Title of the Course: Fluid Mechanics Course Code:UBTC0301	L	T	P	Credits
	3	-	-	3

Course Pre-Requisite: Basic knowledge of mathematics and physics.

Course Description: The basic purpose of this course is to introduce students to the concepts of fluid statics dynamics and its applications.

Course Objectives:

1. To introduce fluid statics for process fluids.
2. To describe fluid dynamics for process fluids.
3. To illustrate the basic principles of flow measuring devices.
4. To explain the general theory of laminar and turbulent boundary layer fundamentals and flow past immersed bodies.
5. To explain selection and scale up of agitation system.
6. To explain screen analysis

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Apply the fundamentals and basic principles of fluid statics	3	Applying
CO2	Analyze the fluid flow through pipes, fluidized bed and packed bed	4	Analyzing
CO3	Select and to scale-up agitation system	3	Applying
CO4	Explain particle size analysis	2	Understanding

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2								1	1		1			
CO2	2	1							1	1		1			
CO3	2												2		
CO4	1														

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment Component	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and **ISE 2** are based on Assignment/Declared test/Quiz/Seminar/Group discussions/Presentation etc.
MSE is based on 50% of course content
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents:

Unit 1:--- Fluid statics and its Applications: Hydrostatic equilibrium, Hydrostatic equilibrium in a centrifugal field, Applications of fluid statics: manometers, continuous gravity decanter, and centrifugal decanter.	7 Hrs.
Unit 2:--- Fluid flow through pipes: Types of flow, shear rate and shear stress, rheological properties of fluids, Continuity equation, Bernoulli equation, Pump power calculations. Shear stress distribution in a cylindrical tube, laminar and turbulent flow in pipes, effect of roughness, friction factor chart, Pressure drop calculations across fittings.	8 Hrs.
Unit 3:--- Transportation and metering of fluids: Pumping devices for gases: fans, blowers and compressors, Measurement of flowing fluids: venturimeter, orifice meter, rotameter, pitot tube.	6 Hrs.
Unit 4:--- Flow past immersed bodies: Drag and drag coefficients, Friction in flow through beds of solids, Motion of particles through fluids, Fluidization.	7 Hrs.
Unit 5:---Mixing: Agitated vessels, flow patterns in agitated tanks, mechanism of mixing, power requirements for mixing Agitator selection and scale up.	7 Hrs.
Unit 6:---Screening: Types of screens, Screen efficiency, Average particle diameter, Comparison of ideal and actual screens, Industrial screening equipments.	7 Hrs.

Textbooks:

SN	Title	Edition	Author/s	Publisher	Year
1.	Unit Operations of Chemical Engineering	6	W.L. McCabe, W.L. Smith, and P. Harriot	McGraw-Hill International	2001
2.	Bioprocess Engineering Principles	1	Pauline M. Doran	Elsevier Science and Technology Books	1995

Reference Books:

SN	Title	Edition	Author/s	Publisher	Year
1.	Fluid Mechanics for Chemical Engineers.	2	J.O.Wilkes	Prentice Hall	1999
2.	Transport Phenomena	2	R. B. Bird, W.L. Stewart and E.L. Lightfoot	Wiley Singapore	2002

Title of the Course: Microbiology Course Code:UBTC0302	L 4	T -	P -	Credit 4

Course Pre-Requisite: Basic knowledge of prokaryotes

Course Description: This course explains the basics of microbiology and applied microbiology

Course Objectives:

1 To acquaint students with the world of microorganisms, their types and characteristics.
2 To find the growth requirements and their role in bacterial growth.
3 To describe disinfection and sterilization techniques.
4 To explain role of various environmental factors on microbial growth.

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Explain the world of microorganisms, their types and characteristics	2	Understanding
CO2	Select the media constituents, types of media and various culturing methods used for microbial growth	3	Applying
CO3	Examine various physical, chemical and biological agents affecting microbial growth	4	Analyzing
CO4	Apply suitable methods to control microbes	3	Applying

CO-PO Mapping

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	2	2			2			1		1	3	2	
CO2	1	1	2	1						1		1	2	3	
CO3	2	2	1	3	3	3	2			1		1	2	3	
CO4	1		1	1									3	3	

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment Component	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and **ISE 2** are based on Assignment / Declared test / Quiz / Seminar / Group discussions / Presentation etc.
MSE is based on 50% of course content
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents:

Unit 1:--- Introduction to microorganisms • History of Microbiology: - Spontaneous generation, Germ theory of diseases. • Prokaryotic cell structure :- The bacterial nucleus, cell wall, cell membrane, capsules and slimes, flagella, pili, reserve materials and other cellular inclusions, endospores.	9 Hrs.

Unit 2:---General characteristics of microorganisms :- • Archaebacteria, • Actinomycetes, • Fungi • Viruses • Rickettsia, Mycoplasma, Chlamydia,	9Hrs.
Unit 3:--- Microbial Nutrition And Identification And Characterization Of Bacteria • Requirement for C, N, S and growth factors, Role of oxygen • Various types of culture media, pure culture techniques, aerobic and anaerobic culturing,	9Hrs.
Unit 4:--- Microbial Growth • Microscopy, types of staining, analysis of Cultural characteristics, Culture preservation methods • Nutritional categories among microorganisms, Typical growth curve, Diauxic growth, synchronous growth, batch and continuous culture	9Hrs.
Unit 5:--- Effect of Environmental Factors And Antibiotics On Growth Of Microorganisms • Effects of solutes on growth and metabolism, effect of temperature on microbial growth, effect of ion concentration, effect of hydrostatic pressure, effect of heavy metal ions on microbial growth • Antibiotics :- historical highlights, characteristics of antibiotics and their mode of action, microbial susceptibility testing of antibiotics and resistance to antibiotics	9Hrs.
Unit 6:--- The Control Of Microorganisms • Physical agents :- High Temperature a) Moist heat - Stem under pressure, Fractional sterilization, boiling water, pasteurization, b)Dry heat – Hot air sterilization, Incineration, c) Desiccation, d) Osmotic pressure, e)Radiations-ionizing and non-ionizing f) Filtration • Chemical agents:-Definitions and terms , Phenol, Alcohol, Halogens, Heavy metals, gaseous agents	9 Hrs.

Textbooks:

SN	Title	Edition	Author/s	Publisher	Year
1	General Microbiology	5	Stanier R.Y. *et al*	Macmilan press	1999
2	Microbiology	5	Pelczar, Jr. *et. al*	Tata McGrawHill	1998

Reference books:

SN	Title	Edition	Author/s	Publisher	Year
1	General Microbiology	7	Schlegel H.G	Cambridge University Press	1999
2	Microbiology	6	Purohit, S.S.	Agrobios	1998
3	Brock biology of microorganism	14	M T Madigan	Pearson	2017
4	Comprehensive Biotechnology	Vol 1-4	M. M. Young	Pergamon	1987

Title of the Course: Biochemistry CourseCode:UBTC0303	L	T	P	Credit
	4	-	-	4

Course Pre-Requisite:

1. Basic understanding of the living cells, bioorganic chemistry in order to follow the physicochemical properties and metabolic reactions of biomolecules.

Course Description:

1. The course deals with structure and function of biomolecules, metabolism of biomolecules and bioenergetics.

Course objectives:

1. To state properties and functions of biomolecules.
2. To explain the energetics and transport mechanism of biomolecules.
3. To summarize the metabolism of Biomolecules.
4. To understand the importance of metabolic pathways and associated disorders.

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	
		Level	Descriptor
CO1	State properties and functions of biomolecules.	1	Remembering
CO2	Explain the energetic and transport mechanism of biomolecules.	2	Understanding
CO3	Summarize the metabolism of biomolecules.	2	Understanding
CO4	Analyze the metabolic pathways and cause for a metabolic disorder.	4	Analyzing

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1		1									2		
CO2				1								1	3		
CO3				1	2				3	3		1			
CO4				1					3	3		1			

Assessments:

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE)and one End Semester Examination(ESE) having20%,30%and50% weights respectively.

Assessment Component	Marks
ISE1	10
MSE	30
ISE2	10
ESE	50

ISE1and ISE2arebasedonassignment/declared test/quiz/seminar/Group Discussions etc. MSE: Assessment is based on 50% of course content

ESE: Assessment is based on 100% course content with 60-70% weight age for course content covered after MSE.

