	9

Plasmids: molecular properties, plasmid stability, plasmid incompatibility groups - Mechanisms of Gene-Exchange: sexual reproduction - transformation - conjugation: Mechanism of conjugation, F plasmid, phage lambda - lytic and lysogenic cycles, host-controlled restriction modification system, complementation of rII mutants of T4 - transduction: generalised - specialised transduction and their importance - Horizontal Gene Transfer.

UNIT – 4	MECHANISMS OF GENETIC EXCHANGE – EUKARYOTES	9

Recombination: Mechanisms - Breakage and reunion of DNA molecules, Chiasmata, Holliday model, Enzymatic mechanism of recombination - Transposable Elements: The discovery (McClintock's Experiment) – Insertion sequences, transposons, and integrons - Transposition: Structure of transposons and target-sites, Replicative transposition, Non-replicative transposition, Excision and transposase-mediated rearrangements, Regulation of transposition (Phage Mu), Transposon insertions - Use of transposons as portable regions of homology: Local mutagenesis, Chromosomal rearrangements, In vivo cloning - Transposons and evolution.

UNIT – 5	MUTATION GENETICS & POPULATION GENETICS	9

Mutation Genetics: Occurrence, Selection and Induction, Mutation Breeding - Mechanisms of Gene Mutation: Molecular basis of gene mutations, Spontaneous mutations, Induced mutations, Reversion analysis, Relation between mutagens and carcinogens

Population Genetics: Genotypes and phenotypic distribution - Heritability of a trait, Quantifying heritability - Variation and its modulation, Effect of sexual reproduction on variation, Sources of

variation, Selection, Artificial selection, Random events - Process of speciation, Origin of new genes, Rate of molecular evolution.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1	Describe the Mendelian's laws and their interactions, gene arrangement in chromosomes and their physical importance.	Understand
CO2	Illustrate Menedelian's principles, sex influence, linkage and mutations	Apply
CO3	Infer the results of genetic experiments in animal and plant model systems.	Analysis
CO4	Examine gene arrangement in chromosomes and their physical importance in terms of distance as evident by mapping	Evaluate
CO5	Manipulate genetic material by modern tools with the help of knowledge gained	Modern Tool Usage

TEXT BOOKS:

1. Snustad D.P. and Simmons M.J., "Principles of Genetics", Wiley, 6th Edition, 2011.
2. Brown T.A. "Introduction to Genetics: A Molecular Approach", Garland Science, 1st Edition, 2011.
3. Elrod S. and Stansfield S., "Schaum's Outline of Genetics", Schaum's Outlines, 5th Edition, 2010

REFERENCES:

1. Klug, W.S. and Cummings, M.R., "Concepts of Genetics", Pearson Education, New Delhi, 2003.
2. Elrod S. and Stansfield S., "Schaum's Outline of Genetics", Schaum's Outlines, 5th Edition, 2010.
3. Gardner, E.J, Simmons, M.J, and Snustad, D.P., "Principles of Genetics",8th Edition, John Wiley & Sons, Singapore, 2003.
4. Strickberger, M.W., "Genetics", 3rd Edition, Prentice Hall of India, New Delhi, 2008.

21UBT406	CHEMICAL ENGINEERING LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to:

- Understand practically the basic chemical engineering principles and operations.
- Apply the concepts of chemical engineering for the understanding and the development of bioprocesses.

LIST OF EXPERIMENTS:

1. Laboratory regulations and safety precautions.
2. Flow measurement - Orifice meter.
3. Flow measurement – Venturimeter.
4. Flow measurement – Rotameter.
5. Pressure drop in flow through annular pipe.
6. Pressure drop in flow through fluidized beds.
7. Heat transfer characteristics in Shell and Tube heat exchanger.
8. Heat transfer characteristics in Parallel flow heat exchangers.
9. Heat transfer characteristics in Counter flow heat exchangers.
10. Particle Size Reducion by Ball mill.
11. Filtration through plate and frame filter press.
12. Filtration using leaf filter.
13. Simple and steam distillation.

TOTAL : 45 PERIODS

EQUIPMENTS REQUIREMENT:

Sl. No.	Name of the equipment	Quantity required
1.	Orifice meter	1
2.	Venturimeter	1
3.	Rotameter	1
4.	Annular pipes	1
5.	Fluidized bed	1
6.	Shell and Tube heat exchanger	1
7.	Parallel and counter flow heat exchanger	1
8.	Ball mill	1
9.	Plate and frame filter press	1
10.	Filter leaf	1
11.	Distillation unit	1

Glassware, Chemicals, Media as required

COURSE OUTCOMES:

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

CO1	Operate flow measurement devices, heat exchangers, filters and distillation unit	**Understand**
CO2	Analyze the experimental data and interpret necessary process	**Analyze**

	parameters controlling a reaction	
CO3	Optimize the design and working principle of various Unit operations.	**Apply**

TEXT BOOKS;

1. Geankoplis C.J. "Transport Processes and Unit Operations", Prentice Hall India, 4th Edition, 2004.
2. Mccabe& Smith "Unit Operations of Chemical Engineering", McGraw Hill, 7th Edition, 2017.
3. Brown G.G., "Unit Operations", CBS, 1st Edition, 2005.

21UBT407	INSTRUMENTAL METHODS OF ANALYSIS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to:

- Practice and visualize the theory concepts of instrumental analysis.
- Gain practical knowledge and interpretation on qualitative and quantitative analysis of different molecules.

LIST OF EXPERIMENTS:

1. Precision and validity of absorption spectrophotometer.
2. Experiment on verification of Lamberts-Beer law
3. Experiment to find maximum absorbance wavelength in spectrometer
4. Separation of microbial cells by differential centrifugation.
5. Separation technique-Thin Layer Chromatography.
6. Separation technique-Column Chromatography
7. Estimation of $Al3^{+}$ by flourometry
8. Estimation of sulphate ions by nephelometry.
9. Chemical Actinometry using potassium ferrioxolate.
10. Separation of proteins by SDS electrophoresis.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- Demonstrate various quantitative analysis of molecules in given samples.
- Analyse the biomolecules using separation technology.
- Evaluation of ions for the study of physical characteristics.

