BVVS

BASAVESHWAR ENGINEERING COLLEGE (AUTONOMOUS), BAGALKOT

DEPARTMENT OF BIOTECHNOLOGY

SCHEME OF TEACHING AND EXAMINATION
B.E. III SEMESTER

2021-22

Sl. No	Subject Code	Subject Title	Hours/Week					Exam marks		
			Credits	Lecture	Tutorial	Practical	Total hours	CIE	SEE	Total
1	UMA392C	Numerical Techniques and Fourier series	3	3	0	0	3	50	50	100
2	UBT313C	Microbiology	3	3	0	0	3	50	50	100
3	UBT305C	Biochemistry	3	3	0	0	3	50	50	100
4	UBT315C	Bioprocess Principles and Calculations	3	2	2	0	4	50	50	100
5	UBT317C	Cytogenetics & Cell Culture Techniques	3	3	0	0	3	50	50	100
6	UBT312C	Unit Operations	3	3	0	0	3	50	50	100
7	UBT307L	Biochemistry Lab	1.5	0	0	3	3	50	50	100
8	UBT308L	Microbiology Lab	1.5	0	0	3	3	50	50	100
9	UBT311L	Unit Operations Lab	1	0	0	2	2	50	50	100
10	UHS388C UHS389C	Saamskrutika Kannada* Balake Kannada**	1	2	0	0	2	50	50	100
			23	**19**	**2**	**8**	**29**	**500**	**500**	**1000**

UMA392C: Numerical Techniques & Fourier Series
3 Credits (3-0-0)

Unit-I

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-II

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-III

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-IV

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.

Resources:

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:

On the successful completion of this course, students are able

1. The ability to solve engineering problems using non-linear equations and interpolation techniques.
2. The ability to solve problems using numerical differention
3. Be capable to perform numerical integration and solutions of ordinary differential equations.
4. Fourier analysis provides a set of mathematical tools which enable the engineer to break down a wave into its various frequency components. It is then possible predict the effect of a particular waveform.
5. It is essential to understand the basic concepts of Fourier transforms to solve ordinary differential equation and pde..

UBT313C: Microbiology
3 Credits (3-0-0)

UNIT 1

Introduction **10 Hours**

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

UNIT 2

Microorganisms **10 Hours**

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

UNIT 3

Control of Microorganisms **10 Hours**

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

UNIT 4

Agricultural and Environmental Microbiology **12 Hours**

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

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

Total: 42 hours

Text Books

1. Pelczar, Chan and Noel Kreig, "Microbiology"- 7th Edition Tata Macgraw Hill, 2019
2. Tortora, Funke and Case, "Microbiology an Introduction" -8th Edition, Pearson Education, 2006

Reference Books

1. Stainer R.Y., Ingraham J.L., "General Microbiology"- 5th Edition Mc.Millan Press, 2010
2. Madigan, Martinko, Parker, Brock's, "Biology of Microorganisms" - 10th Edition, Prentice Hall, Pearson Education, 2010
3. Prescot and Dunn, "Industrial Microbiology"-Agribios India, 2004
4. J. Salle, "Fundamental Principles of Bacteriology" – 7th Edition, Tata Macgraw Hill, 2007
5. E Alcamo I "Fundamentals of Microbiology"6th Edition, Jones & Bartlet, Pub. 2001.
6. Prescott, Harley & Klein, "Microbiology" -7th Edition, WCB/McGraw Hill, Int., 2008.

Course Outcomes

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

UBT305C: Biochemistry
3 Credits (3-0-0)

UNIT- 1

Principles of Bioenergetics and introduction of enzymes: 12 Hours

Energy Flow cycle, energy conversion. Structure and properties of ATP, Bioenergetics of metabolic pathway. Definition & Classification of Enzymes , Chemical nature and properties of enzymes

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)

UNIT- 2

Lipid Metabolism: 10 Hours

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

Disorders of lipid metabolism- Sphingolipidoses. Etc

UNIT- 3

Nucleic acid Metabolism: 10 Hours

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

Disorders of nucleic acid metabolism-Lesch-Nyhan Syndrome and Gout.

UNIT- 4

Amino Acid Metabolism: 10 Hours

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

Total: 42 Hours

Text Book

1. David L. Nelson and Michael Cox, "Lehninger Principles of Biochemistry" –7th Edition, 2017.

Reference Books

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

Course Outcomes

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

UBT315C: Bioprocess Principles and Calculations
3 Credits (2-2-0)

UNIT 1

Introduction & Basic Chemical Calculations **10 Hours**

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

UNIT 2

Material balance without chemical reactions **10 Hours**

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

UNIT 3

Material balance involving chemical reactions **10 Hours**

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

UNIT 4

Energy Balance **10 Hours**

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

Total: 40 hours

Text 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.

