BASAVESHWAR ENGINEERING COLLEGE, BAGALKOTE
DEPARTMENT OF BIOTECHNOLOGY
SCHEME OF TEACHING AND EXAMINATION

2021-2022

B.E. III SEMESTER

Sl. No.	Subject Code	Subject Title		Hours/Week			Examination Marks		
			Credits	Lecture	Tutorial	Practical	CIE	SEE	Total
1	UMA392C	Numerical Techniques & Fourier Series	3	3	0	0	50	50	100
2	UBT305C	Biochemistry	3	3	0	0	50	50	100
3	UBT315C	Bioprocess Principles & Calculations	3	2	2	0	50	50	100
4	UBT312C	Unit Operations	3	3	0	0	50	50	100
5	UBT313C	Microbiology	3	3	0	0	50	50	100
6	UBT317C	Cytogenetics and Cell Culture Techniques	3	3	0	0	50	50	100
7	UBT307L	Biochemistry Lab	1.5	0	0	3	50	50	100
8	UBT308L	Microbiology Lab	1.5	0	0	3	50	50	100
9	UBT311L	Unit Operations Lab	1.0	0	0	2	50	50	100
10	UHS388C	Samskruthika Kannada	1	2	0	0	50	50	100
Total			**23**	**19**	**02**	**8**	**500**	**500**	**1000**

UMA392C	NUMERICAL TECHNIQUES AND FOURIER SERIES	Credits : 03
L:T:P - 3:0:0		CIE Marks : 50
Total Hours /Week: 03		SEE Marks : 50

UNIT – 1	10 Hrs.

Numerical Analysis-I: **10 Hours**

Introduction to root finding problems, Bisection Method, Newton-Raphson method. Finite differences, forward and backward difference operators (no derivations on relations between operators) Newton-Gregory forward and backward interpolation formulae. (Without proof), Lagrange's and Newton's divided difference interpolation formulae (without proof).

UNIT – 2	10 Hrs.

Numerical Analysis-II: **10 Hours**

Numerical differentiation using Newton's forward and backward formulae-problems.Trapezoidal rule, Simpson's one third rule, Simpson's three eighth rule and Weddle's rule (no derivation of any formulae)-problems. Euler's and Modified Euler's method, Runge-Kutta 4^{th} order method.

UNIT – 3	10 Hrs.

Fourier series: **10 Hours**

Periodic functions, Conditions for Fourier series expansions, Fourier series expansion of continuous and functions having finite number of discontinuities, even and odd functions. Half-range series, practical harmonic analysis.

UNIT – 4	10 Hrs.

Fourier transforms and z-transforms: **10 Hours**

Infinite Fourier transforms and inverse Fourier transforms- simple properties, Fourier sine and Fourier cosine transforms, Inverse Fourier sine and cosine transforms. Z-transforms-definition, standard forms, linearity property, damping rule, shifting rule-problems.

Reference Books *

1. Numerical Methods for Engineers by Steven C Chapra& Raymond P Canale.
2. Higher Engineering Mathematics by Dr. B.S. Grewal, Khanna Publishers, New Delhi.
3. Advanced Engineering Mathematics by H. K. Das, S. Chand & company Ltd. Ram Nagar, New Delhi.
4. Advanced Engineering Mathematics by E Kreyszig (John Wiley & Sons)

Course Outcomes **

After completion of the course the students shall be able to,

1. Solve engineering problems using non-linear equations and interpolation techniques.
2. Solve problems using numerical differentiation and numerical integration.
3. Solve ordinary differential equations using numerical methods.
4. Solve Problems using the Fourier series.
5. Solve problems using the basic concept of Fourier transforms.

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-

CO5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-

UBT305C	**BIOCHEMISTRY**	**Credits: 03**
L:T:P – 3:0:0		**CIE Marks: 50**
Total Hours/ Week: 03		**SEE Marks: 50**

UNIT-I	**12 Hrs.**

Principles of Bioenergetics:

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

Carbohydrate Metabolism:

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

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

Osazone formation to identify the carbohydrates.

UNIT–II	**10 Hrs.**

Lipid Metabolism:

Biosynthesis of fatty acids. cholesterol, phospholipids and glycolipids, Regulation of fatty acid biosynthesis, biodegradation of fatty acid, ketone bodies production during starving and diabetes.

Disorders of lipid metabolism- Sphingolipidoses etc.

UNIT–III	**10 Hrs.**

Nucleic acid Metabolism:

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

UNIT–IV	**10 Hrs.**

Amino Acid Metabolism:

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

Reference Books *

1. David L. Nelson and Michael Cox (2011). “Lehninger Principles of Biochemistry” –6th Edition.
2. Lubert Stryer (2010)., “Biochemistry” -Freeman & Co., Pub.
3. Voet&Voet (2004). “Biochemistry”- 3rd Edition, John Wiley, New York Pub.
4. Thomas M. Davlins (2001). “Biochemistry with clinical correlations” Wiley-Liss; 5 edition.
5. Mathews, Vanholde & Arhen (2010). “Biochemistry” -3rd Edition, Pearson Education Pub., 3rd Edition.
6. K. Trehan (2003). “Biochemistry” -New Age International Pub, 2nd edition.
7. Elliot & William H (2005). “Biochemistry & Molecular Biology” Oxford Pub.
8. Helmreich JEM (2005). “Biochemistry of cell signaling” –Oxford Pub.
9. U. Sathyanarayana (2007). “Biochemistry” -Books and Allied Pub.
10. Berg J.M., Stryer, Tymoczko J.L (2010). “Biochemistry” Freeman & co.
11. Freifelder D (2003). “Molecular Biology” -Narosa Publications, 2nd Edition.

Course Outcomes**

After completion of the course student will have the

1. Ability to understand the principles of high energy compounds & interpret the metabolic pathways in the carbohydrates and their disorders
2. Ability to recognize the regulation of lipid metabolism along with the in born errors.
3. Ability to understand the origin of atoms in purine and pyrimidine & also interpret the pathways in the nucleic acid metabolism disorders
4. Ability to comprehend pathways involved in amino acid metabolism and its disorders

*** Books to be listed as per the format with decreasing level of coverage of syllabus**

**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	2	3	2	-		-	-	-	-	-	1	2	2	-
CO2	2	3	3	3	-	3	-	-	-	-	-	1	2	1	1
CO3	2	2	3	3	-	3	-	-	-	-	-	3	2	2	-
CO4	2	2	2	2	-	2	-	-	-	-	-	2	2	2	-

UBT315C	BIOPROCESS PRINCIPLES AND CALCULATIONS	Credits: 03
L:T:P – 2:2:0		CIE Marks: 50
Total Hours/Week: 04		SEE Marks: 50

UNIT–I	10 Hrs.

Introduction & Basic Chemical Calculations:

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

UNIT–II	10 Hrs.

Material balance without chemical reactions:

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

UNIT–III	10 Hrs.

Material balance involving chemical reactions:

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

UNIT–IV	10 Hrs.

Energy Balance:

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

Reference Books *

1. Hougen OA, Wats (2018) Chemical Process Principles: Part I, 2nd Edn., John Wiley, USA.
2. P.M.Doran (2012) Bioprocess Engineering Principles, 2nd Edition, Elsevier India Pvt Ltd.
3. Gavhane K A (2009) Process Calculations Stoichiometry, 2nd Edn, Nirali Prakashan, India.
4. M.L.Shuler and F.Kargi (2008) Bioprocess Engineering--basic Concepts, 2nd Edn. Prentice-hall of India Pvt Ltd.
5. Narayanan K V, Lakshmikutty B (2016) Stoichiometry and Process Calculations, 2nd Edition, PHI India.
6. D.M.Himmelblau (2014) Basic Principles and Calculations in Chemical Engineering, 8th Edn,
7. Phi Learning Pvt Ltd.
8. Segel IH (2010) Biochemical Calculations 2nd Edn., John Wiley & Sons, NewYork.
9. Bailey JE and Ollis DF (1993) Biochemical Engg. Fundamentals, McGraw Hill, Newyork, USA.

Course Outcomes**

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

*** Books to be listed as per the format with decreasing level of coverage of syllabus**

**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	2	2	1	1	-	-	-	-	-	-	-	3	-	-
CO 2	3	2	3	2	1	-	-	-	-	-	-	-	3	-	-
CO 3	2	3	2	2	1	-	-	-	-	-	-	-	3	-	-
CO 4	3	2	1	1	1	-	-	-	-	-	-	-	3	-	-
CO 5	2	3	3	1	1	-	-	-	-	-	-	-	2	-	-
CO 6	2	2	2	2	1	-	-	-	-	-	-	-	2	-	-

UBT312C	UNIT OPERATIONS	Credits: 03
L:T:P – 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

Introduction to Fluid Mechanics:

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

UNIT–II	10 Hrs.

Flow past Immersed Bodies:

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

UNIT–III	10 Hrs.

Flow measurements:

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

UNIT–IV	10 Hrs.

Mechanical Operations:

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

Reference Books *

1. McCabe WL, Smith JC and Harriott (2005) Unit operations of Chemical Engineering, 7th Edn., McGraw-Hill Publications, USA.
2. Gavhane K. A (2012) Unit Operations I & II, 22nd Edn. Nirali Prakashan, India.
3. Alan S Foust, Wenzel LA, Clump CW, Maus L, and Anderson LB (2008) Principles of Unit Operations. 3rd Edn. John Wiley & Sons, USA.
4. R. P. Chhabra V. Shankar (2017) Coulson and Richardson's Chemical Engineering Volume 1A: Fluid Flow: Fundamentals and Applications. 7th Edition, Elsevier, USA.
5. R.P. Chhabra Basavaraj Gurappa (2019) Coulson and Richardson's Chemical Engineering Volume 2A: Particulate Systems and Particle Technology. 6th Edition, Elsevier, USA.

Course Outcomes**

After completion of the course student will be able to

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

*** Books to be listed as per the format with decreasing level of coverage of syllabus**

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Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	2	2	1	1	-	-	-	-	-	-	-	3	-	-
CO 2	3	2	3	2	1	-	-	-	-	-	-	-	3	-	-
CO 3	2	3	2	2	1	-	-	-	-	-	-	-	3	-	-
CO 4	3	2	1	1	1	-	-	-	-	-	-	-	3	-	-
CO 5	2	3	3	1	1	-	-	-	-	-	-	-	2	-	-
CO 6	2	2	2	2	1	-	-	-	-	-	-	-	2	-	-

UBT313C	MICROBIOLOGY	Credits: 03
L:T:P – 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hours

Introduction:
Scope of microbiology, History of microbiology-Evolution of microbes. Contributions of Scientist for the development of microbiology. Microbial diversity & taxonomy, Prokaryotes & Eukaryotes.