EQUIPMENTS REQUIREMENT:

Sl. No.	Name of the equipment	Quantity required
1	Spectrophotometer	1
2	Colorimeter	2
3	Centrifuge	1
4	Nephelometry	1
5	Thin Layer Chromatography	5
6	Column Chromatography	5
7	SDS – PAGE Unit	1

Glassware, Chemicals, Media as required

TEXT BOOKS

1. Skoog, D.A. et al. “Principles of Instrumental Analysis”, V Edition, Thomson / Brooks – Cole, 1998.
2. Braun, R.D. “Introduction to Instrumental Analysis”, Pharma Book Syndicate, 1987.
3. Willard, H.H. et al. “Instrumental Methods of Analysis”, VI Edition, CBS, 1986.
4. Ewing,G.W. “Instrumental Methods of Chemical Analysis”, V Edition, McGraw-Hill, 1985.

SEMESTER - V

21UBT501	MOLECULAR BIOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should gain knowledge and understand

- Molecular mechanism of DNA and RNA synthesis and Protein synthesis
- Mechanisms of central dogma of life
- Role of the nucleic acids in gene expression and its regulation

UNIT – 1	INTRODUCTION TO MOLECULAR BIOLOGY	9

Scope and history - Structure of DNA - Nucleoside – Nucleotide - Base pairing – Base stacking - Double helix - Features of Watson and crick model - Major and minor groove - Supercoiling – Twist - Writhe and linking number - Conformational variants of double helical DNA - Structure and function of RNAs — mRNA- rRNA— tRNA –Secondary structures in RNA-Organization of bacterial, viral and eukaryotic chromosome.

UNIT – 2	REPLICATION AND REPAIR	9

Types and functions of DNA polymerases in prokaryotic and eukaryotic replication and proof-reading activity-5'-3'exonucleaseactivity-Topoisomeraseactivity-Telomeric DNA replication - Plasmid replication - theta model - Strand displacement model and Rolling circle model– Bidirectional — Unidirectional – DNA repair – Nucleotide excision repair – Mismatch repair - Photo-reactivation – Recombination repair - SOS repair.

UNIT – 3	TRANSCRIPTION	9

RNA polymerases in prokaryotic and eukaryotic cells - Types and their function -Promoters and transcription factors - Transcription of mRNA, rRNA, and tRNA genes in prokaryote and eukaryote – Processing — Fine structure of prokaryotic and eukaryotic genes-Post translational processing of eukaryotic mRNA.

UNIT – 4	TRANSLATION	9

Genetic code and wobble hypothesis - Process of translation in prokaryotes and eukaryotes - Inhibitors of protein synthesis – Post translational modifications –Protein transport and trafficking in prokaryotic and eukaryotic cells.

UNIT – 5	REGULATION OF GENEEXPRESSION	9

Regulation of Gene expression in Prokaryotes: Operon concept (Lac and Trp) –Regulation of Gene expression in Eukaryotes – Transcriptional activation – Galactose metabolism in yeast.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will able to

CO1	Describe the composition, structures, functions and internal controls within individual cells, explain the principal molecular events of cell incorporating DNA Replication, Transcription and Translation in prokaryotic and eukaryotic organisms and regulation mechanisms.	Understand
CO2	Correlate DNA based technologies for innovations by clarify the nature of genes and sources of variation	Apply

CO3	Analysis of DNA and proteins in a comprehensive view of patterns of variation, common ancestry, and how evolution works.	Analyze
CO4	Evaluate the complexities involved in regulatory pathways during gene expression.	Evaluate
CO5	Gain ideas to use modern tools for the study of prokaryotic and eukaryotic organisms at molecular level.	Create

TEXT BOOKS:

1. Lodish; Arnold Berk; Chris A. Kaiser; Monty Krieger; Anthony Bretscher; Hidde Ploegh;'' Molecular Cell Biology'', IX edition,2021.
2. ''Molecular Biology of the Gene VIII'' by Benjamin Lewin, James D. Watson, Stephen P.Bell, Alexander Gann, Michael Levine, Richard Losick.

REFERENCES:

1. Karp,Gerald"Cell and Molecular Biology: Concepts and Experiments" IV Edition, John Wiley, 2005.
2. Friefelder, David."Molecular Biology."Narosa Publications, 1999.
3. Tropp, BurtonE."Molecular Biology: Genes to Proteins". II Edition. Jones and Bartlett, 2008.
4. Glick, B.R. and J.J.Pasternak. "Molecular Biotechnology: Principles and Applications of Recombinant DNA" 4thEdition. ASM, 2010.

21UBT502	BIOPROCESS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Provide the students with the basics of bioreactor engineering and acquire the concepts involved in the scale up of the reactors.
- Gain knowledge about reactor systems for immobilized enzymes and develop bioengineering skills for the production of biochemical product using integrated biochemical processes.

UNIT – 1	CONFIGURATION OF BIOREACTORS	9

Stirred Tank Reactor - Non-ideal behavior — RTD - Tanks-in-series and dispersion models - Application to design of continuous sterilizers - Fed batch cultivation – Cell recycle cultivation and its usage in waste water treatment- Two stage cultivation – Packed bed reactor-Air lift reactor - Fluidized bed reactor-Bubblecolumnreactors-
Stability analysis of bioreactors.

UNIT – 2	SCALE-UP OF BIOREACTORS	9

Regime analysis of bioreactor processes - Oxygen mass transfer in bioreactors –Microbial oxygen— Demands-Methods for the determination of mass transfer coefficients-Mass transfer correlations-Scale up criteria for bioreactors based on oxygen transfer –Power consumption-Impeller tip speed.

UNIT – 3	MODELLING AND SIMULATION OF BIOPROCESSES	9

Studyofstructuredmodelsforanalysisofvariousbioprocess-Compartmentalmodels - Models of cellular energetics and metabolism - Single cell models - Plasmidreplication-Plasmidstabilitymodels-Dynamicsimulationofbatch,fedbatch,steady
- Transientculturemetabolism- ModelsimulationusingMATLAB-SIMULINK.

UNIT – 4	BIOREACTOR CONSIDERATION IN ENZYME SYSTEMS	9

Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions — Formulation of dimensionless groups and calculation of effectiveness factors -Design of immobilized enzyme reactors - Packed bed - Fluidized bed – Membrane reactors.