Course Contents:

Unit 1:-Water in Biological System Physical and chemical properties of water, weak interactions in macromolecular structure and function, Water as solvent for biochemical reaction- physical and chemical properties of water, ion product of water: pH scale, Acid, Base, Acid-Base Indicators, Buffers, Fitness of the aqueous environment for Living organism.	7 Hrs.
Unit 2:- Amino acids and Proteins : Classification, Structure and properties of amino acids, stereochemistry of amino acids , absorption spectra, analysis of amino acid mixtures. Composition of protein, Classification of protein based on structure and function, Case study : Protein physiology function, Ramachandran Plot (Allowed and Disallowed confirmation)	9 Hrs.
Unit 3:- Bioenergetics & Transport Mechanism: Structure and properties of ATP. High energy compounds, Biological membranes: structure, permeability, properties, passive transport and active transport, facilitated transport, energy requirement, mechanism of sodium-potassium, glucose and amino acid transport. Organization of transport activity in cell	7 Hrs.
Unit 4:--- Metabolism of Carbohydrates Basics of bioenergetics in metabolism(anabolism and catabolism), Classification and chemical properties of carbohydrates- monosaccharides, disaccharides, oligo and polysaccharides, Glycoconjugates (proteoglycans, glycoprotein, glycolipids) Metabolism of carbohydrates : Glycolysis and alternate pathways, TCA cycle, Electron transport chain, Gluconeogenesis, Metabolism Disorders	10 Hrs.
Unit 5:-Metabolism of Lipids Classification and chemical properties of lipids**,** Function of lipids (simple- storage and functional-membrane lipids) Metabolism of lipids: β oxidation of saturated and unsaturated fatty acid, propionate pathway, Biosynthesis of lipids, Metabolism Disorders	10 Hrs.
Unit 6:--- Metabolism of amino acids and nucleotides Catabolism amino acids, Biosynthesis of amino acids, Catabolism of purines and pyrimidines, Biosynthesis of purines and pyrimidines, Urea cycle, Metabolism	9 Hrs.

Textbooks:

SN	Title	Edition	Author/s	Publisher	Year
1.	Textbook of Biotechnology	**5**	H.K. Das	John Wiley Pub	2017

References:

SN	Title	Edition	Author/s	Publisher	Year
1.	Lehninger-Principles of Biochemistry	**5**	Nelson and Cox	W.H.Freeman and Company Pub	2017
2.	Biochemistry	**9**	Berg, Tymoczko and Stryer	W. H. Freeman and Company Pub	2019
3.	Text Book of Biochemistry	**4**	Rao RamaV.S.S	Narosa Pub. House, New Delhi	2008

Title of the Course: Enzyme Technology	L	T	P	Credits
Course Code:UBTC0304	3	-	-	3

Course Pre-Requisite: Basic knowledge of amino acids and chemistry.

Course Description: Study of enzymes, their classification, production, mechanism of enzyme catalysis, kinetics, immobilization techniques and its application in industrial sector.

Course Objectives:

1. To understand the various concepts of enzymes, their classification, mechanism of catalysis.
2. To apply different kinetics of enzyme, and determination of enzyme activity.
3. To understand different enzyme immobilization techniques.
4. To understand enzyme production and purification along with their applications in different industrial sector.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Explain various concepts of enzymes, their classification, and mechanism of catalysis.	2	Understanding
CO2	Apply enzyme kinetics for calculation of enzyme activity	3	Applying
CO3	Explain the enzyme immobilization techniques.	2	Understanding
CO4	Illustrate enzyme production and purification along with their applications in different industrial sector.	2	Understanding

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1											1			
CO2	1	1													
CO3	1				2							1	3		
CO4	1	1	1		1	2	1		1	1		2	3		

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment Component	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and **ISE 2** are based on Assignment/Declared test/Quiz/Seminar/Group discussions/Presentation etc.
MSE is based on 50% of course content
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents:

UNIT 1:--- Enzymes Classification and nomenclature, chemical nature and structure of enzymes, coenzyme and cofactors, concept of active site, lock-key hypothesis, induced fit hypothesis, transition-state stabilization hypothesis, specificity of enzymes, chemical mechanisms of enzyme catalysis proximity and orientation effects, distortion or strain, different mechanisms of enzyme catalysis, acid base and covalent catalysis and metal-ion catalysis.	7 Hrs.
UNIT 2:--- Enzyme kinetics and inhibition Catalysis, Activation energy, transition state theory, time course of enzymatic reaction, kinetics of single substrate enzyme catalyzed reaction- Michaelis-Menten equation, significance of Km and Vmax, turnover number, catalytic efficiency, modifications of Michaeli's-Menten plot, allosteric enzymes and sigmoidal kinetics, enzyme inhibition reversible and irreversible inhibition, kinetics of inhibition.	7 Hrs.

UNIT 3:--- Experimental measures of enzyme activity Concept of enzyme activity, initial velocity measurements- direct, indirect, and coupled assays; analysis of progress curves; continuous versus end point assays; initiating, mixing and stopping reactions, detection methods- assays based on optical spectroscopy, fluorescence measurements, radioisotopic measurements**,** reporting enzyme activity data, enzyme stability-stabilizing enzyme during storage, enzyme inactivation during activity assay.	7 Hrs.
UNIT 4:--- Enzyme immobilization Concept and need of enzyme immobilization, Methods of immobilization - Immobilization on Supports: carrier-bound enzymes, immobilization by entrapment (encapsulation), carrier-free immobilization by cross-linking, immobilization on/in nonmaterial's, terminology and general considerations- immobilization yield, the immobilization efficiency and the activity recovery, properties of immobilized enzymes.	7Hrs.
UNIT 5:--- Production of enzymes Sources of enzymes-animal, plant and microbial sources, Large scale production of enzymes-basic methodology of enzyme production, enzyme extraction and purification, enzyme formulation, recombinant DNA technology in enzyme production.	7 Hrs.
UNIT 6:--- Biotechnological applications of enzymes Enzyme biosensors, Applications of enzymes in food, leather, detergent industries etc., use of enzymes in drug and medicine, use of enzymes to make amino acids and peptides, use of enzymes in biofuels production, use of enzymes in bioremediation, legislative and safety aspects.	7 Hrs.

Textbooks:

SN	Title	Edition	Author/s	Publisher	Year
1.	Enzymes	2	Travor Palmer and Philip Bonner	Horwood Publishing Series	2007
2.	Enzyme Biocatalysis principles and applications	1	Andr´ esIllanes	Springer	2008
3	Enzymes a practical introduction to structure, mechanism and data analysis	2	Robert A. Copeland	John wiley& Sons, INC., Publication	2000
4	Basic Biotechnology	2	Ed.-Ratledge, C and Kristiansen B.	Cambridge University Press	2012

Reference Books:

SN	Title	Edition	Author/s	Publisher	Year
1.	Lehninger: Principles of Biochemistry	4	Nelson D. et al	Worth Publishers	2004

Title of the Course: Cell and Molecular Biology Course Code: UBTC0305	L	T	P	Credits
	4	-	-	4

Course Pre-Requisite:
Student must have a basic knowledge of macromolecules and organelle's basic structure, organization and characteristics.

Course Description:
The course contains basic features of cellular organelle's, cell cycle and control, stem cells, DNA analysis and its expression.

Course Objectives:
1. Define the basics of Cell organelle, cell cycle control and stem cells
2. Explain the DNA expression in the form of replication, transcription and translation
3. Identify and analyze the various techniques of genetic mutation, repair and recombination..

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	To acquaint students with fundamental of cellular organelles, cell cycle control and stem cells	2	Understanding
CO2	To get the knowledge with the necessary background and technical skills to work professionally in r-DNA Technology and Molecular Biology.	3	Applying
CO3	Analyze the gene manipulation, mutation and recombination.	3	Analyzing

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1											1	1		
CO2	1				1								1		
CO3	1								3	3		1	1		

Assessment Scheme:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment Component	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and **ISE 2** are based on Assignment/Declared test/Quiz/Seminar/Group discussions/Presentation etc.
MSE is based on 50% of course content
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents:	
Unit 1:--- Cell structure Introduction to Prokaryotes and eukaryotes - The compartmentalization of higher cells, the cytosol, the endoplasmic reticulum, the Golgi apparatus, lysosomes and peroxisomes, mitochondria and chloroplasts , The nucleus: Nuclear membrane, nuclear pores, chromosomes, nucleolus and other nuclear bodies	8 Hrs.
Unit 2:--- Cell signaling and transport Molecular mechanism of signal transduction, Principles and importance of cell signaling, Signaling through G- protein linked receptors, Signaling through enzyme linked cell surface receptors, Ion channel gated receptors, active and passive transport	8 Hrs.
Unit 3:--- Cell Cycle and Stem cell biology Components of cell cycle control system, Cell division: Mitosis and Meiosis, Introduction to stem cells, classification- ES cells and adult stem cells, Unipotency, pluripotency, multipotency and differentiation of stem cells.	6 Hrs.
Unit 4:---Organization of genetic material Different forms of DNA, Central dogma of Molecular Biology, Viruses: Nature of genetic material, unfolding and packing, Organization of genetic material in prokaryotes, Eukaryotes: Nucleosomes, Chromatin and heterochromatin, histones and non-histone proteins, Giant chromosomes, satellite DNA. Classes of the genes, Split genes and overlapping genes.	8 Hrs.
Unit 5:---DNA Replication, damage, repair and recombination Prokaryotic DNA replication, Eukaryotic DNA replication , Organelle DNA replication – chloroplasts and mitochondria, Plasmid – replication and general properties, Types of damages, damaging agents, repair mechanisms - Photo- reactivation, dark repair, post replicational recombination repair, SOS repairs, Homologous recombination, Site-specific recombination	8Hrs.
Unit 6:---Transcription and Translation Transcription in prokaryotes and eukaryotes, RNA processing, structures ofrRNA, tRNA and mRNA, post-transcriptional processes, Novel structural motifs in transcription factors in eukaryotes and prokaryotes, Genetic code-Deciphering of genetic code and important properties of genetic code, Translation in prokaryotes and eukaryotes, Molecular aspects of gene regulation and expression, Operon models-lactose, tryptophan and arabinose, Post-translational modifications.	6 Hrs.