Microscopy:
Principles and applications of Bright field microscopy, Dark-Field Microscopy, Phase contrast microscopy, Fluorescence Microscopy and Electron microscopy (SEM & TEM).

UNIT–II	10 Hrs.

Microorganisms:
Bacteria- Morphology and ultrastructure of Bacteria, Culturing of bacteria, Types of media reproduction and growth (continuous and batch). Viruses, fungi, algae, protozoa, actinomycetes- structure and modes of reproduction. Fastidious microorganisms. Microbial toxins.

Microbial Techniques: Culture techniques- Aerobic and Anaerobic culture techniques. Fermentation(acid & alcohol).

UNIT–III	10 Hrs.

Control of Microorganisms:
Control of microorganisms by Physical methods and chemical methods, antibiotics, chemotherapeutic agents and Phage biotics.

Medical Microbiology: **Normal**
microflora, common diseases caused by microbes-pathogenesis, symptoms, diagnosis, treatment, prevention and control (Typhoid, Malaria,Polio, Sars, Dengue, hepatitis, Cholera)

UNIT–IV	12 Hrs.

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

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

Reference Books *

1. Pelczar, Chan and Noel Kreig, 2010 “Microbiology”- 5th Edition Tata Macgraw Hill
2. Tortora, Funke and Case, 2006, “Microbiology an Introduction” -8th Edition, Pearson Education.
3. E Alcamo I 2001. “Fundamentals of Microbiology”6th Ed, Jones & Bartlet, Pub.
4. Prescott, Harley & Klein, 2008, “Microbiology” -7th Edition, WCB/McGraw Hill, Int. Edition.
5. Prescot and Dunn, 2002, “Industrial Microbiology”-Agribios India.

Course Outcomes**

1. Ability to know the basic concepts of Microbiology, scope ,organization
2. Ability to analyze the techniques to study microorganisms through microscopy
3. Ability to analyze the structure of different microbes and interpret the techniques used to grow and identify the microbes

4. Ability to discuss the causative organisms of the disease and their effect on society
5. Ability to comprehend the applications in the industry and their use in society
6. Ability to analyse the applied techniques in the environment and create awareness to society

*** Books to be listed as per the format with decreasing level of coverage of syllabus**

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Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	2	-	-	2	-	-	-	-	-	-	1	1	1
CO2	2	2	2	-	2	3	-	-	-	-	-	-	2	1	2
CO3	3	3	2	-	2	2	-	-	-	-	-	1	1	1	2
CO4	3	3	3	-	2	3	-	-	-	-	-	1	2	1	3
CO5	2	2	1	-	2	1	-	-	-	-	-	2	1	1	1
CO6	2	2	1	-	3	1	-	-	-	-	-	2	2	1	3

UBT317C	CYTOGENETICS AND CELL CULTURE TECHNIQUES	Credits: 03
L:T:P – 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hours

Cell cycle and its regulation:

Cell & cell organelles, chromosome structure and its organisation, Cell division-mitosis and meiosis & their significance, (gametogenesis) cell cycle: check points, cell cycle and Regulation, factors regulating M phase initiation, M phase kinase, activation and inactivation.

Introductory genetics:

Mendel's laws of inheritance, Gene interactions-complete, incomplete, supplementary, complimentary, epistasis-inhibitory. Multiple allelism, Linkage, recombination and chromosomal mapping. Sex linked inheritance and extra chromosomal inheritance.

UNIT–II	10 Hrs.

Plant cell culture

History and Introduction, requirements, lab organisation, media constituents, choice of media sterilization of media, explant selection, sterilisation and preparation for inoculation, role of growth hormones in cell culture. Cellular totipotency, cytodifferentition, organogenic differentiation, embryogenesis. Plant growth factors and hormones - auxins, gibberlins, cytokines and others. Stoichometry of cell growth and product formation.

Culture techniques and applications, cell and organ culture, protoplast culture, somatic hybridization, haploid production ,micro propagation: somaclonal variation Regeneration of plantlets-shooting, rooting and hardening, synthetic seeds.

UNIT–III	10 Hrs.

Animal cell culture Techniques:

History and development of mammalian cell culture. Lab organization, Introduction to balanced salt solutions. Cell culture media (Natural and Artificial) - components of the medium, functions of media components. Role of antibiotics in media. Cell lines – Mechanical and enzymatic mode of desegregation, establishment of primary culture. Subculture - passage number, split ratio, seeding efficiency, criteria for subculture. Cell lines -definite and continuous cell lines. Measurement of cell number Haemocytometer and coulter counter.

UNIT–IV	12 Hrs.

Cell line Characterisation and Maintenance:

Measurement of Cell viability and Cytotoxicity. Dye exclusion and inclusion tests, clonogenic assay, and MTT, PDT. Characterization, maintenance and preservation of cell lines (cryopreservation). Cell line contaminations, detection and control, cell transformation – normal v/s. Transformed cells, growth characteristics of transformed cells. In Vitro Fertilization (IVF) and Embryo Transfer Technique (ETT). Embryo splitting. Diagnosis of genetic diseases.

Reference Books *

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter Molecular biology of The Cell, GS pub, 2002.
2. Culture of Animal cells-3rd Edition-R.Ian Freshney.Wiley Less 2010.
3. Rastogi S C "Cell Biology" - New Age International Pub. 2005.
4. Powar C.B., "Cell Biology", Himalaya Pub. 2006.
5. Channarayappa, Cell biology, Universities Press, 2010.
6. Gardener, Simmons and Snustad,"Principles of Genetics"John Willey Publisher,2003

7. Singh B.D, “Fundamentals of Genetics”, Kalyani Pub, 2010.
8. Biotech Expanding Horizons-B. D. Singh, Kalyani Publishers, 2010.
9. Introduction to Plant biotechnology by H. S. Chawla, 2nd Edition, Oxford and IBH Publishers, 2010

Course Outcomes**

Student will be

1. Able to understand the chromosome structure, cell cycle regulation and Mendalian genetics.
2. Able to use the plant cells to produce in vitro cultures
3. Able to apply the tissue culture techniques in various applications
4. Able to acquire working knowledge of culture of animal cells in *in vitro* conditions.
5. Able to identify, describe and classify the contaminants of cell culture and cryopreservation techniques
6. Able to identify the various applications of cell culture techniques

*** Books to be listed as per the format with decreasing level of coverage of syllabus**

**** Each CO to be written with proper action word and should be assessable and quantifiable**

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

UBT307L	BIOCHEMISTRY LABORATORY	Credits: 1.5
L:T:P – 0:0:3		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

LIST OF EXPERIMENTS IN BIOCHEMISTRY LABORATORY

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

Reference Books *

1. Laboratory manual of Biochemistry by Pattabiraman , 4th Edition, International book publishers India, 2017.
2. Sadasivam and Manickam, "Biochemical Methods", 2nd Edition, New age international Publishers, 2017.

Course Outcomes**

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

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	3	2	-	-	3	3	-	-	-	3	2	3	1
CO2	2	3	3	2	-	-	2	3	-	-	-	3	2	3	1
CO3	2	3	3	3	-	3	2	2	-	-	-	2	2	1	2
CO4	3	3	3	2	-	2	2	2	-	-	-	2	3	1	1
CO5	2	2	2	2	-	1	2	2	-	-	-	3	3	2	1
CO6	2	2	3	3	-	3		3	-	-	-	2	3	2	1

UBT308L	MICROBIOLOGY LABORATORY	Credits: 1.5
L:T:P – 0:0:3		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

LIST OF EXPERIMENTS IN MICROBIOLOGY LABORATORY

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

Reference Books *

1. Pelczar, Chan and Noel Kreig, 2010 , "Microbiology"- 5th Edition Tata Macgraw Hill,.
2. Tortora, Funke and Case, 2006. "Microbiology an Introduction" -8th Edition, Pearson Education,
3. K. R. Aneja, 2004. "Experiments in Microbiology, Plant Pathology and Biotechnology" ,4th Edition, New age International Pub.

Course Outcomes**

After completion of the course student will be able to

1. Analyze the principle and procedures of different experiments
2. Perform simple and differential staining techniques
3. Prepare the media for culturing microbes
4. Observe the motility of organisms
5. Interpret the instruments and different components used in lab interpret the subject orally.

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	-	-	2	1	-	-	-	-	-	3	1	1	1
CO2	2	2	-	-	2	3	-	-	-	-	-	2	2	1	2
CO3	3	3	-	-	3	2	-	-	-	-	-	2	1	1	2
CO4	3	3	-	-	2	3	-	-	-	-	-	3	2	1	3
CO5	1	3	-	-	3	1	-	-	-	-	-	3	1	2	1
CO6	2	1	-	-	3	1	-	-	-	-	-	3	1	2	1

UBT311L	UNIT OPERATIONS LABORATORY	Credits: 01
L:T:P -0:0:2		CIE Marks: 50
Total Hours/Week: 02		SEE Marks: 50

LIST OF EXPERIMENTS IN UNIT OPERATIONS LABORATORY

1. Friction in circular and non-circular pipes
2. Flow rate measurement using Orifice meter
3. Flow rate measurement using Venture meter
4. Batch sedimentation test
5. Constant pressure /constant filtration using leaf filter
6. Verification of Stoke's law in Free / Hindered settling
7. Determination of screen effectiveness and sieve analysis
8. Verification of Bernoulli's theorem
9. Unsteady state flow
10. Study of pump characteristics
11. Study of packed bed characteristics
12. Distillation

Reference Books *

1. Mccabe W.L. And Smith J.C, "Unit Operations In Chemical Engineering" -7th Edition, Mcgraw-Hill, 2017.
2. Goenkloplis, "Principles of Unit Operations" -P H I Publication, 1993.
3. Badger, Banchero and Walter (1955). Introduction to Chemical Engineering, 3rd Edn, Mcgraw- Hill Publications, USA.
4. Alan S Foust, Wenzel LA, Clump CW, Maus L, and Anderson LB (2008). Principles of Unit Operations. 2nd Edn., John Wiley & Sons, USA.
5. Coulson And Richardson's (2011); Chemical Engineering, Vols I & II., 6 Th Edn., Reed Educational And Professional Publishing Ltd., USA.