UNIT – 5	LARGE SCALE CULTIVATION OF CELLS	9

Different host vector system for recombinant cell cultivation strategies and its advantages - *E.coli*- yeast *Pichiapastoris*/ *Saccharomyces cereviseae*- Animal cell cultivation-Plant cell cultivation-Insect cell cultivation-High cell density cultivation - Process strategies - Reactor considerations in the above system.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will able to

CO1	Select appropriate bioreactor configurations and operation modes based upon the nature of bio-products and cell lines and other process criteria	Understand
CO2	Justify the mass transfer significance in designing of immobilized enzymes-based reactors	Apply
CO3	Design the scaled-up reactors based on power, oxygen transfer and mixing time.	Analysis

CO4	Integrate research lab and Industry; identify problems and seek practical solutions for large-scale implementation of Biotechnology	Evaluate
CO5	Use modeling and simulation of bioprocesses so as to reduce costs and enhance the quality of products and systems	Create

TEXT BOOKS:

1. Pauline,D.,"BioprocessEngineeringPrinciples",Elsevier,2ndEdition,2012.
2. Shuler,M.L.,KargiF.,"BioprocessEngineering",PrenticeHall,2ndEdition,2002.

REFERENCES:

1. James. E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
2. Stanbury,P.F.,StephenJ.H.,WhitakerA.,"PrinciplesofFermentationTechnology",Elsevier, 2ndEdition,2009.
3. Lydersen,B.K.,"BioprocessEngineeringSystems,EquipmentandFacilities"Wiley-India,1stEdition,2010.
4. HarveyW.Blanch,DouglasS.Clark,BiochemicalEngineering,MarcelDekker,Inc.

21UBT503	ENZYME ENGINEERING AND TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Learn enzyme reactions and its kinetics.
- Acquire knowledge about the enzyme production and purification process.
- Understand enzyme immobilization techniques and bio-sensors.

UNIT – 1	INTRODUCTIONTOENZYMES	9

Classification of enzymes - Mechanisms of enzyme action - Concept of active site andenergeticsofenzymesubstratecomplexformation-Specificityofenzymeaction-Principlesofcatalysis—Collisiontheory-Transitionstatetheory-Roleofentropyin catalysis.

UNIT – 2	ENZYMEKINETICS	9

Kinetics of single substrate reactions - Estimation of Michaelis-Menten parameters – Lineweaver-Burk Plot - Eadie-Hofstee plot - Hanes-Woolf plot — Multi-substrate reactions - Introduction to ping-pong bi-bi mechanism — Random order mechanism and compulsory order mechanisms - Turnover number - Types of inhibition & models for substrate and product – Allosteric regulation of enzymes - Monod-Changeux-Wyman model – pH and temperature effect on enzymes-Deactivation kinetics.

UNIT – 3	ENZYME IMMOBILIZATION	9

Physical and chemical techniques for enzyme immobilization — Adsorption – Matrix entrapment — Encapsulation - Cross-linking – Covalent binding –Matrix used in immobilization – Advantages and disadvantages – Application of immobilized enzymes - Mass transfer effect on immobilization – Properties of immobilized enzymes.

UNIT – 4	PRODUCTION, PURIFICATION AND CHARACTERIZATION OF ENZYMES	9

Production and Extraction of crude enzymes from various sources like plant, animal and microbial sources — Purification-Criteria of purity — Precipitation - Dialysis and Chromatography techniques-Determination of molecular weight of enzymes – PAGE – X- ray spectroscopy - Enzyme assays-Case study - Pectinases and amylases.

UNIT – 5	ENZYME BIOSENSORS	9

Application of enzymes in analysis - Principles of electrochemistry-Design of enzyme electrodes and their application as biosensors in industry, healthcare, food and environment.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will able to

CO1	Describe enzyme classification, enzyme reaction mechanisms and kinetics with production and purification techniques.	Understand
CO2	Apply the kinetics of enzyme reaction, the ways of its inhibition and pH and temperature effects on enzyme reactions on production and purification techniques.	Apply

CO3	Analyze fundamental concepts of enzyme immobilization along with its properties and the mass transfer effects on immobilized enzymes.	Analysis
CO4	Summarize the production, purification strategies, characterize enzymes and find method to enhance it.	Evaluate
CO5	Implement the knowledge for the production enzyme biosensors.	Create

TEXT BOOKS:

1. Palmer,T., Enzymes: Biochemistry Biotechnology and Clinical Chemistry, East WestPressPvtLtd,NewDelhi,2ndEdition,2007
2. Chaplin,M.andBucke,C.EnzymeTechnology,1stEdition,CambridgeUniversityPress, London, 1st Edition, 1990

REFERENCES:

1. Harvey W.Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.
2. James M. Lee, Biochemical Engineering, PHI, USA.
3. James.E. Bailey & David F.Ollis, Biochemical Engineering Fundamentals, McGraw-Hill.
4. Wiseman, Enzyme Biotechnology, Ellis Horwood Pub.

21UBT504	HEAT TRANSFER AND MASS TRANSFER OPERATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand various modes of heat transfer operations and its mechanisms.
- Understand various types of heat exchanger and evaporators and its principles.
- Acquire knowledge on fundamentals of mass transfer operations and techniques involved in diffusion, convective mass transfer, drying and crystallization.

UNIT– 1	PRINCIPLES OF HEAT TRANSFER	9

Introduction to various modes of heat transfer — Conduction - Steady state conduction -Combined resistances - Unsteady state conduction - Lumped heat capacity – Extended surfaces-Convection-Dimensional analysis – Forced and natural convection - Convection in flow over surfaces through pipes, boiling and condensation – Combined conduction and convection-Introduction to radiation heat transfer – Stephen Boltzmann Law - Emissivity and Kirchhoff law – Concept of grey body-Emissive power calculation.

UNIT– 2	HEAT TRANSFER OPERATIONS	9

Heat Exchangers - Flow patterns in Heat Exchangers — Types of heat exchangers – LMTD calculation - LMTD correction factors - Overall heat transfer coefficients - Design of heat exchangers – Heat exchanger effectiveness – NTU concept – Fouling factor – Evaporators: natural, forced circulation and agitated film evaporators, Methods of operation of evaporators, single-effect and multiple-effect evaporators, Evaporation of Biological materials – Fruit juices, sugar solution and paper – Pulp waste liquors – Mass and enthalpy balances.