Textbooks:

SN	Title	Edition	Author/s	Publisher	Year
1.	Cell Biology	4	Roy S.C. and De Kalyan Kumar	New Central Book Agency	2019
2.	Cell and Molecular biology	8	De Robertis E.D.P. and De Robertis, Jr. E.M.F.	Lippincott Williams & Wilkins	2017

Reference Books:

SN	Title	Edition	Author/s	Publisher	Year
1.	Molecular Biology of the genes	7	James D. Watson et al,	Pearson and Benjamin Cummings Publication.	2013
2.	Genes and Genomes	2	Maxine Singer and Paul Berg	University Science book, Mill Vally California Publication.	1991

Title of the Course: Constitution of India Course Code: UBTA0361	L	T	P	Credit
	2	--	--	--

Course Pre-Requisite: Basics of Indian History, Independence Movement, Fundamentals of Civics.

Course Description: This Course is an introduction of Indian Constitution and basic concepts highlighted in this course for understanding the Constitution of India. This course is structured to give a deeper insight for making the nexus between the other law subjects.

Course Objectives

At the end of the course the student is expected to have acquired:

1. A basic understanding of Constitution of India.
2. Builds the ability to apply the knowledge gained from the course to current social legal issues.
3. Ability to understand and solve the contemporary challenges.
4. Understanding constitutional remedies.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Explain the significance of Indian Constitution as the fundamental law of the land	II	Cognitive (Understand)
CO2	Exercise his fundamental rights in proper sense at the same time Identifies his responsibilities in national building.	II	Cognitive (Applying)
CO3	Analyze the Indian political system, the powers and functions of the Union, State and Local Governments in detail	II	Cognitive (Understand)
CO4	Understand Electoral Process, Emergency provisions and Amendment procedure.	II	Cognitive (Understand)

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1						3		3				3			
CO2						3		3	3	3		3			
CO3						3			3			3			
CO4						3			3			3			

Assessments:

Teacher Assessment:

One End Semester Examination (ESE) having 100% weights respectively.

Assessment Component	Marks
ESE	100

ESE: Assessment is based on 100% course content

Course Contents:

Unit 1:-Constitution – Structure and Principles 1.1: Meaning and importance of Constitution 1.2: Making of Indian Constitution – Sources 1.3: Salient features of Indian Constitution	3 Hrs.
Unit 2:- Fundamental Rights and Directive Principles 2.1: Fundamental Rights & Fundamental Duties 2.2: Directive Principles of State Policy	10 Hrs.
Unit 3:-Union Government & Executive 3.1: President of India – Qualification, Powers and Impeachment 3.2: Lok Sabha & Rajya Sabha Sabha- Composition, Powers & Functions, Scope to amendment in Constitution	4 Hrs.

Unit 4:- State Government & Executive 4.1: Governor – Qualification, Appointment, Powers & Functions 4.2: Legislative Assembly & Legislative Council – Composition, Powers & Functions	3 Hrs.
Unit 5:-The Judiciary 5.1: Features of Judicial System in India 5.2: Hierarchy of Courts, Composition and Jurisdiction	3 Hrs.
Unit 6:- Local Self Government and other constitutional Organizations 6.1: 73rd and 74th Constitutional Amendments 6.2: Public Service Commission, Election Commission, CAG, National Commissions for SC, ST etc.	3 Hrs.

Textbooks:

SN	Title	Edition	Author/s	Publisher	Year
1.	Indian Constitutional Law		M.P. Jain,		
2.	Constitutional Law of India		M.P. Singh (ed.) ,V.N. Shukla,		
3.	Commentary on the Constitution of India		D.D. Basu,		
4.	Constitutional Law--I & II		S.S.Desai		

References:

SN	Title	Edition	Author/s	Publisher	Year
1.	Introduction to the Constitution of India	(23rd edn.)	Durga Das Basu	Gurgaon,; LexisNexis	2018
2.	The Constitutional Law of India, Allahabad	(55th edn.)	J.N. Pandey	Central Law Agency	2018
3.	Constitutional Law--I	--	Shripad Shridhar Desai	S.S. Law Publication	2021
4.	Constitutional Law --II	--	Shripad Shridhar Desai	S.S. Law Publication	2021
5.	Constitution of India (Full Text), India.gov.in	--	https://www.india.gov.in/sites/upload_files/npi/files/coi_part_full.pdf	National Portal of India	
6.	Bharatada Samvidhana Parichaya ,	--	Durga Das Basu,	Gurgaon LexisNexis Butterworths Wadhwa	2015

Title of the Course: Fluid Mechanics Laboratory Course Code:UBTC0331	L	T	P	Credits
	-	-	2	1

Course Pre-Requisite: Basic knowledge of mathematics

Course Description: The purpose of this lab is to study fluid flow, flow measuring devices and screen analysis.

Course Objectives:

1. To understand the basic principles of different flow measuring devices.

2. To use screen analysis for particle size determination.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Identify the flow patterns and regimes of fluid flow in pipe.	3	Applying
CO2	Demonstrate the operational principles of flow measuring devices	2	Understanding
CO3	Summarize the screen analysis data	2	Understanding

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1			1					2						
CO2	1			1					3						
CO3	1			2					1						
CO4													1		

Assessment:

One component of In Semester Evaluation (ISE) with 100% weightage.

Assessment Component	Marks
ISE	25

ISE is based on practical performance and assignment/declared test/quiz/seminar/group discussions/presentation etc.

Course Contents:

Experiment No. 1:---Reynold's experiment **Aim and Objectives:** To study the Laminar and Turbulent flow by Reynold's apparatus	2 Hrs.
Experiment No. 2:---Venturimeter **Aim and Objectives:** To calculate coefficient of discharge of venturimeter	2 Hrs.
Experiment No. 3:--- Orifice meter **Aim and Objectives:** To calculate coefficient of discharge of orificemeter	2 Hrs.
Experiment No. 4:--- Bernoulli's experiment **Aim and Objectives:** To study and verify the Bernoulli's theorem	2 Hrs.

Experiment No. 5:--- Rotameter **Aim and Objectives:** To calculate flow rate using rotameter	2 Hrs.
Experiment No. 6:---Pitot tube **Aim and Objectives:** To calculate coefficient of discharge of pitot tube	2 Hrs.
Experiment No. 7:---Friction factor **Aim and Objectives:** To determine friction factor	2 Hrs.
Experiment No. 8:---Screening **Aim and Objectives:** To calculate average particle size	2 Hrs.

Textbooks:

Sr. No.	Title	Edition	Author/s	Publisher	Year
1.	Unit Operations of Chemical Engineering	6	W.L.McCabe, W.L.Smith,and P.Harriot	McGraw-Hill International	2001
2.	Bioprocess Engineering Principles	1	Pauline M. Doran	Elsevier Science &Technology Books	May 1995

Reference Books:

SN	Title	Edition	Author/s	Publisher	Year
1.	Fluid Mechanics for Chemical Engineers.		J.O.Wilkes	Prentice Hall	1999
2.	Transport Phenomena.	2	R.B.Bird,W.L.StewartandE.L.Lightfoot	Wiley Singapore	2002

Title of the Course: Microbiology Laboratory Course Code:UBTC0332	L 0	T 0	P 2	Credit 1

Course Pre-Requisite: Basic knowledge of microorganisms

Course Description: Microbiological staining and culturing techniques.

Course Objectives:

1. To demonstrate the structure of microorganism using staining and microscopic techniques.
2. To perform media preparation and describe sterilization techniques.
3. To examine the effect of various physical, chemical, biological factors on microbial growth.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's level	Bloom's Descriptor
CO1	Demonstrate the structure of microorganism using staining and microscopic techniques	2	Understanding
CO2	Analyze effect of various factors on growth of microbes	3	Applying
CO3	Select sterilization techniques for equipments, glassware, media	4	Analyzing

CO-PO-PSO Mapping:

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	1	1			1			1		1	3	3	
CO2	2	2	3	2	3	3	2	2		2	2	1	2	3	
CO3	2		1	1						1	1		3	2	

Assessments :

One component of In Semester Evaluation (ISE) and one component End Semester Examination (ESE) having 67% and 33% weights respectively.