Reference Books

1. D.M.Himmelblau (2014) Basic Principles and Calculations in Chemical Engineering, 8th Edn, Phi Learning Pvt Ltd.
2. Segel IH (2010) Biochemical Calculations 2nd Edn., John Wiley & Sons, NewYork.
3. 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 oneor 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.

UBT317C: Cytogenetics and Cell Culture Techniques
3 Credits (3-0-0)

UNIT- 1

Cell cycle and its regulation: 10 hours

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- 2

Plant cell culture 12 Hours

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 3

Animal cell culture Techniques: **10 Hours**

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 4

Cell line Characterisation and Maintenance: 10 Hours

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.

Total: 42 Hours

Textbooks

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.

Reference Books

1. Rastogi S C "Cell Biology" - New Age International Pub. 2005.
2. Powar C.B., "Cell Biology", Himalaya Pub. 2006.

3. Channarayappa, Cell biology, Universities Press,2010.
4. Gardener, Simmons and Snustad,"Principles of Genetics"John Willey Publisher,2003
5. Singh B.D, "Fundamentals of Genetics", Kalyani Pub, 2010.
6. Biotech Expanding Horizons-B. D. Singh, Kalyani Publishers,2010.
7. 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

UBT312C: Unit Operations
3 credits (3-0-0)

UNIT 1

Introduction to Fluid Mechanics **10 Hours**

Units, 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 2

Flow Past Immersed Bodies **10 Hours**

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

UNIT 3

Flow measurements **10 Hours**

Orifice meter, Venturimeter, Rota meter principles advantages and disadvantages derivation the discharge and numerical problems. Pumps, principle, construction numericals. Centrifugal & Reciprocating pumps, Characteristics of centrifugal pumps. Pipes, fittings and valves.

UNIT 4

Mechanical Operations **10 Hours**

Filtration: 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 theory (Kynch), Agitation: Theory of mixing, Power number calculations, mixing equipment. Flow patterns in agitated tanks, mechanism of mixing, scale up of mixing systems. Size Separation: Particle shape, size, screen analysis, screening equipment. Size Reduction: Characteristics of comminute products, crushing laws and work index; Size reduction equipment.

Total: 40 hours

TEXT BOOKS

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

REFERENCE BOOKS:

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

COURSE OUTCOMES:

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

UBT307L: Biochemistry Lab

1.5 Credits (0-0-3)

LIST OF EXPERIMENTS

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.

UBT308L: Microbiology Lab
1.5 Credits (0-0-3)

LIST OF EXPERIMENTS

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

Reference Books

1. Pelczar, Chan and Krieg, "Microbiology" -7th Edition, Tata McGraw Hill, 2019.
2. K. R. Aneja, "Experiments in Microbiology, Plant Pathology and Biotechnology" – 5th Edition, New age International Pub. 2010.

Course Outcomes

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

UBT311L: Unit Operations Lab

1 Credit (0-0-2)

LIST OF EXPERIMENTS

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

QUESTION PAPER PATTERN FOR CIE AND SEE:

CIE:

1. Question paper consists of two parts viz., part A and part B.
2. Part A is compulsory and will consist of 10 questions each one mark or 5 questions of each two marks or a combination of one and two marks totaling to 10 marks.
3. Part B consists of 2 units. Two questions from each unit uniformly covering the syllabus of the unit under consideration. Each question will carry 15 marks and should not have more than 3 sub divisions. Any one full question to be answered from each unit.
4. Each CIE test will be for a total of 40 marks then reduced to 20 marks.

SEE:

1. Question paper consists of two parts viz., part A and part B.
2. Part A is compulsory and it consist of 20 questions of each one mark or 10 questions of each two marks or a combination of one and two marks totaling to 20 marks.
3. Part B consists of 4 units. Two questions from each unit uniformly covering the syllabus of the unit under consideration. Each question will carry 20 marks and should not have more than 4 sub divisions. Any one full question to be answered from each unit.
4. The SEE will be for a total of 100 marks then reduced to 50 marks