UNIT– 3	PRINCIPLES OF MASS TRANSFER	9

Introduction to Mass transfer and diffusion – Fick's law for molecular diffusion — Molecular diffusion in gases, liquid and solids - Introduction to convective mass transfer – Convective mass transfer coefficients – Analogy between Mass, Heat and momentum transfer.

UNIT– 4	GAS LIQUID AND VAPOUR LIQUID OPERATIONS	9

Absorption-Principles of gas absorption—Single and Multi-component absorption-Absorption with Chemical Reaction – Design principles of absorbers – Industrial absorbers HTU, NTU concepts - V-L Equilibria – Distillation – Types of distillation –Simple, Steam, Vacuum, Continuous distillation - McCABE-THIELE & ONCHON-SAVARIT Principles-Industrial distillation equipment (PackedBed) - HETP, HTU and NTU concepts.

UNIT– 5	LIQUID-LIQUIDAND SOLID-LIQUIDOPERATIONS	9

L-L equilibria — Batch and Continuous extractions - Solid-liquid equilibria – Leaching Principles - Adsorption equilibria — Batch and fixed bed adsorption - Drying - Batch and continuous dryers – Rate of Drying curves – Freeze drying and Sterilization of Biological materials – Crystallization theory - Equipment's for crystallization, Tank, DTB Crystalliser, circulating – Magma vacuum crystallizer – Swenson walker crystalliser.

TOTAL:45PERIODS

COURSEOUTCOMES:
At the end of the course the student will be able to:

CO1	Understand basis of heat transfer and mass transfer operations	Understand
CO2	Apply concepts of evaporation, heat exchangers and design the respective equipment.	Apply
CO3	Analyze mass transfer coefficients for gas, liquid contacting systems.	Analysis
CO4	Evaluate the number of stages for distillation and absorption column for an industrial usage	Evaluate
CO5	Implement the learnt concepts to solve the problems related to extraction, leaching, adsorption and drying.	Implement

TEXTBOOKS:

1. Treybal,R.E.-MassTransferOperations-McGrawHill,NewDelhi-3rdEdition-1981
2. Geankoplis,C.J.-TransportProcessesandUnitOperations-PrenticeHallofIndia, NewDelhi-3rdEdition-2002.

REFERENCES:

1. Coulson,J.M.,Richardson,J.F.,Backhurst,J.R.,Harker,J.M.,CoulsonandRichardsons Chemical Engineering - Volume II - Butter worth Heinemann, Oxford-5thEdition-2002.
2. McCabe and Smith, Unit Operations of Chemical Engineering, 7th Edition, McGrawHill,2009.
3. K.V.NarayananandLakshmikutty,ChemicalProcessCalculations,PrenticeHall, 2004.

21UBT505	MOLECULARBIOLOGYLABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to:

- Acquire skills required for handling and isolation of DNA.
- Understand the chemical, biochemical and biophysical characteristics of DNA.
- Understand in overall the different methodologies in molecular biology.

LIST OFEXPERIMENTS:

1. Isolation of genomic DNA from bacteria
2. Plasmid DNA isolation
3. Purity analysis of isolated plasmid DNA using spectrophotometer
4. DNA characterization by Agarose gel electrophoresis (AGE)
5. Restriction digestion of Plasmid DNA
6. Ligation of digested DNA
7. Competent Cell Preparation
8. Transformation and recombinant selection
9. Polymerase Chain Reaction
10. Elution of DNA from agarose gels

TOTAL:45PERIODS

COURSEOUTCOMES:

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

- Gain the technical skills involved in extraction, manipulation of biomolecules and identification of gene and its expressions.
- Apply the isolation and transformation techniques for the development of new research.
- Analyze nucleic acids and its characteristics so as to study the gene variations
- Gain knowledge to undertake research projects in the area of modern biology

EQUIPMENTSREQUIREMENT:

Sl.No.	Name of the equipment	Quantity required
1	Spectrophotometer	2
2	Light Microscopes	4
3	Incubator Shaker	1
4	Incubators	1
5	Thermocycler	1
6	Laminar Flow Chamber	1
7	Electrophoresis set up and Gel doc	2

Glasswares, Chemicals, Media as required and DNA kits

TEXT BOOKS:

1. Sambrook et al., “Molecular Cloning” A Laboratory Manual.
2. Berger S.l., Kimmer A.R.,“Methods in Enzymology -Volume152”, Academic Press, 1st Edition,1987.

21UBT506	BIOPROCESS PRINCIPLES LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to:

- Develop knowledge and skills in enzyme characterization, immobilization
- Develop their knowledge and skills in optimizing the medium and process parameters for the effective fermentation process.

LIST OFEXPERIMENTS:

1. Enzyme kinetics–Determination of Michaelis-Menten parameters
2. Enzyme activity–Effect of Temperature and pH
3. Enzyme activity–Deactivation Kinetics
4. Enzyme inhibition kinetics
5. Enzyme immobilization–Gel entrapment
6. Enzyme immobilization–Cross-linking
7. Enzymatic conversion in Packed bed Column
8. Growth of Bacteria – Estimation of Biomass, Calculation of Specific Growth Rate, Yield Co-efficient.
9. Preparation of fungal biomass by solid state fermentation.
10. Optimization by Plackett-Burman Design
11. Optimization by Response Surface Methodology.

TOTAL:45PERIODS

COURSEOUTCOMES:

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

- Understand the concepts of enzyme immobilization.
- Illustrate practical skill in solid state fermentation
- Developanoptimaldesignofmediumandprocessparametersformicrobialgrowthandproductproduction.
- EvaluateenzymekineticparametersandoptimizethespecificactivityonpHand temperature.