Assessment Component	Marks
ISE	50
ESE(POE)	25

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

ESE Assessment is based on practical and oral examination.

Course Contents:

Experiment No. 1:--- Washing of glassware, Preparation of plug, wrapping of glassware, pipettes, standard practicing of tagging **Aim and Objectives:** To Learn various laboratory practices	2 Hrs.
Experiment No. 2:--- Preparation of nutrient broth and nutrient agar bacteriological media sterilization using autoclave, sterilization of heat sensitive material, sterilization of glassware using autoclave or hot air oven, preparation of slants and stabs, liquid culturing , aseptic transfers using wire loop and needle **Aim and Objectives:** To Learn preparation of media, sterilization techniques and aseptic transfers	2 Hrs

Experiment No. 3:---Spread, pore, streak - Plating methods for pure culture, Observation of growth and its interpretation **Aim and Objectives:** To learn various culturing techniques.	2 Hrs.
Experiment No. 4:---Effect of temperature on microbial growth. **Aim and Objectives:** To examine effect of temperature on metabolic activities of microorganisms.	2 Hrs.
Experiment No. 5:--- Effect of pH on microbial growth. **Aim and Objectives:** To examine effect of pH on metabolic activities of microorganisms.	2 Hrs.
Experiment No. 6:--- Effect of antibiotics on microbial growth **Aim and Objectives:** To examine effect of various antibiotics on metabolic activities of microorganisms.	2 Hrs.
Experiment No. 7:--- Gram staining **Aim and Objectives:** To perform gram staining.	2 Hrs.
Experiment No. 8:--- Motility testing **Aim and Objectives:** To perform motility testing.	2 Hrs.

Textbooks:

SN	Title	Edition	Author/s	Publisher	Year
1.	General Microbiology	5	Stanier R.Y. *et al*	Macmilan press	1999
2.	Microbiology	5	Pelczar, Jr. *et. al*	Tata McGraw Hill	1998

Reference Books:

	Title	Edition	Autor/s	Publisher	Year
1.	General Microbiology	7	Schlegel H.G	Cambridge University Press	1999
2.	Microbiology	6	Purohit, S.S.	Agrobios	1998
3.	Brock biology of microorganism	14	M T Madigan	Pearson	2017
4.	Comprehensive Biotechnology	Vol 1-4	M. M. Young	Pergamon	1987

Title of the Course: Biochemistry Laboratory CourseCode:UBTC0333	L	T	P	Credit
	-	-	2	1

Course Pre-Requisite:
Basic knowledge of chemistry.

Course Description:
This lab is related to the qualitative and quantitative analysis of biomolecules.

Course Learning objectives:
1. To analyze the biomolecules qualitatively and quantitatively in a given sample.

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Analyze the biomolecules qualitatively and quantitatively from given sample	4	Analyze

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2	2				2	1		1	3		

Assessments:
One component of In Semester Evaluation (ISE) and one component End Semester Examination (ESE) having 67% and 33% weights respectively.

Assessment Component	Marks
ISE	50
ESE(POE)	25

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.
ESE Assessment is based on practical and oral examination.

Lab Experiment Contents:

Experiment No. 1:---Preparation of buffers, molar and normal solutions. **Aim and Objectives:** To prepare buffers and solutions.	02 Hrs.
Experiment No.2:---Isoelectric precipitation of casein present in Milk. **Aim and Objectives:** To perform the isoelectric precipitation of casein present in milk.	02 Hrs.
Experiment No. 3:--- Spectrophotometry. **Aim and Objectives:** To identify absorption maximum wavelength and verify Beer's law.	02 Hrs.
Experiment No. 4:---Qualitative tests for carbohydrates **Aim and Objectives:** To analyze presence carbohydrates both qualitatively	02 Hrs.
Experiment No. 5:---Estimation of reducing sugars by DNS method **Aim and Objectives:**. To analyze presence of different types of amino acids	02 Hrs.

Experiment No. 6:---Protein analysis – qualitative detection **Aim and Objectives:** To analyze presence of different types of proteins	02 Hrs.
Experiment No. 7:---Estimation of total proteins by Lowry's method **Aim and Objectives:** To estimate the total protein content in the sample	02Hrs.
Experiment No. 8:---Quantitative Estimation of Amino Acids by Ninhydrin **Aim and Objectives:** To estimate the amino acid in the given sample	02 Hrs.
Experiment No. 9:---Lipid analysis – qualitative and quantitative detection **Aim and Objectives:** To analyze presence of lipids qualitatively and quantitatively	02 Hrs.

Note: Any 8 experiments out of 9 may be conducted.

References:

SN	Title	Edition	Author/s	Publisher	Year
1.	Biochemistry & Biotechnology- A Laboratory Manual	1	Yadav V.K	Pointer Publishers, Jaipur	2012
2.	Introduction to Practical Biochemistry	3	Plummer D.T.;	TMH Pub. New Delhi	1987
3.	Laboratory Manual in Biochemistry	2	J. Jayaraman	New Age International.	2011

Title of the Course: Cell and Molecular Biology Laboratory Course Code: UBTC0334	L	T	P	Credits
	-	-	-	1

Course Pre-Requisite:
Student must have a basic knowledge of macromolecules and organelle's basic structure, organization and characteristics.

Course Description:
The course contains basic features of cellular organelle's, cell cycle and control, stem cells, DNA analysis and its expression.

Course Objectives:

1. To perform and study isolation of Cell organelles and cell cycle control
2. To isolate and estimate DNA and RNA from various sources
3. To identify and analyze the technique of in vitro transcription

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Acquaint students with isolation and define of cellular organelles and cell cycle control.	2	Understanding
CO2	Isolate and estimate DNA and RNA from various sources	3	Applying
CO3	Identify and analyze the technique of in vitro transcription	3	Analyzing

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	1	1	1	2	2				2	1		1			
									1						
	2			2	1	2						2			

Assessment Scheme:
One component of In Semester Evaluation (ISE) and one component End Semester Examination (ESE) having 67% and 33% weights respectively.

Assessment Component	Marks
ISE	50
ESE(POE)	25

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.
ESE Assessment is based on practical and oral examination

Course Contents:

Experiment No. 1:--- Isolation of Nucleus. **Aim:** Isolation of Cellular Organelles and visualize under microscope.	2 Hrs.
Experiment No. 2:--- Mitosis **Aim:** Perform and observe cell division and cell cycle.	2 Hrs.
Experiment No. 3:--- Isolation of Mitochondria or chloroplast **Aim:** Isolation of Cellular Organelles and visualize under microscope.	2 Hrs.
Experiment No. 4:--- Meiosis **Aim:** Perform and observe cell division and cell cycle.	2 Hrs.

Experiment No. 5:--- Agarose Gel Electrophorosis **Aim :**To perform agarose gel electrophoresis of DNA or RNA	2 Hrs.
Experiment No. 6:--- Isolation of DNA from plant **Aim:** Spooling of chromosomal DNA from onion cells.	2 Hrs.
Experiment No. 7:--- Spectrophotometric analysis of DNA **Aim:** To measure the concentration of DNA from given sample spectrophotometric method	2 Hrs.
Experiment No. 8:---Isolation of plasmid from bacteria **Aim:** To isolate plasmid DNA from bacteria by alkaline lysis method.	2 Hrs.

Textbooks:

Sr. No.	Title	Edition	Author/s	Publisher	Year
1.	Cell Biology	4	Roy S.C. and De Kalyan Kumar	New Central Book Agency	2019
2.	Cell & Molecular Biology-Concepts & experiments	3	Gerald Karp	John Wiley and sons. New York	2002

Reference Books:

SN	Title	Edition	Author/s	Publisher	Year
1.	Molecular Cloning Vol. I, II & III	4	J.F. Sambrook and D.W. Russell	Cold Spring Harbor University Publishing	2002
2.	Genes and Genomes	2	Maxine Singer and Paul Berg	University Science book, Mill Vally California Publication.	1991

Title of the Course: Biostatistics	L	T	P	Credits
Course Code: UBTC0401	3	1	---	4

Course Pre-Requisite: Basic terminologies on probability and data

Course Description: This course contains study of probability distribution, test of significance, regression analysis and analysis of variance.