Course Outcomes**

On successful completion of this course students will be able to

1. Determine energy loss due to friction in flow systems
2. Measure flow rate of incompressible fluids
3. Perform particle size analysis
4. Evaluate performance of size reduction and filtration equipments
5. Understand the working principles of mass transfer equipments
6. Evaluate the performance of mass transfer equipments

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	-	-	2	1	-	-	-	-	-	3	1	1	1
CO2	2	2	-	-	2	3	-	-	-	-	-	2	2	1	2
CO3	3	3	-	-	3	2	-	-	-	-	-	2	1	1	2
CO4	3	3	-	-	2	3	-	-	-	-	-	3	2	1	3

CO5	1	3	-	-	3	1	-	-	-	-	-	3	1	2	1
CO6	2	1	-	-	3	1	-	-	-	-	-	3	1	2	1

BASAVESHWAR ENGINEERING COLLEGE, BAGALKOTE
DEPARTMENT OF BIOTECHNOLOGY
SCHEME OF TEACHING AND EXAMINATION
2021-2022
V SEMESTER

Sl. No.	Subject Code	Subject Title		Hours/Week			Examination Marks		
			Credits	Lecture	Tutorial	Practical	CIE	SEE	Total
1	UBT516C	Bioprocess & Reaction Engineering	3	3	0	0	50	50	100
2	UBT519C	Genetic Engineering & Applications	3	3	0	0	50	50	100
3	UBT520C	Fundamentals of Bioinformatics	3	2	2	0	50	50	100
4	UBT52XE	Elective-1	3	3	0	0	50	50	100
5	UBT506H	Industrial Safety and Bioethics	3	3	0	0	50	50	100
6	UBT514L	Bioinformatics Lab	1	0	0	2	50	50	100
7	UBT515L	Genetic Engineering Lab	1	0	0	2	50	50	100
8	UCS559L	Advanced C Programming Lab	2	0	0	4	50	50	100
9	UHS002N	Advanced Quantitative Aptitude and Soft Skills	1.0	1	0	0	50	50	100
Total			**20**	**15**	**02**	**8**	**450**	**450**	**900**

Elective-1
UBT521E: Environmental BT
UBT522E: Biomedical Instrumentation
UBT525E: Stem cell technology
UBT527E: Nutraceuticals

UBT516C	BIOPROCESS & REACTION ENGINEERING	Credits: 03
L:T:P - 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

Kinetics of Homogeneous reactions

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

UNIT–II	10 Hrs.

Interpretation of Batch Bioreactor Data

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

UNIT–III	10 Hrs.

Introduction to Reaction Design

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

UNIT–IV	10 Hrs.

Design for single reactions

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

Reference Books *

1. Scott Fogler, H (2016) Elements of Chemical Reaction Engineering, 6th edn., Prentice Hall India Pvt. Ltd.
2. Levenspiel O (2006) Chemical Reaction Engineering, Wiley Eastern, 3rd edn, New Delhi.
3. Kargi and Shuler (2015) Bioprocess Engineering. 3nd edn., Prentice Hall PTR.
4. Bailey JE and Ollis DF (2010) Biochemical Engineering Fundamentals, 2nd edn. Mc Graw- Hill.
5. Charles D. Holland (1990) Fundamentals of Chemical Reaction Engineering, John Wiley and Sons.
6. Pauline M Doran., Bioprocess Engineering Principles, 2nd Edition, Academic Press, USA, 2013.
7. Tapobrata Panda., Bioreactors: Analysis and Design, 1st Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2011.

Course Outcomes**

After completion of the course student will be able to

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

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	-	1	2	3	1	-	-	-	-	-	1	1	2	3
CO2	1	-	2	2	3	1	-	-	-	-	-	1	1	2	3
CO3	1	-	3	2	3	1	-	-	-	-	-	1	1	2	1
CO4	1	-	3	2	3	1	-	-	-	-	-	1	1	2	1
CO5	1	-	3	2	3	3	-	-	-	-	-	1	1	2	1
CO6	1	-	1	2	3	3	-	-	-	-	-	1	1	2	1

UBT519C	GENETIC ENGINEERING & APPLICATIONS	Credits: 03
L:T:P - 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

Introduction:

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

Enzymes in genetic engineering:

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

UNIT–II	10 Hrs.

Nucleic acid hybridization and amplification:

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

Construction of cDNA libraries:

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

UNIT–III	12 Hrs.

Gene transfer techniques:

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

Transgenic science and genetic improvement:

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

UNIT–IV	10 Hrs.

Gene therapy:

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

Applications:

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

Reference Books *

1. Bernard Glick and J. Pasternak (2017). Molecular Biotechnology – Principles and applications of recombinant DNA, 2nd edition, ASM Press.
2. Watson (2010), Recombinant DNA, 2nd edition, Freeman Publishers.
3. Primrose S.B, Richard Twyman and Bob (2010), Principles of gene manipulation Blackwell 6th edition, Scientific Publications.
4. NPTEL Course material.

Course Outcomes**

After completion of the course student will be able to

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

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	-	1	2	3	1	-	-	-	-	-	1	1	2	3
CO2	1	-	2	2	3	1	-	-	-	-	-	1	1	2	3
CO3	1	-	3	2	3	1	-	-	-	-	-	1	1	2	1
CO4	1	-	3	2	3	1	-	-	-	-	-	1	1	2	1
CO5	1	-	3	2	3	3	-	-	-	-	-	1	1	2	1
CO6	1	-	1	2	3	3	-	-	-	-	-	1	1	2	1

UBT520C	FUNDAMENTALS OF BIOINFORMATICS	Credits: 03
L:T:P – 2:2:0		CIE Marks: 50
Total Hours/Week: 04		SEE Marks: 50

UNIT-I	12 Hrs.

Introduction to Bioinformatics and Biological Database

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

UNIT–II	10 Hrs.

Sequence alignment and database searches:

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

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

Tutorials: Solving problems on pairwise sequence alignment

UNIT–III	10 Hrs.

Phylogenetic analysis and predictive methods using sequences

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

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

Tutorials: Practices on prediction of phylogenetic trees

UNIT–IV	10 Hrs.

Plasmid mapping and primer designing &molecular modelling techniques

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

Tutorials: Solving problems related to Restriction mapping and Primer designing

Reference Books *

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

Course Outcomes**

After completion of the course student will be able to

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

* **Books to be listed as per the format with decreasing level of coverage of syllabus**

** **Each CO to be written with proper action word and should be assessable and quantifiable**

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

UBT521E	ENVIRONMENTAL BT	Credits: 03
L:T:P - 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

Microorganisms

Issues and scope of Environmental BT. Characteristics of soil, microbial flora of soil, interactions among soil microorganisms, biogeochemical role of soil microorganisms.

Bioaccumulation of toxicants

Characteristics of Xenobiotics, Relationship of Bioaccumulation with Chemical Structure, Ecophysiology of Bioaccumulation, Process of toxicants uptake, Factors affecting bioaccumulation, measurement of bioaccumulation.

UNIT–II	12 Hrs.

Biological treatment of waste water

Waste water characteristics BOD, COD, Primary & Secondary treatment, nanofiltration, ultafilration and microfiltration. Microbial removal of phosphorous and Nitrogen, Nutrient removal by Biomass production Wastewater treatment of food processing industries like sugar factories, vegetable oil industries, potato processing industries, dairy industries, beverages industries, and distilleries.

Solid waste management

Basic aspects, general composition of urban solid wastes, aerobic treatment, anaerobic treatment, biogas generation; Solid waste management through Biotechnological processes involving Hazardous wastes, Biomedical wastes, MoEF rules.

UNIT–III	10 Hrs.

Bioleaching and Biomining

Microbes in Bioleaching- types, methods of bioleaching, Microbial recovery of metal, phosphate, petroleum.

Bioremediation

Major contaminants of air, water and soil, Biomonitors of environment (Bioindicators), Bioremediation using microbes, Phytoremediation, Biofilms its applications. Bio-stimulation of Naturally occurring microbial activities, Bio-augmentation.

UNIT–IV	10 Hrs.

Biotechnology in biodiversity conservation

Value of biodiversity, threats to biodiversity, Biosphere reserves and Ecosystem Conservation, Approaches to Bioresource conservation programme, Biotechnological processes for bioresource assessment, BT in ex situ conservation of Biodiversity, BT and its role in utilization of Biodiversity, International initiatives for biodiversity management.

Reference Books *

1. Mahopatra P K (2006), Textbook of Environmental Biotechnology, I K International Publishing House Pvt. Ltd.
2. Dubey R C and Maheshwari D K (2022), Text book of microbiology (5th edition), S Chand and Company Ltd.
3. Forster C F, Wase D A J (1987), Environmental Biotechnology, United Kingdom: Ellis Horwood.

Course Outcomes**

After completion of the course student will be able to

1. Understand issues and scope of Environmental BT and concepts of Bioaccumulation.
2. Develop different treatment methods for waste water by using BT approach.
3. Develop different treatment methods for solid waste by using BT approach.
4. Apply the knowledge of bioleaching for metal recovery and bioremediation processes to remove

environmental contaminants.

5. Understand the Value of biodiversity and threats to biodiversity.
6. Apply the knowledge of BT in biodiversity conservation.

*** Books to be listed as per the format with decreasing level of coverage of syllabus**

**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	3	2	2	-	-	-	2	-	3	-	1	2	3	1
CO2	2	3	2	1	-	-	-	1	2	-	-	-	3	3	1
CO3	2	3	2	1	-	-	-	1	2	-	-	-	3	3	1
CO4	1	3	2	3	-	-	-	2	2	3	-	-	2	3	-
CO5	-	-	-	-	-	-	-	2	-	3	-	3	-	-	-
CO6	1	3	2	2	-	-	-	-	2	2	-	-	1	3	-

UBT527E	NUTRACEUTICALS	Credits: 03
L:T:P – 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

Introduction to Nutraceutical and dietetics

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

UNIT–II	10 Hrs.

Nutrition related diseases and disorders:

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

UNIT–III	10 Hrs.

Nutraceuticals of microbial, plant and animal origin

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

UNIT–IV	10 Hrs.

Biotechnology in Phytonutraceuticals

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

Reference Books *

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

Course Outcomes**

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

6. To know about the role of biotechnology in production of plant secondary metabolites.

*** Books to be listed as per the format with decreasing level of coverage of syllabus**

**** Each CO to be written with proper action word and should be assessable and quantifiable**

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

UBT522E	BIOMEDICAL INSTRUMENTATION	Credits: 03
L:T:P - 3:0:0		CIEMarks:50
Total Hours/Week: 03		SEEMarks:50

UNIT-I	10 Hrs.

Introduction

Sources of Biomedical signals, Basic medical instrumentation system, Performance requirements of medical instrumentation systems, PC based medical instruments, General constraints in design of medical instrumentation systems.