EQUIPMENTS REQUIREMENT:

Sl. No.	Name of the equipment	Quantity required
1	Light Microscope	2
2.	Shaking incubator	2
3.	Autoclave	1
4.	Laminar Air Flow	1
5.	Centrifuge	1
6.	pH meter and Thermometer	1
7.	Micro-pipettes and tips	1
8.	Distillation Unit	1
9.	Inoculation loop, L-rod	1
10.	Gas Burner.	1

SEMESTER – VI

19UBT601	GENETIC ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To discuss the gene cloning methods and the tools and techniques involved in gene cloning and genome analysis and genomics.
- To explain the heterologous expression of cloned genes in different hosts to produce a recombinant protein product.
- To gain knowledge on various recombinant DNA techniques and their applications

UNIT – 1	BASICS OF RECOMBINANT DNA TECHNOLOGY	9

Introduction about milestones in Genetic Engineering - Manipulation of DNA - Restriction and Modification enzymes - RFLP and RFLP markers - Characteristics of cloning vector – Plasmid-transcription and translation vectors - Design of linkers and adaptors – Homopolymeric tailing.

UNIT – 2	DNA LIBRARIES & SEQUENCING	9

Construction of genomic and cDNA libraries - Artificial chromosomes – BACs and YACs - Chromosomal walking - Screening of DNA libraries using nucleic acid probes and antisera - Southern blotting - Western blotting - Yeast di and trihybrid system. Maxam Gilbert's, Sanger's methods of DNA sequencing and modern automated DNA sequencing principles.

UNIT – 3	AMPLIFICATION OF DNA	9

Development of mutants - Single and multiple point mutations by primer extension - PCR mediated mutations - Kunkel method of mutagenesis - Random mutagenesis - Phage display Hot start PCR - Inverse PCR - Nested PCR - FRET principle - Real-time PCR/qPCR – SYBR green assay - Taqman assay and Molecular beacons.

UNIT – 4	PROKARYOTIC AND EUKARYOTIC EXPRESSION VECTORS	9

Bacteriophage vectors – Cosmid – Phasmid - Modern prokaryotic T7 expression vectors - Heterologous expression in eukaryotes - Eukaryotic Expression vector - Insect, Yeast and Mammalian vectors - Viral vectors used for gene therapy. Case study: TOPO vector- Vector Map

UNIT – 5	APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY	9

DNA fingerprinting - Gene silencing - RNAi and gene knockout - Site directed mutagenesis - Genome editing - CRISPR-Cas9 technology - TALEN tool - Modern molecular diagnostic tools - Q –PCR - Spectral karyotype Imaging – MPLA - Application of genetically modified organisms in medicine and agriculture - Biosafety guidelines and release procedure for GMOs in India - Case study: BT cotton - Safety issues

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1	Enumerate the basic concepts in recombinant DNA technology	Remember
CO2	Characterize the clones using the variety of screening techniques	Understand
CO3	Perform the cloning techniques of a gene of interest and what are	Apply
CO4	Correlate the significance and power of recombinant DNA technology within the constraints of environmental and ethical consequence of practicing Genetic engineering.	Analyze
CO5	Measure the parameters to be considered while designing a cloning strategy.	Evaluate
CO6	The importance of PCR in cloning, diagnosis and mutant generation including the development of high value products.	Create

TEXT BOOKS:

1. Primrose S.B., Twyman R.M., "Principles of Gene Manipulation, An Introduction To Genetic Engineering ", Blackwell Publishing Professional, 7th Edition, 2006.
2. Primrose S.B., Twyman R.M., "Principles of Genome Analysis and Genomics", Wiley Blackwell, 3rd Edition, 2002.

REFERENCES:

1. Ansubel F.M., Brent R., Kingston R.E., Moore D.D., "Current Protocols In Molecular Biology" John Wiley & Sons, LSLF Edition, 2004.
2. Berger S.l, Kimmer A.R., "Methods in Enzymology-Vol 152", Academic Press, 1987.
3. Krebs J.E., Goldstein E.S., Kilpatrick S.T., "Lewin's Gene XI", Jones & Bartlett Learning; 11th Edition, 2012.
4. Brown T.A., "Genomes 3", CBS Publishers & Distributors-New Delhi, 3rd Edition, 2006.

19UBT602	IMMUNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To discuss the structure, functions and integration of immune system.
- To explain the antigen-antibody interactions and how the immune system is protecting the body from foreign pathogens/germs.
- To explain various techniques of monoclonal and engineered antibodies (important therapeutic molecules) production, for treating most of the human diseases

UNIT – 1	INTRODUCTION TO IMMUNE SYSTEM	9

Organisation and classification of immune system – Immune cells and organs - Innate and acquiredimmunity - Toll receptors and responses - Classification of antigens – Chemical and molecularnature – Haptens – Adjuvants – Cytokines - Complement pathway - Antigen presenting cells – Major histocompatibility complex

UNIT – 2	MECHANISM OF CELL MEDIATED IMMUNITY	9

Development – Maturation – Activation – Regulation - Differentiation and classification of T-cells and B-cells - Antigen processing and presentation - Theory of clonal selection – TCR – Antibodies: structure and functions – Genes and Generation of diversity - Antigen-antibody reactions - Regulation of T-cell and B-cell responses

UNIT – 3	IMMUNITY AGAINST PATHOGENS AND TUMORS	9

Inflammation - Protective immune responses to virus, bacteria, fungi and parasites - Tumor antigens - Tumor immune response - Tumor diagnosis - immuno surveillance, immunoediting and immunotherapy – cytokines.

UNIT – 4	IMMUNE TOLERANCE AND HYPERSENSITIVITY	9

Immune tolerance - Immuno deficiencies - Transplantation – Genetics of transplantation - Laws of transplantation - Allergy and hypersensitivity – Types of hypersensitivity – Autoimmunity – Autoimmune disorders and diagnosis.