Course Objectives:

1. To make familiar the prospective biological engineers with techniques in data analysis techniques, probability, probability distributions and test of significance.
2. To enable students to use statistical techniques learned for the analysis, modeling and solution of realistic engineering problems.
3. To develop abstract, logical and critical thinking and the ability to reflect critically upon their work.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	Understand various concepts of data, statistical techniques, probability and test of significance.	2	Understanding
CO2	Solve problems on tendency of data and bivariate data using statistical techniques.	3	Applying
CO3	Use knowledge of probability, probability distributions and test of significance on biological experiments.	3	Applying
CO4	Apply the knowledge of probability distributions to the given data and select the appropriate method for testing of significance and analyze the variance.	4	Analyzing

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3		2	1								2		
CO2	3	3		1	1								2		
CO3	3	3			1								2		
CO4	3	3			1								2		

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment Component	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and **ISE 2** are based on Assignment / Declared test / Quiz / Seminar / Group discussions / presentation, etc.
MSE is based on 50% of course content
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE

Course Contents:

Unit 1: Exploratory Data Analysis: Introduction to Biostatistics, Nature of Data, Measures of Central Tendency, Measures of Dispersion, Measures of Skewness and Kurtosis	7 Hrs.
Unit 2: Statistical Techniques for data analysis. Correlation and Coefficient of correlation, Simple Linear Regression, Prediction, Interpreting and Diagnostics using Regression, Fitting of curves by method of least-squares, Fitting of straight lines, Fitting of exponential curves	6 Hrs.
Unit 3: Probability and Probability distributions. Statistical Probability, Conditional probability, Random Variable, Probability mass function and density function, Discrete Distributions: Binomial, Poisson distribution and properties, Continuous Distributions: Normal distribution and properties	8 Hrs.
Unit 4: Test of Significance - I Parameter and Statistic, Confidence Interval, p – value, Large sample tests: Test of significance for single population mean, Test of significance for equality of two population means, Small sample tests:t-test for single mean, t-test for difference of mean, Paired t-test for difference of mean.	8 Hrs.
Unit 5: Test of Significance – II Chi – square distribution, Test for single variance, Goodness of fit test, Test for independence of attributes by Yates's Correction	6 Hrs.
Unit 6: Analysis of Variance F- distribution, Test by using F- Test, Principles of experimental designs, Analysis of variance (ANOVA) and its uses in the designs, One Way Analysis of variance followed by t test (pair wise), Two Way Analysis of variance followed by t test (pair wise)	7 Hrs.

Textbooks:

SN	Title	Edition	Author/s	Publisher	Year
1.	Fundamentals of Mathematical statistics	12	S. C. Gupta and V. K. Kapoor	Sultan Chand and Sons	2020
2.	Design and Analysis of Experiments	8	Douglas C. Montgomery	Wiley Student Edition	2013

Reference Books:

SN	Title	Edition	Author/s	Publisher	Year
1.	Probability and statistics for Engineers and Scientists.	9	Ronald Walpole	Persons Education	2013
2.	Applied Statistics and Probability for Engineers	6	Douglas C. Montgomery	Wiley Student Edition	2012

Title of the Course: Heat Transfer	L	T	P	Credits
Course Code:UBTC0402	4	-	-	4

Course Pre-Requisite: Basic knowledge in thermodynamics, fluid mechanics, units, dimensions and conversions

Course Description: The course will introduce the fundamental concepts of various modes of heat transfer. It deals with fundamental applied aspects of process design principles of heat transfer equipments and governing equations.

Course Objectives:

1. To introduce the mechanism and principles of heat transfer.
2. To explain heat transfer to fluids without phase change and with phase change
3. To explain different types of heat exchange equipments.
4. To analyze performance and design of evaporator

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Explain the mechanism and principles of heat transfer.	3	Applying
CO2	Calculate the heat transfer co-efficient in laminar, transition and turbulent regime.	2	Understanding
CO3	Explain the mechanism of boiling and condensation.	4	Analyzing
CO4	Analyze the design and performance of heat exchangers and Evaporators.	4	Analyzing

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2														
CO2	2														
CO3	1														
CO4	3	2		1					2	1			2		

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment Component	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and **ISE 2** are based on Assignment/Declared test/Quiz/Seminar/Group discussions/Presentation etc.
MSE is based on 50% of course content
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents:	
Unit 1:--- Mechanism of heat flow: Conduction, Convection, radiation. Heat transfer by conduction in solids: Fourier's law, steady state heat conduction through walls, single and multilayer. Heat flow through a cylinder and sphere, unsteady state heat conduction, and critical radius of lagging, Problems.	8 Hrs.
Unit 2:--- Principles of heat flow in fluids: Typical heat exchange equipment, co-current and counter current flow. Energy balances, rate of heat transfer, overall and individual heat transfer coefficient. Calculation of overall heat transfer co-efficient from individual heat transfer coefficients, fouling factors. Problems.	8 Hrs.
Unit 3:--- Heat transfer to fluids without phase change: Thermal boundary layer, heat transfer by forced convection in laminar flow. Heat transfer by forced convection in turbulent flow, Heat transfer in transition region, heat transfer by forced convection outside tubes, Estimation of heat transfer coefficient in natural convection, Problems.	9 Hrs.
Unit 4:--- Heat transfer to fluids with phase change: Heat transfer from condensing Vapors, drop wise and film wise condensation, Heat transfer to boiling liquids: Types of boiling, boiling of saturated liquid, maximum flux and critical temperature drop, minimum heat flux , film boiling and sub cooled boiling.	8Hrs.
Unit 5:--- Heat exchange equipments: Types of heat exchangers, single and multi-pass heat exchangers, correction of LMTD for multi-pass exchangers. Design calculations of heat exchangers.	9 Hrs.
Unit 6:-- Evaporation: Types of evaporators, Performance of tubular evaporator-capacity, economy. Enthalpy balances for single and multiple effect evaporators, Methods of feeding, single and multiple effect calculations.	10 Hrs.

Textbooks:

SN	Title	Edition	Author/s	Publisher	Year
1.	Unit Operations of Chemical Engineering	6	McCabe, W. L.,Smith, J. C., and Harriott,P.	McGraw-Hill	2001
2.	Process Heat Transfer		Kern D. Q	Tata McGraw-Hill	1997

Reference Books:

SN	Title	Edition	Author/s	Publisher	Year
1.	Bioprocess Engineering Principles		Pauline M. Doran,	Elsevier Science & Technology Books	May 1995
2.	Heat Transfer	9	Holman J.P	McGraw-Hill	2002

Title of the Course: Immunology Course Code:UBTC0403	L 3	T -	P -	Credit 3

Course Pre-Requisite: Basic knowledge of Cell biology and general biology.

Course Description: The course covers types of immunity, antigen, antibody, cells and organs involved in immunology, faulty B: T cell interactions hypersensitivity, autoimmunity, cancer immunology and antigen presentation.

Course Objectives:

1. To describe the structure, component, function and mechanism of immune system.
2. To explain mechanisms involved in immune system development and responsiveness.
3. To apply the knowledge of immunotechniques in various industries.

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's level	Bloom's Descriptor
CO1	Explain the structure, component, function and mechanism of immune system	2	Understanding
CO2	Explain mechanisms involved in immune system development and responsiveness	2	Understanding
CO3	Apply the knowledge of immunotechniques in various industries	3	Applying

CO-PO-PSO Mapping:

Course Objectives	Programme Outcomes												Programme specific outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
W	2	1	1	1						1		2	3		
CO2	2	1	1	2		3		2		1		2	3		
CO3	2		1	1						1			3		

Assessments :

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment Component	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:--- Outlines of Immunology - Types of Immunity, Primary and Secondary lymphoid organs, Antigen structure and Function, Antibody structure and Function	7 Hrs.
Unit 2:--- Immune Response - Cells of Immune system- Macrophages, T cells, B Cells, NK Cells, Mast cells. Subtypes of T Cells and their functions: Cytotoxic T cells, Helper T cells, Suppressor T cells and Regulatory T cells. Cytokines and their biological role; Phagocytosis; Humoral and Cell mediated Immune Response	7 Hrs.
Unit 3:--- Immunity of diseases - CD4 and CD8 mediated antibacterial, antihelmenthic, antiviral immunity. MHC and its significance, Hypersensitivity Type I, II, III, IV	7 Hrs.
Unit 4:--- Transplantation and Tumor Immunity -Transplantation - immunological basis of graft rejection, Immunological tolerance sub- acute, acute and chronic graft rejection Tumor immunology – ADCC, natural killer cell and CTL mediated Immunity	7 Hrs.

Unit 5:--- Autoimmune diseases and Immunodeficiencies - SLE, Rheumatoid Arthritis. T cell mediated immunodeficiency, B cell mediated immunodeficiency/ B combined cell mediated immunodeficiency, Disorders of phagocytosis, complement system and Disorders of complement	7 Hrs.
Unit 6:---Immunotechniques - Antigen – Antibody interactions- cross reactivity, precipitation, agglutination, neutralization, opsonization etc and their applications	7 Hrs.

Textbooks:

SN	Title	Edition	Author/s	Publisher	Year
1	Immunology	1	Lydyard, P.M et al	Viva Books	
2	Essential Immunology	9	Roitt, I.M	Blackwell Scientific	1997
3	Immunology	3	Kuby, J Freeman, W.H	Oxford	1997
4	Immunobiology	3	Janeway, et al	Garland Science	2004

Reference Books :

SN	Title	Edition	Author/s	Publisher	Year
1.	Fundamental immunology	5	William E Paul	Lippincott Williams	2003
2.	Practical Immunology	4	Frank C. Hay,M.R	Westwood	
3.	Short Protocols in Immunology	-	John E. Coligan		

Title of the Course: Genetic Engineering	L	T	P	Credits
Course Code:UBTC0404	3		-	3

Course Pre-Requisite: Student must have knowledge of basic Molecular Biology.