Bioelectric Signals and Electrode

Origin of bioelectric signals, Recording electrodes, - Electrode-tissue interface, metal electrolyte interface, electrolyte -skin interface, Polarization, Skin contact impedance, Silver – silver chloride electrodes, Electrodes for ECG, EEG, EMG, Electrical conductivity of electrode jellies and creams, Microelectrode. Patient Safety: Electrode shock hazards, Leakage currents.

UNIT–II	12 Hrs.

ECG & EEG

Electrical activity of heart, Genesis & characteristics of Electrocardiogram (ECG), Block diagram description of an Electrocardiograph, ECG Lead Systems, and Multichannel ECG machine Genesis of Electroencephalogram (EEG), Block diagram description of an Electroencephalograph, 10-20 Electrode system, Computerized analysis of EEG.

Cardiac pacemakers and defibrillators

Need for Cardiac pacemaker, External pacemaker, Implantable pacemaker, Programmable pacemakers, DC defibrillator, AC defibrillator and Implantable Defibrillator.

UNIT–III	10 Hrs.

Patient monitoring system

Bedside monitors, Central Monitoring System, Measurement of Heart rate -Average heart rate meter, Instantaneous heart rate meter, (Cardio tachometer), Measurement of Pulse Rate, Blood pressure measurement -direct and indirect method, Rheographic method, Oscillometric method, Ultrasonic Doppler shift method, Measurements of Respiration rate -Thermistor method, impedance puenmography, CO2 method, and Apnea detector. Blood flow meters: Electromagnetic and its types, Ultrasonic, NMR, Laser Doppler. Blood gas analyzers: Blood pH measurement, Measurement of Blood pCO2, pO2.

Physiological transducers

Introduction, classification, performance characteristics of transducers-static and dynamic transducers, Displacement, position and motion transducers, Pressure transducer, Transducers for body temperature measurement, Optical Fiber sensor and Biosensor

UNIT–IV	10 Hrs.

Recording systems

Basic recoding system, general considerations for signal conditioners, preamplifiers-instrumentation amplifier, isolation amplifier, and ink jet recorder, potentiometric recorder, thermal array recorder and electrostatic recorder.

Analysis of Cardiac output measurement: Indicator dilution method, Dye dilution method, Thermal dilution techniques, Measurement of Continuous cardiac output derived from the aortic pressure waveform, Impedance technique. Pulmonary function analysis: Pulmonary function measurement, Spirometry, Puemotachometer, Measurement of Volume, Nitrogen washout technique.

Reference Books *

1. Khandpur R S (2003), Hand book of Biomedical Instrumentation (2nd Edition), Tata McGraw-Hill Publishing Company Limited.

2. Enderle J, Blanchard S &Bronzino J (2005), Introduction to Biomedical Engineering, Elsevier.
3. Carr J J, Brown J M (2005), Introduction to Biomedical equipment technology(4th Edition), Prentice hall.

Course Outcomes**

After completion of the course student will be able to

1. Able to understand basic concepts of biomedical signals.
2. Able to know ECG and EEG.
3. Able to understand the patient monitoring system and recording systems
4. Able to know characteristics of transducers
5. Able to understand various analysis techniques
6. Able to understand the recording systems.

***Books to be listed as per the format with decreasing level of coverage of syllabus**

**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	2	-	-	-	-	-	-	-	1	-	2	-
CO2	2	3	2	-	-	-	-	-	-	-	-	-	2	3	1
CO3	2	3	2	1	-	-	-	-	-	-	-	-	3	3	1
CO4	1	2	2	3	-	-	-	-	-	-	-	-	1	3	-
CO5	1	3	2	2	-	-	-	-	-	-	-	-	2	3	1
CO6	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-

UBT525E	STEM CELL TECHNOLOGY	Credits: 03
L:T:P - 3:0:0		CIEMarks:50
Total Hours/Week: 40		SEEMarks:50

UNIT-I	10 Hrs.

Stem cells and cellular pedigrees

Scope of stem cells – definition of stem cells – concepts of stem cells – differentiation , maturation , proliferation , pluripolericy, self – maintainance and self – renewal –problems in measuring stem cells – preservation protocols.

UNIT–II	12 Hrs.

Stem cell concept in plants

Stem cell and founder zones in plants – particularly their roots – stem cells of shoot meristems of higher plants.

UNIT–III	10 Hrs.

Stem cell concept in animals

Skeletal muscle stem cell – Mammary stem cells – intestinal stem cells – keratinocyte stem cells of cornea – skin and hair follicles –Tumour stem cells, Embryonic stem cell biology - factors influencing proliferation and differentiation of stem cells – hormone role in differentiation.

UNIT–IV	10 Hrs.

Haemopoietic stem cell

Biology – growth factors and the regulation of haemopoietic stem cells.

Potential uses of stem cells

Cellular therapies – vaccines – gene therapy – immunotherapy – tissue engineering –blood and bone marrow – Fc cells.

Reference Books *

1. Mao J. J, Vunjak-NovakovicG (2008), Translational Approaches in Tissue Engineering & Regenerative Medicine, Artech House, INC Publications.
2. Lanza R et al.(2007), Principles of Tissue Engineering(3rd Edition), Academic Press.

Course Outcomes**

After completion of the course student will be able to

1. Isolate and Culture of Hematopoietic Stem cells
2. Isolate and Culture of Mesenchymal Stem cells
3. Analyse Differentiation of Pluripotent stem cells
4. Interpret Cell culture in Scaffolds
5. Anayse growth of haemopoietic stem cells
6. Apply the potential uses of stem cells

***Books to be listed as per the format with decreasing level of coverage of syllabus**

****** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	-	-	-	-	-	1	1	2	2	2
CO2	2	3	2	-	-	-	-	-	-	-	1	1	2	3	1
CO3	2	3	2	1	-	-	-	-	-	-	-	1	3	3	1
CO4	1	2	2	-	-	-	-	-	-	-	1	2	1	3	-
CO5	1	3	2	2	-	-	-	-	-	-	-	1	2	3	1
CO6	-	-	-	-	-	-	-	-	-	-	1	3	2	2	2

UBT506H	INDUSTRIAL SAFETY AND BIOETHICS	Credits: 03
L:T:P – 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

Introduction to Bioethics & Biosafety

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

Biosafety regulation guidelines

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

UNIT–II	10 Hrs.

Biosafety Regulation:

Genetically modified organisms and their release in environment, Laboratory associated infections and other hazards, Good Lab Practices and Good Manufacturing Process (GLP &GMP). Biosafety levels for microorganismBL1,BL2,BL3,BL4) plants (BL1-P,BL2-P,BL3-P,BL4-P) animals (BL1-N,BL2-N,BL3-N,BL4-N).

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

UNIT–III	10 Hrs.

Food and Pharma safety:

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

UNIT–IV	10 Hrs.

Industrial safety

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

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

Fire: Fire extinguishers and fire exits, extinguishing agents.

Importance of safety in food and Pharma industry. Food safety, Biological, chemical and Physical Hazards-HAACP system, Pharma safety. Food and safety act. Injuries by industrial sector.

Reference Books *

1. Sateesh M.K.(2012),Bioethics and Biosafety,I.K.International Publication
2. Singh B.D.(2010), Biotechnology Expanding Horizon(3rd revised edition), Kalyani Publishers.
1. Goel D and Parashar S (2010), IPR-Biosafety and Bioethics(2nd edition), Pearson Education India Publishers.

Course Outcomes**

After completion of the course student will be able to

1. Emphasize on the basic aspects of Biosafety and ethics; the key areas and apply the knowledge in the social, legal & ethical issues connected with BT, BWC and Bioterrorism
2. Interpret & describe biosafety regulation guidelines committees, Cartagena protocol & their relevant

applications in BT

3. Identify biosafety levels as relevant to Biotechnology & apply this knowledge in maintenance of biosafety, GLP, GMP in research lab, field & industry.
4. Acquire working knowledge on the risk assessment, containment, GMO labeling and transgenic field trials in the research.
5. Identify the various forms of IPR and understand the importance of patents in modern scientific and industrial research and discuss special application of patent laws in biotechnology with case studies.
6. Identify & discuss the potential dangers in Biotechnology and gain knowledge on safety aspects in food and Pharma industry and apply precautionary measures to avoid /overcome it.

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	-	1	1	1	3	1	3	-	-	-	-	3	2	3
CO2	1	-	1	2	1	2	1	2	-	3	-	-	3	1	1
CO3	1	-	2	2	1	2	1	2	-	-	-	-	3	1	1
CO4	1	-	1	2	3	3	1	2	-	2	-	-	3	2	1
CO5	1	-	1	3	3	2	1	1	2	-	2	-	2	2	1
CO6	1	-	2	2	1	3	1	1	-	-	-	-	2	2	1

UBT514L	BIOINFORMATICS LAB	Credit: 01
L:T:P – 0:0:2		CIE Marks: 50
Total Hours/Week: 02		SEE Marks: 50

LIST OF EXPERIMENTS IN BIOINFORMATICS LABORATORY	28 Hrs.

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

Reference Books *

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

Course Outcomes**

After completion of the course student will be able to

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

*** Books to be listed as per the format with decreasing level of coverage of syllabus**

**** Each CO to be written with proper action word and should be assessable and quantifiable**

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

UBT515L	GENETIC ENGINEERING LABORATORY	Credits: 01
L:T:P – 0:0:2		CIE Marks: 50
Total Hours/Week: 02		SEE Marks: 50

LIST OF EXPERIMENTS IN GENETIC ENGINEERING LABORATORY

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

Reference Books *

1. Sambrook & Russell, (2002), Molecular Cloning (3rd Edition), Cold Spring Harbor Lab.
2. Sadashiva and Manickam, (2017), Biochemical methods (2nd Edition), W.H. Freeman

Course Outcomes**

After completion of the course student will be able to

7. Demonstrate proficiency in Transformation and screening of transformants.
8. Apply the knowledge of thermal denaturation to calculate Tm value.
9. Use research-based knowledge of restriction digestion and Ligation in the field of Biotechnology.
10. Demonstrate proficiency in Electro-blotting and detection.
11. Demonstrate understanding of SOP and PCR.
12. Gain knowledge in common and advanced laboratory practices in Genetic engineering lab.