UNIT – 5	APPLIED IMMUNOLOGY	9

Monoclonal antibodies – Antibody based drugs - Engineering of antibodies - Classification of Vaccines - Methods of vaccine development - Immunodiagnostic methods (Immuno diffusion, ELISA, FACS) – Immunemodulatorydrugs.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1	Comprehend the general concepts of immune system and elaborate the cells and organs of the immune system.	Understand
CO2	Apply the concept of immunology in vaccine development and treatment of infectious disease	Apply
CO3:	Interpret the properties of antigens and antibodies with special emphasis on haptens.	Analyze
CO4:	Examine various antigen-antibody interactions and techniques.	Evaluate
CO5:	Illustrate the mechanisms behind hypersensitivity and autoimmunity mechanisms.	Create

TEXT BOOKS:

1. Kuby J., "Immunology", WH Freeman & Co., 8th Edition, 2018.
2. Peter J Delves, Seamus J Martin, Dennis R Burtn and Ivan M Roitt., Roitts Essential Immunology, 13th Edition, Wiley –Blackwell, 2016.
3. Judith a Owen, Jenni Punt and Sharon A Stranford, Kuby Immunology, Macmillan Internation, 7th Edition, 2012

REFERENCES:

1. Coico, Richard "Immunology: A Short Course" VIth Edition. John Wiley, 2008.
2. Khan, FahimHalim "Elements of Immunology" Pearson Education, 2009.
3. Christine D., "Clinical Immunology and Serology: A laboratory Perspective"; F.A. Davis Co.; Philadelphia 2nd Edition, 2003
4. Ashim K. Chakravarthy, Immunology, Tata McGraw-Hill, 2006

19UBT606	GENETIC ENGINEERING LABORATORY	L	T	P	C
		3	0	2	1.5

OBJECTIVES:

The student should be made to:

- Provide hands-on experience in performing basic recombinant DNA techniques.
- Realize the importance of the tools of Genetic Engineering for the development of commercially important products
- Learn the implications of genetically modified organisms on environment (GMOs)..

1. Isolation of RNA and cDNA synthesis
2. Mini scale Isolation of Plasmid DNA – Alkaline lysis method
3. Design of primers and PCR of target DNA
4. Cloning of gene in cloning vectors and transformation into E. coli.
5. Analysis of recombinants by blue white selection and restriction analysis.
6. IPTG induction of recombinant proteins and identification of induced protein by SDS PAGE using coomassie brilliant blue.
7. Western blotting.
8. Restriction Fragment Length Polymorphism (RFLP)
9. Colony lysate PCR.
10. Southern Blotting.

TOTAL : 45 PERIODS

COURSE OUTCOMES

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

- Describe the principles of methods for isolation, cloning and separation of DNA from various organisms.
- Express clearly about the gene amplification and methods for analysis of DNA, such as hybridization, restriction analysis and gene expressions.
- Interpret the analytical results from the conducted experiment with their gained knowledge
- Apply the genetic engineering tools to produce products beneficial in agriculture and healthcare
- Learn the ethical and biosafety issues and consequences while performing experiments in the Laboratory

EQUIPMENTS REQUIREMENT:

Sl. No.	Name of the equipment	Quantity required
1.	Gel - Documentation	2
2.	Electrophoresis Kit	2
3.	Blotting unit	1
4.	Shaking incubator	2
5.	Autoclave	1
6.	Laminar Air Flow	1
7.	Centrifuge	1

8.	pH meter and Thermometer	1
9.	Micro-pipettes and tips	1
10.	Distillation Unit	1
11.	Inoculation loop, L-rod and Gas Burner.	1
12.	Magnetic stirrer with beads	2
13.	Heating mantle and Cyclomixer	2
14.	Weighing balance and Gel rocker	1
15.	Refrigerator (4°C)	1
16.	-20°C Deep freezer	1
17.	Hot air oven	1
18.	UV-Visible Spectrophotometer	1
19.	Thermocycler	1

Glassware, Chemicals, Media and experimental kits as required

TEXT BOOKS

1. Sambrook J., David W.R., "The Condensed Protocols: From Molecular Cloning: A Laboratory Manual" Cold Spring Harbor, 4th Edition, 2012.
2. Frederick M.A., Roger B., Robert E. K.,, David D. M.,, Seidman J.G., John A.S., Kevin S., "Short protocols in molecular biology- Volume I &II", Wiley & sons, 5th Edition, 2002.
3. Berger Sl, Kimmer AR, "Methods In Enzymology", Vol 152, Academic Press, 1987

19UBT607	BIOPROCESS ENGINEERING LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to:

- Learned about mass transfer in bio reactors and sterilization kinetics
- Acquire skills and gain knowledge in bioprocesses and handling bioreactors useful for solving problems typical for the bio-industry or for research.

LIST OF EXPERIMENTS

1. Batch Sterilization kinetics
2. Batch cultivation and Estimation of K_La – Dynamic Gassing-out method,
3. Estimation of K_La – Sulphite Oxidation Method
4. Estimation of K_La – Power Correlation Method
5. Fed batch cultivation and Total cell retention cultivation
6. Continuous cultivation – experimental set up
7. Bioreactor with immobilized biocatalyst
8. Photobioreactor
9. Residence time distribution
10. Estimation of Overall Heat Transfer Coefficient
11. Estimation of Mixing Time in reactor

TOTAL : 45 PERIODS

COURSE OUTCOMES

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

- Gain ability to investigate, design and conduct experiments, analyze and interpret data, and apply the laboratory skills to solve complex bioprocess engineering problems.
- Become creative, innovative and adaptable engineers as leaders or team members in their organizations and society.
- Perform competently in chemical and bioprocess industries and become important contributors to national development.
- Demonstrate advancement in their careers through increasing professional responsibility and continued life-long learning.

EQUIPMENTS REQUIREMENT:

Sl. No.	Name of the equipment	Quantity required
1.	Reactors	2
2.	Electrophoresis Kit	2
3.	Light Microscope	2
4.	Shaking incubator	2
5.	Autoclave	1
6.	Laminar Air Flow	1
7.	Centrifuge	1
8.	pH meter and Thermometer	1
9.	Micro-pipettes and tips	1
10.	Distillation Unit	1
11.	Inoculation loop, L-rod and Gas Burner.	1
12.	Magnetic stirrer with beads	2
13.	Heating mantle	2
14.	Weighing balance	1
15.	Refrigerator (4°C)	1
16.	-20°C Deep freezer	1
17.	Hot air oven	1
18.	UV-Visible Spectrophotometer	1
19.	Cyclomixer (Vortex)	1

Glassware, Chemicals, Media as required

TEXT BOOKS

1. Anton Moser, "Bioprocess Technology, Kinetics and Reactors", Springer Verlag.
2. James E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
3. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Decker Inc.

Stanbury P.F., Stephen J.H., Whitaker A., "Principles of Fermentation Technology", Science & Technology Books, 2nd Edition, 2009.

19UBT608	PRODUCT DEVELOPMENT PROJECT	L	T	P	C
		0	0	8	4

OBJECTIVE:

To develop competency with a set of tools and methods for product design, manufacturing and marketing functions in creating a new product.