Course Description: Course contains basic processes used in Genetic Engineering, Gene Manipulation techniques and their applications**.**

Course Objectives: The student will be able to:

1. To define Biohazards and bioethics as well as need of Genetic Engg.
2. To categorize, select and use most suitable enzymes as well as vectors for gene manipulation.
3. To explain and apply the basic principles of cloning, genetic manipulations and DNA library.
4. To analyze and design various molecular techniques for r DNA technology.
5. To evaluate heterologous protein expression and applications in Protein Engineering

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Define Biohazards and bioethics as well as need of Genetic Engineering	1	Recalling
CO2	Categorize, select and use most suitable enzymes as well as vectors for genemanipulation	2	Understanding
CO3	Explain and apply the basic principles of cloning, genetic manipulation DNA library	1	Recalling
CO4	Analyze and design various molecular techniques for r DNA technology	4	Analyzing
CO5	Evaluate heterogonous protein expression and host expression system	5	Evaluating

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1				1		2		2				1			
CO2	1	1	2	1	1	1									
CO3	1	1	2	1	2	2						1			
CO4		1	2	1	2	2						1			
CO5	1	1	2	1	3	2						1			

Assessment Scheme:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment Component	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and **ISE 2** are based on Assignment/Declared test/Quiz/Seminar/Group discussions/ Presentation etc.

MSE is based on 50% of course content

ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents:

Unit 1: Recombinant DNA technology The recombinant DNA concept, Important Discoveries, Principles of cloning, Biohazards; risk for human health, environment, agriculture, interaction with non-target organism and Bioethics of Genetic Engineering	3 Hrs.
Unit 2: The Tools – Enzymes Nucleases, Restriction Endonucleases, Gibson assembly, Ligation independent , recombinant enzymes, DNA ligase, DNA polymerase I, Reverse transcriptase, Poly A polymerase. Synthetic Biology	6 Hrs.
Unit 3: The Tools – Vectors Vector Systems -*E coli* systems –Plasmid Vectors, Bacteriophage vectors, Plasmid-Phage combination vectors, Eukaryotic Host-Vector Systems: Yeast, Insect, Animal, Plant.	9 Hrs.
Unit 4: The Means: Constructing, Cloning, and Selecting Inserts, Ligating vectors to insert, Infection, Transfection, and Cloning, Screening Cloned Populations of Recombinants, Genomic Libraries:-construction of genomic library, cDNA library: synthesis of cDNA screening of cDNA clone, Ligation independent cloning.	6 Hrs.
Unit 5: Molecular research procedures DNA sequencing techniques; Maxam and Gilbert's chemical degradation method, Sanger and Courlson'sdideoxynucleotide chain termination method, PCR and its types, Blotting Techniques; southern, northern blotting Gene silencing techniques, CRISPER- CAS 9, Knockout Technology.	6 Hrs.
Unit 6: Methods of protein engineering Random and Site directed mutagenesis, PCR and error PCR based strategies for protein engineering, DNA/Gene Shuffling, Directed molecular evolution strategy- Phage Display systems, Cell Surface display systems, CAR-T therapy.	6Hrs.

Textbooks:

SN	Title	Edition	Author/s	Publisher	Year
1.	Molecular Biotechnology: Principles and Applications of Recombinant DNA	6	Bernard R. Glick, Cheryl L. Patten	(American Society for Microbiology)	2022
2.	Genes VIII	8	Benjamin Lewin	(Benjamin Cummings)	2003

Title of the Course : Bioinformatics	L	T	P	Credit
Course Code : UBTC0405	3	-	-	3

Course Pre-Requisite: Biochemistry, Molecular Biology, Genetic Engineering, Chemistry, Mathematics and Computer Literacy.

Course Description:
This subject provides information of biological databases, basics of matrices, genomics, proteomics and various applications of bioinformatics.

Course Objectives:
1. To introduce and impart students to Bioinformatics, its Applications and understandingofdatabasesofBioinformaticswithdifferencesbetweenvarious databases.
2. To learn and demonstrate the data storage, retrieval from different resources and sequence, structure visualization.
3. To illustrate the tools required the questions related genomics and proteomics.
4. To provide the opportunity to think, apply the tools and methods used in the course eg: to address the issues related to structural bioinformatics.

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive Level	Bloom's Cognitive Descriptor
CO1	Explain the importance, opportunities, challenges, applications the differences between various databases in Bioinformatics.	2	Understanding
CO2	Demonstrate the knowledge of data storage, retrieval from different resources, sequence alignment and structure visualization.	2	Understanding
CO3	Make use of the tools required to answer the questions related genomics and proteomics.	3	Applying
CO4	Make use of the tools and methods used in the course to address the issues related to structural bioinformatics.	3	Applying

CO-PO Mapping:

Course Objective	Programme Outcomes												Programme specific outcome		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	1		1									2		
CO2				1								1	3		
CO3				1	2				3	3		1			
CO4				1					3	3		1			

Assessments:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment Component	Marks
ISE1	10
MSE	30
ISE2	10
ESE	50

ISE1and ISE2arebasedon assignment/declared test/quiz/seminar/Group Discussions etc. MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on100%course content with 60-70%weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Unit 1:--- Introduction and Applications of Bioinformatics History, importance, opportunities and challenges of Bioinformatics. **Data generation**: Generation of large scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, microarray and Next Generation Sequencing: Data Analysis). Applications of Bioinformatics.	6 Hrs.
Unit 2:--- Introduction and importance of Databases Primary sequence databases, Secondary sequence databases, Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDBsum).	6 Hrs.
Unit 3:---Data storage and retrieval and Interoperability Flat files, relational, object oriented databases and controlled vocabularies. File Format (Genbank, DDBJ, FASTA, PDB, SwissProt). Introduction to Metadata and search; Indices, Boolean, Fuzzy, Neighboring search. The challenges of data exchange and integration. Ontologies, interchange languages and standardization efforts. General Introduction to XML, UMLS, CORBA, PYTHON.	6 Hrs.
Unit 4:----Sequence Alignments and Visualization Sequence Alignments and Visualization, Introduction to Sequences, alignments and Dynamic Programming, Local alignment and Global alignment (algorithm and example), Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm).Methods for presenting large quantities of biological data: sequence viewers (Artemis, SeqVISTA), 3D structure viewers (Rasmol, SPDBv, Chime, Cn3D, PyMol), Anatomical visualization.	8 Hrs.
Unit 5:--Introducing: Genomics and Proteomics Inheritance pattern in eukaryotes, Mutations, Gene variation, Gene-disease association, diagnostic genes and drug targets, genotyping tools - DNA Chips, diagnostic assays. Introduction to proteins, use of peptides as probes. Proteins as drugs; Mass-spec based analysis of protein expression. "Protein Chip"-interactions and detection techniques. Two dimensional PAGE for proteome analysis, Detection of proteins on SDS gels, Protein cleavage, Edman protein microsequencing, Automation in proteomics.	8 Hrs.
Unit 6:---Introduction to Molecular Structural Bioinformatics Introduction to Molecular Modeling and Simulation, QSAR and QSPR; brief introduction to protein structure hierarchy. Modeling applications – prediction of secondary structure of Protein and RNA. Docking Process – Protein preparation, ligand building, Setting of boundary box, Prediction of Binding pockets, pocket analysis, running of docking calculations.	8 Hrs.

Text books:

SN	Title	Edition	Author/s	Publisher	Year
1.	Bioinformatics: Methods and Applications	4	Rastogi S. C.,N.Mendiratta. , P Rastogi	PHI Learning	2013
2.	Bioinformatics: Databases, Tools, Algorithms	1	Bosu Dripta, ThukralS.K	Oxford UnivPress, New Delhi	2002

Reference Books:

SN	Title	Edition	Author/s	Publisher	Year
1.	Bioinformatics:sequenceandgenomeanalysis	4	David Mount	Cold springer harbour press	2004
2.	Introduction to bioinformatics	1	T.K.Attwoodand Parry-SmithD.J	Pearson Education Ltd.	2007
	Genomics & Proteomics	1	Sabesan	Ane Books	2007

Title of the Course: Audit Course IV : Environmental Studies	L	T	P	Credits
Course Code: UBTA0461	2	-	-	2

Course Pre-Requisite: Students shall have knowledge of: Science and Technology.

Course Description: The objective of the course is imparting fundamental knowledge and awareness of Environmental science among students and importance of conservation of environment.