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	3	3	-	3	1	1	3	-	-	-	3	3	3	1
CO2	-	3	3	-	3	1	1	-	-	-	-	3	2	3	1
CO3	-	3	2	2	3	1	1	-	-	-	-	3	3	3	1
CO4	-	3	2	-	3	-	1	-	-	-	-	3	2	3	2
CO5	-	3	2	1	3	1	1	2	-	-	-	3	3	3	2
CO6	-	3	3	2	3	1	1	1	-	-	-	3	2	3	1

BASAVESHWAR ENGINEERING COLLEGE, BAGALKOTE
DEPARTMENT OF BIOTECHNOLOGY
SCHEME OF TEACHING AND EXAMINATION
2021-2022
VII SEMESTER

Sl. No.	Subject Code	Subject Title		Hours/Week			Examination Marks		
			Credits	Lecture	Tutorial	Practical	CIE	SEE	Total
1	UBT704C	Economics and Plant Design	3	3	0	0	50	50	100
2	UBT715C	Downstream Processing Technology	3	2	2	0	50	50	100
3	UBT72XE	Elective-4	3	3	0	0	50	50	100
4	UBT73XE	Elective-5	3	3	0	0	50	50	100
5	UBT716H	Industrial Management and Entrepreneurship	3	3	0	0	50	50	100
6	UBT733N	Industrial Safety (Open Elective)	3	3	0	0	50	50	100
7	UBT711I	Industrial Internship	2	0	0	4	50	50	100
8	UBT710L	Bioseparation Techniques Lab	1	0	0	2	50	50	100
9	UBT717L	Food Analysis Techniques Lab	1	0	0	2	50	50	100
10	UBT701T	Technical Seminar	1	2	0	0	50	50	100
Total			**23**	**19**	**02**	**8**	**500**	**500**	**1000**

Elective-4
UBT722E: Aquaculture & Marine Biotechnology
UBT723E: Dairy Biotechnology
UBT724E: Food Processing Technology
UBT725E: Protein Engineering and Drug Design
Elective-5
UBT731E: Nanobiotechnology& Biomaterials
UBT732E: Computational Biology
UBT733E: Bioconjugative Technology
UBT734E: Food Biotechnology

UBT704C	ECONOMICS AND PLANT DESIGN	Credits: 03
L:T:P – 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hours

Process design development

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

General design considerations

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

UNIT–II	10 Hrs.

Capital investments

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

Manufacturing costs And plant overheads

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

UNIT–III	10 Hrs.

Cost analysis

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

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

UNIT–IV	10Hrs.

Profitability Analysis

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

Reference Books *

1. Peters and Timmerhaus, Plant Design and Economics for Chemical Engineers, 5th Edition, McGraw Hill. 2017
2. Rudd and Watson (1987) Strategy of Process Engineering, Wiley.
3. Poornima M C, “Entrepreneurship Development and Small Business Enterprises”, Pearson education, 2006
4. Vasanth Desai,”Dynamics of Entrepreneurial Development & Management”, Himalaya Publishing House.4th Edition,2007.
5. Khanka SS ,” Entrepreneurship Development, S Chand & Co. Revised edition, 2007.
6. Thomas W. Zimmer, Norman M. Scarborough, Essentials of Entrepreneurship and small Business Management, Pearson education,5th Edition,2008.

Course Outcomes**

1. Acquire knowledge in the design of a plant.
2. Conduct preliminary feasibility study of the plant design assigned.

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

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	2	-	-	1	-	3	-	-	1	3
CO2	-	-	-	-	-	2	-	-	1	-	3	-	-	1	3
CO3	-	-	-	-	-	2	-	-	1	-	3	-	-	1	3
CO4	-	-	-	-	-	2	-	-	1	-	3	-	-	1	3
CO5	-	-	-	-	-	2	-	-	1	-	3	-	-	1	3
CO6	-	-	-	-	-	2	-	-	1	-	3	-	-	1	3

UBT715C	DOWNSTREAM PROCESSING TECHNOLOGY	Credits: 03
L:T:P – 2:2:0		CIE Marks: 50
Total Hours/Week: 04		SEE Marks: 50

UNIT-I	10 Hours

Introduction

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

UNIT–II	10 Hrs.

Primary Recovery Operations

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

UNIT–III	10 Hrs.

Chromatography

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

UNIT–IV	10Hrs.

Electrophoresis

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

Downstream Processes:

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

Reference Books *

1. B.Sivasankar, Bioseparations-2010 Principles and techniques Kindle edition,PHI Publishers,
2. Upadhay and Nath, 2010,Biophysical chemistry principles and Technques, Himalaya Publishing House, 3rd edition.
3. P.A., Cussier E. and Wei ,Shan Hu. 2008. Bioseparations - Downstream processing for biotechnology by Belter, Wiley Interscience Pub,
4. NPTEL Source material
5. Palanivelu, 2005 Lab manual for separation Techniques.

Course Outcomes**

1. Identify the basic separation unit operation in DSP like membrane separation, enrichment operation, product recovery and various resolutions and fractionation techniques.

2. Interpret and analyze the industrial fermentation processes.
3. Apply the knowledge in identifying various pharma and R&D sections.
4. Analyse the details of experimentation pertaining to chromatography and electrophoresis.
5. Understand analyse and apply the techniques in various tests involved in finding out purity of biological.
6. Apply the knowledge in identifying various biochemicals using advanced purifications like HPLC and to demonstrate DSP flow sheets.

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1	2	-	2	1	-	-	-	-	-	1	2	1	1
CO2	2	-	2	-	3	2	-	-	-	-	-	1	2	1	1
CO3	1	1	1	-	2	1	-	-	-	-	-	1	2	1	2
CO4	2	-	2	-	2	2	-	-	-	-	-	1	2	1	1
CO5	2	1	1	-	3	1	-	-	-	-	-	1	2	1	2
CO6	1	-	1	-	2	1	-	-	-	-	-	2	2	1	1

UBT724E	FOOD PROCESSING TECHNOLOGY	Credits: 03
L:T:P – 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hours

Introduction

Constituents of food, soluble fibres, protein rich foods, popular fats and oils in foods, Food flavours, Browning reactions and its effects. Intrinsic and extrinsic parameters of foods, effect of inhibitors, pH and temperature.

Minerals in foods. Aroma compounds in foods. Food additives, Vitamins, amino acids, Sweeteners, Food colours. Toxic-trace elements in food.

UNIT–II	11 Hrs.

Detection of Microorganisms

Culture, Microscopic and Sampling Methods, Conventional; SPC, Membrane Filters, Microscope colony Counts, Agar Droplets, Dry Films, Most probable Numbers (MPN), Dyereduction, Roll Tubes, Direct Microscopic Count (DMC), Microbiological Examination of surfaces, Air Sampling, Metabolically Injured Organisms, Enumeration and Detection of Food-borne Organisms.

Dairy products

Composition of milk,Sterilization of milk (Pasteurization and UHT), Cheese production, Acidophilus milk Yoghurt, Kumiss and Kefir. Marketing scope of dairy & food products Fruit and vegetable processing: Jam, jelly, Juice, squash, wine, pickles and sauerkraut.

UNIT–III	12 Hrs.

Food Spoilage Preservation

The Role and Significance of Microorganisms, Primary Sources of Microorganisms found in Foods Synopsis of common borne bacteria, Molds; Yeasts. Microbial Spoilage of Vegetables, Fruits, Fresh and Processed Meats, Poultry, and Seafood. Spoilage of Miscellaneous Foods.

Food Preservation

Principles Underlying in spoilage and preservation, Application, Effect and Legal Status of Food Irradiation, Food Preservation with Low Temperatures, High Temperatures and Drying.

Food Industry

Characteristics of Food Industry. Nutritional food supplements. Food packaging, New trends in packing, edible films. Factors influencing food product development, marketing, and promotional strategies, risks and benefits of food industry.

UNIT–IV	9 Hrs.

Food Engineering

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

Reference Books *

1. Sunetra Roady, 2007, Food Science & Nutrition, Oxford University Press.
2. William Frazier and Westhoff D.C, 2005,Food microbiology 4th Edn, TATA McGraw Hill Pub
3. James M.Jay, 2005.Modern Food Micro-Biology, CBS Publishers.
4. K. Vijay Ramesh, 2007, Food Microbiology by MJP Publishers.
5. Potter N.N. and Joseph Hotchkiss, 1996,.Food Science, 5 th Edn, CBS Pub,

Course Outcomes**

1. Ability to understand about basic constituents of food
2. Ability to analyse the techniques involved in detection of microbes in food industry
3. Ability to have idea about Dairy , fruits and vegetable processed products and production
4. Ability to be aware of different food spoilage and preservation techniques
5. Ability to analyse the Characteristics of food industry and scope
6. Ability to comprehend the concepts in food Engineering used in preservation.

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1	2	-	2	1	-	-	-	-	-	1	2	1	1
CO2	2	-	2	-	3	2	-	-	-	-	-	1	2	1	1
CO3	1	1	1	-	2	2	-	-	-	-	-	1	2	1	2
CO4	2	-	2	-	2	1	-	-	-	-	-	1	2	1	1
CO5	2	1	1	-	3	1	-	-	-	-	-	1	2	1	2
CO6	1	-	1	-	2	2	-	-	-	-	-	2	2	1	1

UBT722E	AQUACULTURE & MARINE BIOTECHNOLOGY	Credits: 03
L:T:P – 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hours

Aquatic environment

Major physical and chemical factors (light, temperature, gases, nutrients). Aquatic biota: phytoplankton, zooplankton, benthos, periphyton, macrophytes, fish and other animals. Production & Nutrient dynamics in lakes, rivers, estuaries and wetlands. Eutrophication and water pollution: monitoring and control conservation and management of lakes, rivers and wetlands. Importance of coastal aquaculture- Design and construction of aqua farms, Criteria for selecting cultivable species. Culture systems – extensive, semi intensive and intensive culture practices

Aqua culture

Classification and Characteristics of Arthropoda. Crustacean characteristic key to important species of Prawns and Shrimps, General biology, of – Shrimp and Prawn, Finfish, Marine and freshwater fish. Preparation, culture and utilization of live food organisms, phytoplankton, zooplankton cultures, quality evaluation of Cyst, hatching and utilization, culture and cyst production.

UNIT–II	10 Hrs.

Aquaculture engineering and techniques

Principles and criteria for site selection; multi-design, layout plan for prawn, shrimp and fish hatchery; design, lay-out plan and pond construction for grow- out production, design and construction of feed mill and installation of machineries. Chromosome manipulation in aquaculture - hybridization, ploidy induction, gynogenesis, androgenesis and sex reversal in commercially important fishes. Application of microbial biotechnology in culture ponds, bioaugmentation, bioremediation, nutrient cycling, and biofertilization.Probiotics – imunostimulants. Tools for disease diagnosis in cultivable organisms Enzyme immuno assays - Dot immunobinding assay - Western blotting - Latex agglutination test - Monoclonal antibodies - DNA based diagnosis. Cryopreservation techniques.