Project Description:

Product development is the process of delivering a new product or improving and existing product for customers. This course helps students to convert an idea into a product. Eight periods per week will be allotted in the time table and this time shall be utilized by the students to receive directions from the guide, for library reading, laboratory work, computer analysis and field work as assigned by the guide. There shall be periodical seminar presentations about the progress made in the project. The progress of the project is evaluated based on a minimum of three reviews. The student should submit the report at the end of the semester. The product should be demonstrated at the time of examination. At the end of the project period, the marks shall be awarded by the same committee for the report and viva-voce.

COURSE OUTCOMES:

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

CO1	Design and develop sustainable innovative solutions for societal issues with consideration for public health, safety and environment.	**Create**
CO2	Analyze the market potential and evolve the product strategy	**Analyze**
CO3	Apply modern engineering and IT tools, algorithms, techniques to provide valid conclusion following the norms of engineering practice	**Apply**
CO4	Test and evaluate the performance of the developed innovative product using appropriate techniques and tools	**Evaluate**
CO5	Organize effectively as a team for executing the project	**Organize**
CO6	Write effective reports and make clear presentations	**Respond**

SEMESTER – VII

21UBT701	DOWNSTREAM PROCESSING	L	T	P	C
		3	0	2	4

OBJECTIVES:

The student should be made to:

- Apply the fundamental concepts of bio separation engineering
- Learn and design a downstream processing for product isolation and purification
- Recognize and troubleshoot problems associated with purification of bio products.

UNIT – 1	INTRODUCTION	15

Introduction to downstream processing – Principles and characteristics of bio-molecules and bioprocess - Cell disruption for intracellular product release – Mechanical, enzymatic and chemical methods - Pre-treatment and stabilization of bio-products.

Case study - Cell disruption by ultracentrifugation, chemical and Enzymatic methods

UNIT – 2	PHYSICAL METHODS OF SEPARATION	15

Unit operations for solid-liquid separation – Filtration: Depth & cross flow, Theory of Filtration for incompressible and compressible cakes, Equipment for batch and continuous Filtration – Centrifugation: Laboratory and preparative centrifuges, Differential and density gradient centrifugation – Flocculation – Sedimentation.

Case study - Ultra filtration

UNIT – 3	PRODUCT RECOVERY	15

Adsorption - Liquid-liquid extraction - Aqueous two-phase extraction of biomolecules - Membrane separation – Micro, Ultra, Nano filtrations - Reverse osmosis – Dialysis - Precipitation of proteins by different methods –Selective denaturation of unwanted proteins.

Case study - Membrane separation- Dialysis; Aqueous two phase extraction of biomolecules; Protein Precipitation by Salting-out method and Isoelectric Precipitation

UNIT – 4	PRODUCT PURIFICATION	15

Chromatography - Principles, Instrumentation – Adsorption - Reverse phase - Hydrophobic interaction - Ion exchange - Gel Filtration – Affinity - Bio-affinity - Pseudo affinity chromatographic techniques - High Performance liquid chromatography (HPLC) – Analytical and preparative – UPLC – LCMS.

Case study - High resolution purification by Affinity chromatography, Ion exchange chromatography and Gel permeation chromatography

UNIT – 5	PRODUCT POLISHING, QUALITY ANALYSIS AND PROCESS ECONOMICS	15

Crystallization- Principle, Batch and Continuous - Drying- Principle, spray dryer, fluidized bed dryer – Lyophilisation in final product formulation - Quality assurance: GLP and GMP, Qualification (EQ, IQ, OQ, PQ) and Validation - Comparability Protocols - Process economics: Capital, operating cost analysis and cost cutting strategies.

Case study – Product polishing using freeze drying

TOTAL : 75 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:		
CO1	Describe recovery, purification and finishing of biomolecules by applying various downstream concepts.	Understand
CO2	Apply the knowledge of various unit operations in downstream processing of the product	Apply
CO3	Analyze the problems arising in downstream processing and can solve it.	Analysis
CO4	Identify skills needed to function in modern bio separation engineering.	Evaluate
CO5	Design chromatography methods and various unit operations for the recovery and purification of bio molecules.	Implement

TEXT BOOKS:

1. Belter, P.A., E.L. Cussler and Wei-Houhu "Bio separations – Downstream Processing for Biotechnology", John Wiley, 1988.
2. Sivasankar, B. "Bio separations: Principles and Techniques". PHI, 2005.

REFERENCES:

1. Ghosh, Raja "Principles of Bio separations engineering". World Scientific, 2006
2. "Product Recovery in Bioprocess Technology". (BIOTOL – Biotechnology by Open Learning Series). Butterworth - Heinmann / Elsevier, 2004.
3. Mccabe W., Smith J., Harriott W., "Unit Operations in Chemical Engineering" McGraw Hill, VII Edition, 2014.
4. Asenjo, Juan A. "Separation Processes in Biotechnology". CRC / Taylor & Francis, 1990

19UBT702	BIOINFORMATICS	L	T	P	C
		3	0	2	4

OBJECTIVES:

The student should be made to:

- Understand the basic concepts, methods and tools employed in Bioinformatics.
- Solve biological problems using bioinformatics tools and handle biological databases to solve real research problems.

UNIT – 1	INTRODUCTION TO BIOINFORMATICS	15

Introduction to Operating systems - Linux commands - File transfer protocols ftp and telnet - Introduction to Bioinformatics and Computational Biology - Biological sequences - Biological databases - Genome specific databases – Genomics Data Analysis - Data file formats - Data life cycle - Database management system models - Basics of Structured Query Language (SQL) - Case Study - Design and Storage of data in a web compatible Database format.