Course Objectives:

At the end of the course students will be able to

1. Study scope and importance of natural resources, ecosystems, biodiversity for creating awareness and their conservation in multiple disciplines.
2. Learn various types of pollution, their impacts and control measures for minimizing pollution and sustainable development.
3. Understand social issues related environment, environmental ethics and human rights towards environment.
4. Study various laws and regulations related to environment and its applicability in society and industries

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Describe natural resources, importance of ecosystem and conservation of biodiversity with respect to multiple disciplines	2	Understanding
CO2	Explain causes, effects, solutions for various pollution problems and its minimization strategies.	2	Understanding
CO3	Discuss environmental ethics and their implementation for betterment of environment and human life.	4	Analyzing
CO4	Differentiate between requirements of laws and regulations for environmental conservation and applicability of legislations in society and industries.	4	Analyzing

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1							2								
CO2	3														
CO3								2							
CO4						2									

Assessment Scheme:

ESE: Assessment is based on 100% course content

Assessment Component	Marks
ESE	100

Course Contents:

Unit 1: Nature of Environmental Studies Definition, scope and importance, Multidisciplinary nature of environmental studies, Need for public awareness.	4 Hrs.
Unit 2: Natural Resources and Associated Problems a) Forest resources: Use and over-exploitation, deforestation, dams and their effects on forests and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam's	4 Hrs.

benefits and problems. c) Mineral resources: Usage and exploitation. Environmental effects of extracting and using mineral resources. d) Food resources: World food problem, changes caused by agriculture effect of modern agriculture, fertilizer-pesticide problems. e) Energy resources: Growing energy needs, renewable and nonrenewable energy resources, use of alternate energy sources. Solar energy, Biomass energy, Nuclear energy. f) Land resources: Solar energy, Biomass energy, Nuclear energy, Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of individuals in conservation of natural resources.	
Unit 3: Ecosystems Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers. Energy flow in the ecosystem, Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristics features, structure and function of the following ecosystem :- a) Forest ecosystem, b) Grassland ecosystem, c) Desert ecosystem, d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).	4 Hrs.
Unit 4: Biodiversity and its conservation Introduction- Definition: genetic, species and ecosystem diversity. Bio-geographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. India as a mega- diversity nation, Western Ghats as a biodiversity region. Hot-spot of biodiversity. Threats to biodiversity habitat loss, poaching of wildlife, man wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity	4 Hrs.
Unit 5: Environmental Pollution Definition: Causes, effects and control measures of: Air pollution, Water pollution, soil pollution, Marine pollution, Noise pollution, Thermal pollution,	4 Hrs.
Unit 6: Social Issues and the Environment Disaster management: floods, earthquake, cyclone, tsunami and landslides. Urban problems related to energy Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issue and possible solutions. Global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products.	4 Hrs.
Unit 7: Environmental Protection From Unsustainable to Sustainable development. Environmental Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Population Growth and Human Health, Human Rights	4 Hrs.

Textbooks:

SN	Title	Edition	Author/s	Publisher	Year
1.	Environmental Studies	1	Dr. P.D.Raut		2009

Reference Books:

SN	Title	Edition	Author/s	Publisher	Year
1.	Environmental Science.	5	Miller T.G. Jr.	Wadsworth Publications Co.(TB)	1994
2	Fundamentals of Ecology	5	Odum, E.P.	W.B.Saunders Co. USA,574p	2005
3	Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards,	vol. I and II,	Trivedi R.K.	Environmental Media (R)	2010

Title of the Course: Heat Transfer Laboratory	L	T	P	Credits
Course Code:UBTC0431	-	-	2	1

Course Pre-Requisite: Basic knowledge in thermodynamics, fluid mechanics, units, dimensions and conversions

Course Description: To understand the fundamentals of heat transfer mechanisms and its applications

Course Objectives:

1. To calculate thermal conductivity, heat transfer coefficient.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Determine the thermal conductivity of various materials	5	Evaluating
CO2	Determine heat transfer co-efficient for natural and forced convection	5	Evaluating
CO3	Compare the effectiveness of double pipe heat exchangers for parallel and counter flow	4	Analyzing

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1			2						2					
CO2	1			2						2					
CO3	1	1		2						2					
CO4															

Assessments :

One component of In Semester Evaluation (ISE) and one component of ESE having 67% and 33% weightage respectively.

Assessment Component	Marks
ISE	50
ESE(POE)	25

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

ESE –Assessment based on oral examination.

Course Contents:

ExperimentNo.1:---Heat transfer in metal rod **Aim and Objectives:** To determine thermal conductivity of metal	2 Hrs.
Experiment No. 2:--- Heat Transfer through insulating powder **Aim and objectives: To** determines thermal conductivity of insulating powder**.**	2 Hrs.
ExperimentNo.3:---Double pipe heat exchanger **Aim and Objectives:** To determine experimentally Log Mean Temperature Difference(LMTD), Overallheattransfercoefficient(U)andEffectivenessofParallelflowandCounterflowHeat Exchangers	2 Hrs.
ExperimentNo.4:---Shell & tube heat exchanger **Aim and Objectives;** To explain construction and working of shell and tube heat exchanger	2 Hrs.
ExperimentNo.5:---Forced convection **Aim and Objectives:** To determine average heat transfer coefficient in forced convection	2 Hrs.

ExperimentNo.7:---Heat transfer through Lagged pipe **Aim and Objectives:** To determine thermal conductivity of insulating material used in lagged pipe.	2 Hrs.
ExperimentNo.8:---Heat transfer through composite wall **Aim and Objectives:** To determine the equivalent thermal resistance of composite wall.	2 Hrs.

Textbooks:

SN	Title	Edition	Author/s	Publisher	Year
1.	Unit Operations of Chemical Engineering	6	McCabe, W. L.,Smith, J. C., and Harriott,P.	McGraw-Hill	2001
2.	Process Heat Transfer	6	Kern D. Q	Tata McGraw-Hill	1997

Reference:

SN	Title	Edition	Author/s	Publisher	Year
1.	Bioprocess Engineering Principles	-	Pauline M. Doran,	Elsevier Science & Technology Books	May 1995
2.	Heat Transfer	9	Holman J.P	McGraw-Hill	2002

Title of the Course: Immunology Laboratory Course Code:UBTC0432	L	T	P	Credit
	0	0	2	1

Course Pre-Requisite: Basic knowledge of Cell biology & general biology.

Course Description: The course covers types of immunity, antigen, antibody, cells and organs involved in immunology, faulty B: T cell interactions hypersensitivity, autoimmunity, cancer immunology and antigen presentation.

Course Objectives:

1. To identify different cells of immune system using staining and microscopic techniques.
2. To perform immunotechniques.

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Identify different cells of immune system using staining and microscopic techniques	3	Applying
CO2	Analyze the results of immunotechniques	4	Analyzing

CO-PO Mapping:

Course Objectives	Programme Outcomes												Programme specific outcomes		
	PO1	PO2	PO3	PO4	PO	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1						1		2	3		
CO2	2	1	1	2		3		2		1		2	3		

Assessments :

One component of In Semester Evaluation (ISE) and one component of ESE having 67% and 33% weightage respectively.

Assessment Component	Marks
ISE	50
ESE(POE)	25

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

ESE –Assessment based on oral examination.

Course Contents:

Experiment No. 1:---To examine the cells that comprise the immune system (counts and morphology) **Aim and Objectives:** To perform the examination of the cells that comprise the immune system (counts and morphology)	2 Hrs.
Experiment No. 2:---Immunization, collection of serum. **Aim and Objectives:** To perform Immunization, collection of serum.	2 Hrs.
Experiment No. 3:---Immunological detection of blood group typing.(A,B, AB and O, Rh Factor) **Aim and Objectives:** To perform blood group typing.	2 Hrs.
Experiment No. 4:---Ouchterlony double diffusion **Aim and Objectives:** To perform Ouchterlony double diffusion	2 Hrs.
Experiment No. 5:---Radial immunodiffussion **Aim and Objectives:** To perform Radial immunodiffussion	2 Hrs.
Experiment No. 6:---Immunoelectrophoresis **Aim and Objectives:** To perform Immunoelectrophoresis	2 Hrs.
Experiment No. 7:---ELISA **Aim and Objectives:** To perform ELISA	2 Hrs.

Experiment No. 8:---Western blotting **Aim and Objectives:** To perform western blotting	2 Hrs.
Experiment No. 9:---Detection of pregnancy by HCG technique **Aim and Objectives:** To perform HCG technique	2 Hrs.
Experiment No. 10:---Precipitation assay **Aim and Objectives:** To perform Precipitation assay	2 Hrs.