UNIT–III	10 Hrs.

Marine environment

Biological Oceanography: The division of the marine environment – benthing, pelagic, batuyal, littoral. Ocean waters as biological environment. Distribution and population of plants and animals. Marine ecology and fisheries potential. Effects of pollution on marine life. Geological and geophysical Oceanography: geophysical and geological processes. Ocean basin rocks and sediments.

Marine microbiology

Biology of micro-organisms used in genetic engineering *(Escherichia coil, Rhizobium sp., Agrobacterium tumefaciens, Saccharomyces cerevisiae, phage lambda, Nostoc, Spirulina, Aspergillus, Pencillium and Streptomyces).* Methods of studying the marine micro-organisms collection, enumeration, isolation, culture & identification based on morphological, physiological and biochemical characteristics. Preservation of marine microbes, culture collection centre (ATCC, IMTECH, etc.). Microbial nutrition and nitrogen fixation.Seafood microbiology - fish & human pathogens. Indicator of Pollution - faecai coliforms - Prevention &control.

UNIT–IV	10 Hrs.

Marine biotechnology and pharmacology

Physical, Chemical and Biological aspects of marine life. Air – Sea interaction – Green house gases (CO_2 and Methane). Marine pollution-major pollutants (heavy metal, pesticide, oil, thermal, radioactive, plastics, litter and microbial). Biological indicators and accumulators: Protein as biomarkers, Biosensors and biochips. Biodegradation and Bioremediation. Separation, purification and bioremoval of pollutants. Biofouling - Biofilm formation, Antifouling and Anti boring treatments. Corrosion Process and control of marine structures.

Biosafety – special characteristics of marine environment that bear on biosafety. Ethical and moral issues - food health, and environmental safety concerns. Medicinal compounds from marine flora and fauna - marine toxins –antiviral, antimicrobial. Extraction of crude drugs, screening, isolation, purification and structural characterization of bioactive compounds.

Reference Books *

1. Kirchman, D.L,. Microbial ecology of the oceans. Wiley – liss, New York, 542 pp,2005
2. Kenneth, C. Hingham and Leonard Hill, 1969. The comparative endocrinology of the invertebrates. Edward Arnold Ltd.
3. Farming the edge of the sea. Fishing News Ltd. London.
4. Finger man, M.. Recent advances in Marine Biotechnology. Vol. 4,2000
5. Kenneth, B.D., 2000. Environmental impacts of Aquaculture. CRC. pp. 214 ,2000

Course Outcomes**

1. Ability to understand the importance of coastal aquaculture.
2. Ability to know the different Culture systems.
3. To analyse the cryopreservation techniques.
4. To understand the Seafood microbiology.
5. To understand the applications of marine biology.
6. Ability to extract crude drugs and find the bioactive compounds.

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	-	2	-	1	1	2	2	-	-	-	1	2	1	1
CO2	1	-	2	-	-	2	2	3	-	-	-	1	2	1	2
CO3	-	-	1	1	2	-	2	2	-	-	-	1	2	1	-
CO4	2	-	2	-	-	1	2	2	-	-	-	1	2	1	-
CO5	-	-	1	2	2	-	3	3	-	-	-	1	2	1	1
CO6	1	-	1	-	-	2	2	2	-	-	-	2	2	1	-

UBT723E	DAIRY BIOTECHNOLOGY	Credits: 03
L:T:P – 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hours

Dairy Industry and Microbiology

Overview of dairy industry, Characteristics of dairy Industry. Manufacturing & processing of dairy products, effect of processing on constituents and methods of evaluation of dairy products. Morphological and biochemical characteristics of important groups of milk microbes and their classification i.e.psychrotrophs, mesophiles, thermodurics, and thermophiles. Impact of various stages like milking, chilling, storage and transportation on microbial quality of milk, Direct and indirect rapid technique for assessment of microbial quality of milk. Food infection, intoxication and toxic infection caused by milk borne pathogens. Microbiological changes in bulk refrigerated raw milk; Mastitis milk: organisms causing mastitis, detection of somatic cell count (SCC). Role of microorganisms in spoilage of milk Significance of antimicrobial substances naturally present in milk (responsible for its nutraceutical properties): immunoglobulin, lactoferin, Lysozymes

UNIT–II	10 Hrs.

Dairy biotechnology

Genetic engineering of bacteria and animals intended for dairy-based products: DNA cloning. protoplast fusion & cell culture methods for trait improvement with instances cited. Enzymes in dairy industry & production by whole cell immobilization. Biotechnology of dairy effluent treatment. Ethical issues relating to genetic modification of dairy microbes & milk-yielding animals.

Dairy engineering

Sanitization: Materials and sanitary features of the dairy equipment. Sanitary pipes and fittings, Description, working and maintenance of can washers, bottle washers. CIP cleaning and designing of system. Homogenization, Pasteurization, sterilization septic packaging and equipment. Filling Operation: Principles and working of different types of bottle filters and capping machine, pouch filling machine maintenance.

UNIT–III	10 Hrs.

Dairy process engineering

Evaporation: Basic principles of evaporators, Different types of evaporators used in dairy industry, Drying: Introduction to principle of drying, Equilibrium moisture constant, bound and unbound moisture. Fluidization Mechanization and equipment used in manufacture of indigenous dairy products, Butter and Ghee making machine, Ice-cream and Cheese making equipments. Membrane Processing: Ultra filtration, Reverse Osmosis and electro dialysis in dairy processing, membrane construction & maintenance for electro-dialysis & ultra-filtration, Ultra filtration of milk, Effect of milk constituents on operation.

Dairy plant design and layout

Introduction of Dairy Plant design and layout. Type of dairies, perishable nature of milk, reception flexibility. Classification of dairy plants, selection of site for location. Dairy building planning, Process schedule, basis of dairy layout, General points of considerations for designing dairy plant, floor plant types of layouts, service accommodation, single or multilevel design.

UNIT–IV	10 Hrs.

Quality and safety monitoring in dairy industry

Current awareness on quality and safety of dairy foods; consumer awareness and their demands for safe foods; role of codex alimentations commission (CAC) in harmonization of international standards; quality (ISO 9001:2000) and food safety (HACCP) system National and international food regulatory standards; their role in the formulation of standards for controlling the quality and safety of dairy foods. Good Hygiene Practices (GHP): Rapid assessment of dairy food for microbial and non-microbial contaminants Quality of water and Quality of air & personnel hygiene.

By products technology

Status, availability and utilization of dairy by-products in India and abroad, associated economic and pollution problems. Physico-chemical characteristics of whey, butter milk and ghee residue, by-products from skim milk such as Casein; Whey processing & utilization of products generated from whey.

Reference Books *

1. Diary Science & Technology Handbook (Vols. 1-3). Ed by Hui, Y.H, Wiley Publishers,2007
2. Handbook of Farm, Dairy & Food Machinery - Myer Kutz- Andrew Publishers,2005
3. Diary Microbiology Handbook (3rd Ed). Robinson, R.K., Wiley Publishers,2001
4. Comprehensive Biotechnology (Vol. 6) Ed N.C Gautam- Shree Pblns,2002.
5. General Microbiology (Vol. 2) – Powar & Daginawala- Himalaya Publishers,2005
6. Milk composition, production & biotechnology (Biotechnology in Agriculture Series). CABI Publishers,2005

Course Outcomes**

1. Able to manufacture & processing of dairy products.
2. Ability to know the ethical issues in dairy.
3. Ability to understand principles of evaporators.
4. Ability to plan the Plant design and layout.
5. will be aware of quality and safety of dairy foods.
6. Ability to know the regulatory standards.

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	-	2	-	1	1	2	2	-	-	-	1	2	1	1
CO2	1	-	2	-	-	2	2	3	-	-	-	1	2	1	2
CO3	-	-	1	1	2	-	2	2	-	-	-	1	2	1	-
CO4	2	-	2	-	-	1	2	2	-	-	-	1	2	1	-
CO5	-	-	1	2	2	-	3	3	-	-	-	1	2	1	1
CO6	1	-	1	-	-	2	2	2	-	-	-	2	2	1	-

UBT725E	PROTEIN ENGINEERING AND DRUG DESIGN	Credits: 03
L:T:P – 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hours

Structure of proteins

Overview of protein structure, PDB, structure based classification, databases, visualization tools, structure alignment, domain architecture databases, and protein-ligand interactions.

Protein structure prediction

Primary structure and its determination, secondary structure prediction and determination of motifs, profiles, patterns, fingerprints, super secondary structures, protein folding pathways, tertiary structure, quaternary structure, methods to determine tertiary and quaternary structure, post translational modification.

Protein engineering and design

Methods of protein isolation, purification and quantitation; large scale synthesis of proteins, design and synthesis of peptides, use of peptides in biology, methods of detection and analysis of proteins. Protein database analysis, methods to alter primary structure of proteins, examples of engineered proteins, protein design, principles and examples.

UNIT–II	10 Hrs.

Molecular modeling

Constructing an Initial Model, Refining the Model, Manipulating the Model, Visualization. Structure Generation or Retrieval, Structure Visualization, Conformation Generation, Deriving Bioactive Conformations, Molecule Superposition and Alignment, Deriving the Pharmacophoric Pattern, Receptor Mapping, Estimating Biological Activities, Molecular Interactions: Docking, Calculation of Molecular Properties, Energy Calculations (no derivation), Examples of Small Molecular Modeling Work, Nicotinic Ligands, Sigma Ligands, Antimalarial Agents.

UNIT–III	10 Hrs.

Insilico drug design

Generation of Rational Approaches in Drug Design, Molecular Modeling: The Second Generation, Conceptual Frame and Methodology of Molecular Modeling, The Field Currently Covered, Importance of the "Bioactive Conformation", Molecular Mimicry and Structural Similarities, Molecular Mimicry, Structural Similarities and Superimposition Techniques, Rational Drug Design and Chemical Intuition, An Important Key and the Role of the Molecular Model, Limitations of Chemical Intuition Major Milestones and Future Perspectives.

Computer assisted new lead design

Introduction, Basic Concepts, Molecular Recognition by Receptor and Ligand Design, Active Conformation, Approaches to Discover New Functions, Approaches to the Cases with known and unknown receptor structure.

UNIT–IV	10 Hrs.

Docking methods

Program GREEN Grid: Three -Dimensional Description of Binding Site Environment and Energy Calculation, Automatic Docking Method, Three-Dimensional Database Search Approaches, Automated Structure Construction Methods, Structure Construction Methods with known Three-Dimensional Structure of the Receptor, Structure Construction in the case of Unknown Receptor Structure. Scope and Limitations, Points for Consideration in Structure, Construction Methods, Handling of X-Ray Structures of Proteins, Future Perspectives, Types of programs available for molecular modeling-scope and limitations-interpretation of results.