UNIT – 2	SEQUENCE ALIGNMENT	15

Sequence Analysis - Pair wise alignment - Dynamic programming algorithms for computing edit distance - String similarity - Shotgun DNA sequencing - End space free alignment - Multiple sequence alignment - Algorithms for Multiple sequence alignment - Generating motifs and profiles - Local alignment - Smith Waterman algorithm - Global alignment - Needleman and Wunsch algorithm – BLAST – PSIBLAST - PHIBLAST algorithms - FASTA – Algorithms – Sensitivity – Specificity - Applications - Amino acid substitution matrices PAM and BLOSUM.
Case Study - using BLAST and Clustal tools, Probe Design, Marker Development, Comparative Genomics

UNIT – 3	PHYLOGENETIC AND STRUCTURAL BIOINFORMATICS	15

Introduction to phylogenetics - Distance based trees UPGMA trees - Molecular clock theory – Ultrametric trees - Parsimonious trees - Neighbour joining trees - Trees based on morphological traits – Bootstrapping - Protein Secondary structure and tertiary structure prediction methods - Homology modelling – ab - initio approaches – Threading - Critical Assessment of Structure Prediction - Structural genomics
Case study - Phylogenetic tree construction, Protein Modeling, Design based on Sequence and Structure comparative study

UNIT – 4	PROTEIN STRUCTURE ANALYSIS	15

Introduction Machine learning techniques - Artificial Neural Networks in protein secondary structure prediction - Hidden Markov Models for gene finding - Decision trees - Support Vector Machines. Introduction to Systems Biology and Synthetic Biology - Microarray analysis - DNA computing - Computer Aided drug discovery - Applications of informatics techniques in genomics and proteomics - Assembling the genome - STS content mapping for clone contigs - Functional annotation - Peptide mass fingerprinting.
Case study - Proposing a problem-solving, intelligent system development using machine learning approaches

UNIT – 5	PERL PROGRAMMING	15

Basics of PERL programming for Bioinformatics - Data types: scalars and collections – operators - Program control flow constructs - Library Functions: String specific functions - User defined functions - File handling - A Program to Store a DNA Sequence.

Case Study - Development of modules and packages to perform routine tasks in Bioinformatics using programming approach.

TOTAL : 75 PERIODS

COURSE OUTCOMES:

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

CO1	Understand the basic concepts of OS, Linux commands, databases and get familiarity with biological databases.	Understand
CO2	Compute Perl programming skills in biological studies.	Apply
CO3	Compare DNA and Protein sequences using online databases and perform similarity matching.	Analyze
CO4	Determine the evolutionary relationship between organisms by phylogenetic studies.	Evaluate
CO5	Use machine learning techniques in protein structure prediction and in other fields of biotechnology.	Modern Tool Usage

TEXT BOOKS:

1. Introduction to Bioinformatics by Arthur K. Lesk , Oxford University Press.
2. Algorithms on Strings, Trees and Sequences by Dan Gusfield, Cambridge University Press.

REFERENCES:

1. Bioinformatics The Machine Learning Approach by Pierre Baldi and SorenBrunak.
2. JamilMomand, Concepts in Bioinformatics and Genomics, 2016, 1st Edition, Oxford University Press, UK
3. Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by R.Durbin, S.Eddy, A.Krogh, G.Mitchison.
4. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall, O'Reilley Media.

19UBT707	IMMUNOLOGY LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to

- Gain knowledge on handling of animals and different routes of immunization
- Identify and enumerate various immune system cells.
- Perform agglutination and precipitation reactions.

LIST OF EXPERIMENTS

1. Immunology lab safety operations and animal handling (demo)
2. Identification of blood group
3. Latex agglutination
4. Immuno-precipitation-VDRL
5. Single Radial Immuno Diffusion (SRID)
6. Ouchterlony diffusion on gels for antibody titration
7. Rocket/Counter Current immune-electrophoresis
8. Testing for typhoid antigens by Widal test
9. Enzyme Linked Immunosorbant Assay (ELISA)
10. Isolation of monocytes from blood.
11. Western blottingof serum proteins.
12. MTT assay

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- Design and perform diagnostics tests like identification of blood cells, ELISA and Electrophoresis
- Analyze the components of blood serum by different immuno techniques
- Evaluate the effect of drugs and other foreign bodies and interpret the results to carry out research

EQUIPMENTS REQUIREMENT:

Sl. No.	Name of the equipment	Quantity required
1.	Microwave oven	2
2.	Microscopes	6
3.	Fluorescent Microscope	1
4.	Hot plate	2
5.	Vortex mixer	2
6.	Centrifuge	2
7.	Elisa reader	1

Glasswares, Chemicals, Media as required

TEXT BOOKS

1. ArtiNigam, ArchanaAyyagari, “Lab Manual in Biochemistry, Immunology and Biotechnology”, McGraw Hill Education, India, 2007
2. Harlow., Edward A. Greenfield (Editor) “Antibodies A Laboratory Manual”, Cold Spring Harbor Laboratory Press, 2nd edition, 2013

SEMESTER - VIII

19UBT803	PROJECT WORK	L	T	P	C
		0	0	16	8

OBJECTIVES:

The student should be made to:

- To investigate the societal issues in the healthcare and develop engineering solutions to human health problems.
- To engage the student in integrated activities of researching the problems in healthcare field and identifying novel solution for the unaddressed technical issues.
- To enrich the communication skills of the student and to create awareness on recent development in the medical field through project work.

Course Requirements

In this course, Students shall work in groups (Maximum 3) and focus on research problem and discover solutions by applying the knowledge of subjects that he/she has learnt upto 7thsemester. The project work is also guided by the allocated faculty member for tuning up the report. There shall be three reviews for the project work during the semester by the project review committee. The review committee consisting of the project guide and a senior faculty member, nominated by the Head of the department, in the related field of the project. The students should make a presentation on the progress made by him/her before the committee. The student should submit the report at the end of the semester. The product should be demonstrated at the time of examination. At the end of the project period, the marks shall be awarded by the same committee for the report and viva-voce.

COURSE OUTCOMES:

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

After the successful completion of this course the student will be able to

CO1	Understand the concepts in design of medical equipment, analysis and interpretation of medical data, and synthesis of the information to provide valid conclusions.	Understand
CO2	Implement technology in education and able to identify the characteristics of different types of dynamic environments in Biotechnology	Apply
CO3	Apply the research knowledge to sustain the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the healthcare field.	Apply
CO4	Use the knowledge gained in biomedical instrumentation and Analyze unaddressed technical issues and develop prototype model according to the need of the society	Analysis
CO5	Categorize the list of problems in biotechnology field using different strategies to state the problem precisely, and point out the possible solutions	Analysis

CO6	Communicate the technical information effectively in oral presentation and technical report writing	Evaluate
CO7	Develop the useful products based on the need for sustainable development and offering the solutions in societal and environmental contexts.	Create