Textbooks:

S.N.	Title	Edition	Author/s	Publisher	Year
1	Immunology	1	Lydyard, P.M et al	Viva Books	
2	Essential Immunology	9	Roitt, I.M	Blackwell Scientific	1997
3	Immunology	3	Kuby, J Freeman, W.H	Oxford	1997
4	Immunobiology	3	Janeway, et al	Garland Science	2004

Reference books:

S.N.	Title	Edition	Author/s	Publisher	Year
1	Fundamental immunology	5	William E Paul	Lippincott Williams & Wilkins, Philadelphia	2003.
2	Practical Immunology	4	Frank C. Hay, Olwyn M.R	Westwood	
3	Short Protocols in Immunology	-	John E. Coligan		

Title of the Course: Genetic Engineering Laboratory Course Code:UBTC0433	L	T	P	Credits
	-	-	2	1

Course Pre-Requisite: Student must have a knowledge of basic Molecular Biology

Course Description: Course contain basic processes used in Genetic Engineering, Gene Manipulation techniques and their applications

Course Objectives: The student will be able to:

1) To perform restriction digestion and mapping of DNA
2)To demonstrate and design PCR reaction and blotting of nucleic acid
3) To explain and apply size determination and karyotyping of DNA
4) To analyze and perform transformation of DNA in *E. coli*

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Perform restriction digestion and mapping of DNA	2	Defining
CO2	Demonstrate and design PCR reaction and blotting of nucleic acid	3	Categorizing
CO3	Explain and apply size determination and karyotyping of DNA.	3	Applying
CO4	Analyze and perform transformation of DNA in *E. coli*	4	Analyzing

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1											1			
CO2	1	1			1										
CO3	1								3			1			
CO4	1								3			1			

Assessment Scheme:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment Component	Marks
ISE	50
ESE (POE)	25

ISE 1 and **ISE 2** are based on Assignment/Declared test/Quiz/Seminar/Group discussions/Presentation etc.
MSE is based on 50% of course content
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents:	
Experiment No. 1:---Aim: To perform **r**estriction digestion of DNA. **Outcome:** DNA can be cleaved at specific site by RE enzymes and used for gene manipulation.	2 Hrs.
Experiment No. 2:---Aim: To perform **r**estriction mapping of Plasmid DNA. **Outcome:** DNA can be cleaved at specific site by RE enzymes and used for formation of restriction map of DNA.	2 Hrs.
Experiment No. 3:---Aim: To demonstrate and perform PCR reaction of nucleic acid. **Outcome:** By using this advanced technique, specific segment of DNA can be amplified in vitro.	2 Hrs.
Experiment No. 4:---Aim: To perform size determination of DNA or RNA. **Outcome:** Based on molecular marker and semi log graph size of unknown DNA molecule can be determined.	2Hrs.
Experiment No. 5:---Aim : To perform Southern Blotting of DNA **Outcome:** 1. To blot the DNA on nylon or nitrocellulose membrane.	2 Hrs.
Experiment No. 6:---Aim: To perform karyotyping of chromosomes **Outcomes:** Karyotype of chromosome is useful to identify genetic diseases and analysis.	2 Hrs.
Experiment No. 7:---Aim: To prepare competent *E. Coli* cells for transformation **Outcome:** The bacterial culture get revived and treated with $Cacl_2$ for making them competent for transformation.	2 Hrs.
Experiment No. 8:---Aim: To perform transformation and screening transformants. **Outcome:** The bacterial cultures get transformed by heat shock treatment and later on screened for transformants by blue white screening.	2 Hrs.

Textbooks:

SN	Title	Edition	Author/s	Publisher	Year
1.	Molecular Biotechnology: Principles and Applications of Recombinant DNA	6	Bernard Glick &Cheryl Patten	American Society for Microbiology	2022
2.	Genes VIII	8	Benjamin Lewin	Benjamin Cummings	2003

SN	Title	Edition	Author/s	Publisher	Year
1.	Genes & Genomes, a Changing Perspective	1	Singer M and Berg P	University Science book, Mill Vally California Publication.	1991
2.	Molecular Biology of the Cell	4	Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter	Garland Science	2002
3.	Molecular Cloning Vol. I, II & III	4	J.F. Sambrook and D.W. Russell	ColdSpring HarborUniversity Publishing	2002

Title of the Course: Bioinformatics Laboratory CourseCode:UBTC0434	L	T	P	Credit
	-	-	2	1

Course Pre-Requisite:
Biochemistry, Molecular Biology, Genetic Engineering, Chemistry, Mathematics and Computer Literacy.

Course Description:
1. This course introduces students to the resource to access scientific data and bioinformatics tools
2. This course explains the retrieval of sequences from various databases.
3. This course compares between the different software tools to assess the sequence similarities and also software's for evolutionary studies.
4. This course deals tools used in protein visualization.

Course Objectives:
1. To understand the basics of tools in the bioinformatics.
2. To exploit various software's for sequence retrieval and their analysis.
3. To analyze the differences in the sequences and multiple sequence alignment results.
4. To compare different platforms for sequence alignment and evolutionary studies.
5. To select the platforms for performing tasks to address the problems in Biotechnology.

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive Level	Bloom's Cognitive Descriptor
CO1	Make use of software tools for sequence and data retrieval, drug discovery, etc. and their analysis.	3	Applying
CO2	Analyze the differences in the sequences and multiple sequence alignment results and visualized structures of proteins.	4	Analyzing

CO-PO mapping:

CO	Programme Outcomes												Programme specific outcome		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	2	3				3	1			2		
CO2	1	2	1	2	3				3	1			2		

Assessments:
One component of In Semester Evaluation (ISE) having 100% weightage.

Assessment Component	Marks
ISE	25

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/Internal oral etc.

Course Contents:	
Experiment No. 1:---Introduction to NCBI **Aim and Objective :** To understand and use the features of NCBI (Pubmed and PMC)	2 Hrs.
Experiment No. 2:---Retrieving sequence records with NCBI (Entrez), EMBL, PROSITE, SWISSPROT, etc. **Aim and Objective :** To retrieve nucleotide and protein sequence.	2 Hrs.
Experiment No. 3:---BLAST and FASTA **Aim and Objective :**To study BLAST and FASTA	2 Hrs.
Experiment No. 4:---CLUSTAL-W. **Aim and Objective :**To study multiple sequence alignment	2 Hrs.
Experiment No. 5:--- Visualizing the secondary structure of Protein **Aim and Objective :**To study and wok with Rasmol/Pymol for protein structure visualization	2 Hrs.
Experiment No. 6:---Primary structure visualization of a protein using Protoparam. **Aim and Objectives:** To computes the various physical and chemical parameters of a protein, To perform primary structure analysis of proteins, To introduce a protein analysis software that is available through the ExPASy server.	2 Hrs.
Experiment No. 7:--- Retrieving details of a drug molecule **Aim and Objective:** To find the structure and activity of drug molecule.	2 Hrs.
Experiment No. 8 :---Surface Analysis of a protein using CASTp **Aim and Objective :**To get a detailed and complete quantitative characterization of surface pockets and interior voids of proteins using CASTp (Computed Atlas of Surface Topography of proteins),To familiarize with the online resource CASTp	2 Hrs.

Textbooks:

SN	Title	Edition	Author/s	Publisher	Year
1.	BioinformaticsTheory andPractice	1	Chikhale N.J., GomasV.S	Himalaya Pub. House	
2.	Bioinformatics: A practical guide to the analysis of genes and Proteins	2	Baxevanis, A. D. and Ouellette, B, F, F	John wiley and ons, Inc. publications	2002

Reference Books:

SN	Title	Edition	Author/s	Publisher	Year
1.	Bioinformatics: sequence and genome analysis	1	David Mount	Cold springer harbour press	2004
2.	Introduction to bioinformatics	1	T.K. Attwood and Parry-Smith D.J	John wiley publications	2002

Title of the Course: Mini Project	L	T	P	Credits
Course Code: UBTC0441	-	-	2	1

Course Pre-Requisite: All theoretical concepts and practical skills learnt in second year courses

Course Description: Mini Project I includes a group of students working on a problem statement provided with preparation of work plan, execution and submission of a synoptic summary in the form of report.

Course Objectives: 1. To explain the approach to address the problem statement provided using the fundamental understanding of concepts.
2. To develop a plan of work based on aim and objectives finalized.
3. To elaborate the synoptic plan and executed project work effectively using oral and written means.

Course Outcomes:

COs	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	To explain the approach to address the problem statement provided using the fundamental understanding of concepts.	2	Understanding
CO2	To develop a plan of work based on aim and objectives finalized.	3	Applying
CO3	To elaborate the synoptic plan and executed project work effectively using oral and written means	3	Applying

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3			1			3			3		
CO2		3	2			1			2	3			3		
CO3	3	3	3	3	1			1	3	3	2	1	3		3

Assessment Scheme:
One component of In Semester Evaluation (ISE) with 100% weightage

Assessment Component	Marks
ISE	50

ISE is based on rubrics based progressive report submission and presentation to supervisors.

Description :

The objective of the project is to make use of the knowledge gained by the student at various stages of the degree course. This helps to judge the basic understanding of concepts in various courses, capacity of planning and executing the application of the knowledge. Reporting the outcomes effectively.

Projects Areas can be related to -

1. Microbiology
2. Biochemistry
3. Cell Biology
4. Molecular Biology
5. Enzyme Technology
6. Immunology
7. Genetic Engineering
8. Bioinformatics
9. Fluid Mechanics
10. Heat Transfer