Computer - assisted drug discovery

The Drug Development Process, Introduction, The Discovery and Development Process, New Lead Discovery

Strategies, Composition of Drug Discovery Teams, The Practice of Computer-Assisted Drug Discovery (CADD), Current Practice of CADD in the pharmaceutical Industry, Management Structures of CADD Groups, Contributions and Achievements of CADD Groups, Limitations of CADD Support, Inherent Limitations of CADD Support, State of Current Computational Models, Software and Hardware Constraints.

Reference Books *

1. Bioinformatics Methods & Applications: Genomics, Proteomics & Drug Discovery, S C Rastogi, Mendiratta & P Rastogi, PHI,4th Edition, 2013
2. Moody P.C.E. and A.J. Wilkinson Protein Engineering, IRL Press, Oxford, 3rd Edition,2010.
3. Creighton T.E. Proteins, Freeman W.H. Second Edn,1993.
4. Branden C. and Tooze R. Introduction of protein structure, Garland,1993.
5. The molecular modeling perspective in drug design by N Claude Cohen, 2008, Academic Press.

Course Outcomes**

1. Ability to study protein structure prediction and protein engineering and design
2. Able to understand molecular modeling
3. Able to know computer assisted new lead design
4. Able to study docking methods and computer - assisted drug discovery

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	-	2	-	1	1	2	2	-	-	-	1	2	1	1
CO2	1	-	2	-	-	2	2	3	-	-	-	1	2	1	2
CO3	-	-	1	1	2	-	2	2	-	-	-	1	2	1	-
CO4	2	-	2	-	-	1	2	2	-	-	-	1	2	1	-

UBT731E	NANOBIOTECHNOLOGY AND BIOMATERIALS	Credits: 03
L:T:P – 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.

Introduction to nanotechnology:

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

Applications of nanotechnology in the life sciences:

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

UNIT–II	10 Hrs.

Biopolymers:

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

UNIT–III	10 Hrs.

Synthetic polymers:

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

UNIT–IV	10 Hrs.

Biocompatibility:

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

Medical devices:

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

Reference Books *

1. B.Vishwanath (2011). " Nano Materials" Published by Narosa Publishing House Pvt. Ltd., New Delh.
2. Mark Ratner and Daniel Ratner (2003). "Nanotechnology:A Gentle Introduction to Next Gig Idea" Pearson Ecducation Ltd.
3. K Eric Drexler (1993). "Unbounding the future" Quill.
4. Stephen Lee and Lynn M Savage (2010). "Biological molecules in Nanotechnology".

Course Outcomes**

After completion of the course student will have the

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

*** Books to be listed as per the format with decreasing level of coverage of syllabus**

**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	3	3	-	-	1	2	-	-	-	-	-	2	2	1
CO2	1	2	3	-	-	1	-	-	-	-	-	-	3	-	-
CO3	2	2	3	-	-	2	-	-	-	-	-	-	2	2	1
CO4	3	3	3	-	-	2	-	-	-	-	-	-	2	1	1
CO5	3	3	3	-	-	1	-	-	-	-	-	1	2	-	-
CO6	2	3	3	-		3	3	-	-	-		-	3	1	-

UBT732E	COMPUTATIONAL BIOLOGY	Credits: 03
L:T:P – 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hours

Introduction to computational biology and sequence analysis

Molecular sequences, Genome sequencing: pipeline and data, Next generation sequencing data, Biological databases: Protein and Nucleotide databases, Sequence Alignment, Dynamic Programming for computing edit distance and string similarity, Local and Global Alignment, Needleman Wunsch Algorithm, Smith Waterman Algorithm, BLAST family of programs, FASTA algorithm, Functional Annotation, Progressive and Iterative Methods for Multiple sequence alignment, Applications.

UNIT–II	10 Hrs.

Phylogenetics

Introduction to Phylogenetics, Distance and Character based methods for phylogenetic tree construction: UPGMA, Neighbour joining, Ultrametric and Min ultrametric trees, Parsimonous trees, Additive trees, Bootstrapping.

Protein structure, modelling and simulations

Protein Structure Basics, Visualization, Prediction of Secondary Structure and Tertiary Structure, Homology Modeling, Structural Genomics, Molecular Docking principles and applications, Molecular dynamics simulations.

UNIT–III	10 Hrs.

Machine learning, systems biology and other advanced topics

Machine learning techniques: Artificial Neural Networks and Hidden Markov Models: Applications in Protein Secondary Structure Prediction and Gene Finding, Introduction toSystems Biology and its applications in whole cell modeling, Microarrays and Clustering techniques for microarray data analysis, informatics in Genomics and Proteomics, DNA computing.

UNIT–IV	10 Hrs.

Perl for bioinformatics

Variables, Data types, control flow constructs, Pattern Matching, String manipulation, arrays, lists and hashes, File handling, Programs to handle biological data and parse output files for interpretation

Laboratory Demonstrations for

Biological Databases, Sequence alignment: BLAST family of programs, FASTA, Clustal W for multiple sequence alignment, Phylogenetics software, Homology Modeling and Model evaluation, Auto Dock, GROMACS, Prokaryotic and Eukaryotic Gene finding software, Programs in PERL.

Reference Books *

1. David W. Mount Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, Second Edition, 2004.
2. Arthur M. Lesk, Introduction to Bioinformatics by Oxford University Press, 2008.
3. Baldi, P., Brunak, S. Bioinformatics: The Machine Learning Approach, 2nd ed., East West Press, 2003
4. Baxevanis A.D. and Oullette, B.F.F. A Practical Guide to the Analysis of Genes and Proteins, 2nd ed., John Wiley, 2002
5. Durbin, R. Eddy S., Krogh A., Mitchison G. Biological Sequence Analysis: Probabilistic
6. Models of Proteins and Nucleic Acids. Cambridge University Press, 1998.

Course Outcomes**

1. Ability to know the sequence analysis.

2. Ability to understand and analyze the multiple sequence alignment and applications.
3. Ability to understand the phylogenetics.
4. Ability to analyze the molecular dynamics simulations.
5. Ability to understand perl bioinformatics.
6. Ability to differentiate prokaryote and eukaryote gene finding software.

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	-	2	-	1	1	2	-	-	-	-	1	2	1	-
CO2	1	-	2	-	-	2	2	-	-	-	-	1	2	1	-
CO3	-	-	1	1	2	-	-	-	-	-	-	1	1	1	-
CO4	2	-	2	-	-	1	2	-	-	-	-	1	-	1	-
CO5	-	-	1	2	2	-	-	-	-	-	-	1		1	-
CO6	1	-	1	-	-	2	2	-	-	-	-	2	2	1	-

UBT733E	BIOCONJUGATIVE TECHNOLOGY	Credits: 03
L:T:P – 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hours

Bioconjugative technology

Modification of Amino Acids, Peptides and Proteins – Modification of sugars, polysaccharides and glycoconjugates – modification of nucleic acids and oligonucleotides.

UNIT–II	10 Hrs.

Chemistry of active groups

Amine reactive chemical reactions – Thiol reactive chemical reactions – carboxylate reactive chemical reactions – hydroxyl reactive chemical reactions – aldehyde and ketone reactive chemical reactions – Photoreactive chemical reactions.

Bioconjugate reagents

Zero length cross linkers – Homobifunctional cross linkers – Heterobifunctional cross linkers – Trifunctional cross linkers – Cleavable reagent systems – tags and probes.

UNIT–III	10 Hrs.

Enzyme and nucleic acid modification and conjugation

Properties of common enzymes – Activated enzymes for conjugation – biotinylated enzymes – chemical modification of nucleic acids – biotin labeling of DNA- enzyme conjugation to DNA – Fluorescent of DNA.

UNIT–IV	10 Hrs.

Bioconjugate applications

Preparation of Hapten-carrier Immunogen conjugates - antibody modification and conjugation – immunotoxin conjugation techniques – liposome conjugated and derivatives- Colloidal – gold-labeled proteins – modification with synthetic polymers.

Reference Books *

1. Bioconjugate Techniques, G.T. Hermanson, Academic Press, 2 nd edition 2008
2. Bioconjugate techniques , Greg T Hermanson, academic Press ,Global store , 2016
3. A Text book of biophysics by Dr R.N. Roy,UBS publishers, 2001
4. Bioconjugative Chemistry by Vincent M Rotello, American Chemical society, 2016
5. Bioconjugate techniques , Greg T Hermanson, academic Press ,Global store , 2017

Course Outcomes**

1. Able to understand modification of nucleic acids and oligonucleotides.
2. Ability to know the chemistry of active groups.
3. To analyse the bioconjugate reactants.
4. To analyze bioconjugate applications.
5. Ability to know the conjugate derivatives.
6. Ability tostudy the conjugation process.

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	-	2	-	1	1	2	1	-	-	-	1	2	1	1
CO2	1	-	2	-	-	2	2	-	-	-	-	1	2	1	2
CO3	-	-	1	1	2	-	2	-	-	-	-	1	2	1	-
CO4	2	-	2	-	-	1	2	1	-	-	-	1	2	1	-
CO5	-	-	1	2	2	-	3	1	-	-	-	1	2	1	1
CO6	1	-	1	-	-	2	2	2	-	-	-	2	2	1	-

UBT734E	FOOD BIOTECHNOLOGY	Credits: 03
L:T:P – 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hours

Introduction

Hunger, Technology and World food needs-nutritional problems, approaches to combat world hunger, roles of technology. Recent Developments in food biotechnology, introduction to molecular food biotechnology.

Novel bioprocessing

Biosensors for food quality assessment, cold active enzymes in food processing, biotransformation in food industries.

Nutrigenomics

Definition of Nutriomics, Nutrigenetics, and its applications, Nutritional genomics and applications in brief. Nutrigenetics and cancer.

UNIT–II	10 Hrs.

Microbial biotechnology of food

Metabolic engineering of bacteria for food ingredients (Amino acids, organic acids, vitamins). Introduction to technologies for microbial production of food ingredients. Solid-state fermentation for food applications (enzymes, pigments). Biotechnology of microbial polysaccharides- natural occurrence of microbial polysaccharides in foods, additives (xanthan) and its future, Microbial biotechnology of food flavor, oils and fats. Food applications of algae-nutritional value, source of neutraceuticals and industrial production processes (chlorella, spirulina, Agar, alginate). Genetics of Dairy starter cultures.

UNIT–III	10 Hrs.

Plant food applications

Genomic basics for food improvement, molecular design of soybean proteins for enhanced food quality, Genetic modifications of plant starches, plant oils, for food applications. Bioprocessing of starch using enzyme technology. Molecular biotechnology for neutraceutical enrichment of food crops, Biotechnology of nonnutritive sweeteners, metabolic redesign of vitamin -E biosynthesis, production of new metabolites, Engineering of provitamin- A ,biosynthetic pathway into rice(Golden rice), Engineering of carotenoid biosynthesis for antioxidants, approaches to improve nutritional quality and shelf life of fruits and vegetables.

UNIT–IV	10 Hrs.

Enhancement of leaf quality protein for ruminant animals. Methods of chloroplast transformation, markers for transformation, engineering chloroplast for the production of edible vaccine, Transplastomic maize- a case study.

Animal food applications: Genetic modification of production traits in farm animals, Foods made from GM animals, applications of transgenic fish technology in sea food production, enzymatic synthesis of oligosaccharides-progress and recent trends.

Food safety: international aspects of the quality and safety, genetically modified food controversies. Regulation of the release of genetic modified organisms,patenting inventions in food biotechnology.

Reference Books *

1. Kalidas s, Gopinadhan P, Anthony P and Robert E.Levin- " Food Biotechnology"- second edition, CRC press, 2006
2. Gustavo F.G and Gustavo V.B,-" Food Science and Food Biotechnology"- CRC press, 2003
3. Mahesh S.-" Plant Molecular Biotechnology"- first edition, New age international publishers, , 2008
4. Norman N.Potter and Joseph H. Hotchkiss- Food Science- fifth edition- CBS publishers and distributors, 2007

Course Outcomes**

1. Students will be able to know the importance and current status of food biotechnology
2. Students will acquire the knowledge on novel food bioprocessing, nutrigenomics in brief.
3. Explore the applications of microbes in food biotechnology, new sources of food from microbes etc
4. Will be able to learn about plant food biotechnology and transplastomic technology
5. Will get the knowledge on applications of Animal food biotechnology and food safety and its regulation
6. Able to have an overview recent trends in GMOs and food biotechnology

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1	2	-	2	1	-	-	-	-	-	1	2	1	1
CO2	2	-	2	-	3	2	-	-	-	-	-	1	2	1	1
CO3	1	1	1	-	2	2	-	-	-	-	-	1	2	1	2
CO4	2	-	2	-	2	1	-	-	-	-	-	1	2	1	1
CO5	2	1	1	-	3	1	-	-	-	-	-	1	2	1	2
CO6	1	-	1	-	2	2	-	-	-	-	-	2	2	1	1

UBT716H	INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP	Credits: 03
L:T:P – 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	12 Hrs.

Development of management thoughts and its functions

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

UNIT–II	10 Hrs.

Quantitative techniques in managerial decisions

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

UNIT–III	10 Hrs.

Production And Material Management

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

UNIT–IV	10 Hrs.

Entrepreneurship& personnel management

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

Reference Books *

1. O.P. Khanna - "Industrial Engineering & Management", Dhanpat Rai & Sons, 1992.
2. T. R. Banga & S. C. Sharma - "Industrial Engineering & Management Science", 6th. Edn, Khanna Publications, 2003.
3. C.B.Mamoria and S.V.Gankar- Personnel Management, Himalaya Pub, 21 st edn,2010
4. Veerabhadra Havinal -Management and Entrepreneurship- New Age International, 2009
5. Ramesh Burbure – Management &Entrepreneurship- Rohan Pub. 2008
6. Poornima M. Charanthimath – Entrepreneurship Development, Pearson Education-2005

Course Outcomes**

After completion of the course student will be able to

1. Recall and recollect the history theories and definition of management and its importance in society
2. Analyze and apply the basic concepts of Quantitative techniques of management
3. Know the difference between production and productivity, measurement and cost analysis
4. Explore the knowledge of production costs, planning and material management
5. Make basic economic analysis of project
6. Understand the role and importance of entrepreneurship in economic development

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	-	1	-	-	-	3	1	-	-	2
CO2	-	1	-	-	-	-	-	-	-	-	3	1	-	-	2
CO3	-	1	-	-	-	-	-	-	-	-	3	1	-	-	2
CO4	-	1	-	-	-	-	-	-	-	-	3	1	-	-	2
CO5	-	1	-	-	-	-	-	-	-	-	3	1	-	-	2
CO6	-	1	-	-	-	-	-	-	2	-	3	1	-	-	2

UBT733N	INDUSTRIAL SAFETY	Credits: 03
L:T:P – 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	12 Hrs.

Industrial safety:

Need for safety, importance of occupational health and safety, Health and safety programs, unsafe conditions, factors contributing to unsafe conditions, Good Lab Practices (GLP).

Accidents:

Accident preventive measure, Measurement and control of safety performance, 5E's for accident prevention- Engineering, Education, Enthusiasm, Enforcement and Evaluation. Hierarchy of Controls, Safety policy.

Chemical Hazards:

Types of hazards, Classification of chemicals based on their nature, routes to exposure of chemicals, Health effects of harmful chemicals in the work environment, Control of chemical hazards.

UNIT–II	10 Hrs.

Electrical Hazards and Control measures:

Electrical hazards, protection against voltage fluctuations, effects of shock on human body. Fire- Fire formation, Fire extinguishing agents. Evacuation procedures for workers during emergency conditions.

Physical Hazards and Control measures:

Noise, noise exposure regulation, properties of sound, Workers exposure to electromagnetic field, Ionizing radiation and non-ionizing radiations, effects of radiations, Classification of dangerous materials with pictorial symbols, Safety in transportation of dangerous materials by road, rail, ships and pipelines.

UNIT–III	10 Hrs.

Biological and Construction Hazards and their control measures:

Classification of Bio hazardous agents –bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases –Hazardous material used in labs, Instructions followed for hazardous waste disposal, Biohazard control program, Biological safety cabinets.

Construction Hazards:

Hazards in construction and safety measures, Good Manufacturing Practices (GMP).

UNIT–IV	10 Hrs.

Occupational Health and Toxicology:

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

Reference Books *

1. Mark Friend and James Kohn, (2007), Fundamentals of Occupational Safety and Health The Scarecrow Press, Inc.
2. Phil Hughes and Ed Ferret, (2011), Introduction to Health and Safety at work, (5th edition), Elsevier Ltd.

Course Outcomes**

After completion of the course student will be able to

1. Apply the basic knowledge of Industrial hazards and safety.
2. Interpret & analyze the various types of accidents and chemical hazards.
3. Identify physical hazards and apply control measures in work place.

4. Acquire knowledge of electrical hazards and apply control measures in work place.
5. Identify various types of biological hazards and apply control measures.
6. Identify control measures and apply the knowledge in industrial toxicology and hygiene, occupational diseases in work place.

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	1	1	1	1	1	1	-	-	-	-	-	3	2	1
CO2	-	1	1	3	1	1	1	-	-	-	-	-	3	2	1
CO3	-	1	3	3	3	2	1	-	-	-	-	-	3	2	1
CO4	-	1	3	2	3	2	1	-	-	-	-	-	3	2	1
CO5	-	1	3	3	3	2	1	-	-	-	-	-	3	2	3
CO6	-	1	3	3	3	3	1	-	-	-	-	-	3	2	3

UBT710L	BIOSEPARATION TECHNIQUES LAB	Credit: 01
L:T:P – 0:0:2		CIE Marks: 50
Total Hours/Week: 02		SEE Marks: 50

LIST OF EXPERIMENTS IN BIOSEPARATION TECHNIQUES LABORATORY

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

Reference Books *

1. Scopes R.K., 1993. Protein Purification IRL Press
2. Bioseparations by Belter P.A. and Cussier E., Wiley, 1985.
3. Palanivelu. P, 2001, Analytical Biochemistry and Seperation Techniques, Kalaimani Publishers.

Course Outcomes**

After completion of the course student will be able to

1. Prepare/reproduce the protocols for the experiments.
2. Extract the intracellular product using different cell disruption techniques.
3. Concentrate, purify the desired product using different chromatography/filtration techniques.
4. Analyze the product both quantitative/qualitatively.
5. Record/observe the experimental data and interpret them in the graph/table.
6. Calculate the result and to write the conclusion at the end of the experiment.

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1	1	-	3	-	-	-	-	-	-	1	1	1	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	1
CO3	-	2	-	-	-	-	-	-	-	-	-	-	-	3	1
CO4	-	-	3	-	-	-	-	-	-	-	-	-	2	2	1
CO5	-	-	-	3	3	-	-	-	-	-	-	-	2	2	1
CO6	-	3	-	-	-	-	-	-	-	-	-	2	2	3	1

UBT717L	FOOD ANALYSIS TECHNIQUES LAB	Credit: 01
L:T:P – 0:0:2		CIE Marks: 50
Total Hours/Week: 02		SEE Marks: 50

LIST OF EXPERIMENTS IN FOOD ANALYSIS TECHNIQUES LABORATORY

1. Proximate analysis of foods
2. Nutritional profiling of food samples for labeling (Carbohydrates, protein and fat)
3. Nutritional profiling of food samples for labeling (Vitamins and minerals)
4. Determination of calories in foods.
5. Determination of viscosity and texture of food sample
6. Detection of microbial load in processed food a sample
7. Extraction and detection of active ingredients in foods
8. Extraction of chitin, chitosan and glucosamine from prawn shells/mushrooms
9. Detection of Antioxidant property of Nutraceuticals
10. Sensory evaluation
11. Visit to NABL lab

Reference Books *

1. Food analyses by S Suzanne Nielsen, Fourth edition, Springer publisher, 2010
2. Food Regulation: Law, Science, Policy and Practice, N.D. Fortin, Wiley Publication, 2nd Edition, 2016
3. A Practical Guide to Food Laws and Regulations. Kiron Prabhakar, Bloomsbury Professional India, 1st Edition, 2016.
4. Food Safety and Standards Act and Regulations, Food Safety and Standards Authority of India, Ministry of Health and Family Welfare, Government of India, 2006

Course Outcomes**

After completion of the course student will be able to

1. Analyze different food samples for quality.
2. Evaluate food samples for quality.
3. Evaluate food samples for chemical and microbial safety.
4. Analyze the data for the acceptability of food sample

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1	1	-	3	-	-	-	-	-	-	1	1	1	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	1
CO3	-	2	-	-	-	-	-	-	-	-	-	-	-	3	1
CO4	-	-	3	-	-	-	-	-	-	-	-	-	2	2	1