B.E. IV SEMESTER

2021-22

Sl. No.	Subject Code	Subject Title	Hours/Week					Exam Marks		
			Credits	Lecture	Tutorial	Practical	Total	CIE	SEE	Total
1	UBT415C	Biostatistics & Bio-modelling (BS)	3	2	2	0	4	50	50	100
2	UBT406C	Immunotechnology (PC)	3	3	0	0	3	50	50	100
3	UBT412C	Heat & Mass Transfer (PC)	3	3	0	0	3	50	50	100
4	UBT419C	Thermodynamics (PC)	3	3	0	0	3	50	50	100
5	UBT418C	Molecular Biology (PC)	3	3	0	0	3	50	50	100
6	UHS001N	Fundamentals of Quantitative Aptitude and Soft Skills	1	2	0	0	2	50	50	100
7	UBT410L	Immunotechnology Lab	1	0	0	2	2	50	50	100
8	UBT413L	Biostatistics Lab	1.5	0	0	3	3	50	50	100
9	UBT408L	Molecular biology Lab	1.5	0	0	3	3	50	50	100
Total			**20**	**16**	**2**	**8**	**26**	**450**	**450**	**900**

UBT415C: Biostatistics & Bio-modelling

3 Credits (2-2-0)

UNIT 1

Introduction and Descriptive Statistics **10 Hours**

Scope of biostatistics, presentation of data, Diagrammatic and graphical represent,(simple, multiple, component bar diagrams, pie chart, histogram, frequency polygon, frequency curve, ogive curve). Measure of central tendency (meaning of central tendency, arithmetic mean, median, Quartiles, mode, geometric mean, harmonic mean their merits and demerits). Measure of dispersion: meaning, range, quartile deviation, mean deviation and standard deviation, coefficient of variation, skewness and kurtosis. Correlation and linear regression analysis, curve fittingstraight line).

UNIT 2

Probability and Probability Distributions **10 Hours**

Definition of probability, Event, Mutual Exclusive, Independent, Complimentary Events Addition and Multiplication theorem of probability and examples. Discrete probability distributions: Bernoulli's , Binomial and Poisson distribution. Continuous probability distribution – normal, Standard normal variate, properties of normal curve, T, Fand χ^2 (Chi square -goodness of fit test) distributions and their applications in Biology.

UNIT 3

Statistical Inference , ANOVA and Design of Experiments **10 Hours**

Estimation theory and testing of hypothesis point estimation, interval estimation. Sample, population, sample size determination. Methods of Sampling techniques- random (simple, stratified and systematic) non random sampling -(Judgement and convenience). Definition of analysis of variance(one way and two way classifications), Basic principles of experimental design and limitations-randomization, replication, local control, Types of statistical designs of biological experiments and limitations-CRD, RCBD, LSD, Plackett-Burmann design, Response surface methodology(RSM).

UNIT 4

Bio-modeling **10 Hours**

Microbial Growth in a Chemo-stat, Growth Equations of Microbial Populations, product formation models, Models of Commensalisms, Batch culture model, Mutualism, Predation and Mutation. Simple Prey predator model, Volterra's Model for n Interacting Species. Basic Models for Inheritance, Applications of probability in genetics, Hardy - Weinberg law. Selection and Mutation Models, Genetic Inbreeding Models. Dose response studies.

Total: 40 hours

Text Books

1. Marcello Pagano & Kimberlee Gauvreu, "Principles of Biostatistics" -Thompson Learning Pub, 2006.
2. J.N.Kapur, "Mathematical Models in Biology and Medicine", 1st Edition, New age international Pvt. Ltd, 2001.

Reference Books

1. Norman T J Bailey, "Statistical methods in Biology" -Cambridge Press, 3rd Edition, 2000.
2. B.L.Agarwal Basic statistics, New age international Publishers, Fifth Edition 2009.
3. Ronadd N Forthofer and Eun Sul Lee, "Introduction to Biostatistics" -Academic Press, 1995.
4. Khan and Khanum, Fundamentals of Biostatistics,Ukaaz pub,3 rd edn,2008
5. S I Rubinow, "Introduction to Mathematical Biology" -John Wiley, 1975.
6. Richard A. Johnson, "Miller & Freund's Probability and statistics for engineers" Prentice Hall, 6th Edition,, 2000.

7. Veer Bala Rastogi, “Fundamentals of Biostatistics” -Ane Books, 3rd Edition, 2015
8. S C Gupta and V.K. Kapoor, Fundamentals of Applied Statistics, Sultan Chand and Sons.4th Edition, 2007.

Course Outcomes

1. Demonstrate and understand the basic concepts of biostatistics, analysis of measure of central tendency and dispersion.
2. Ability to know the basic principles of probability and distributions in Biology and Genetics
3. Analyse and interpret data regarding various distributions (T-test, F-test, and chi square)
4. Basic principles and designs of experimentation and ANOVA
5. Perform experimental design (RSM, Plakett Burman, LSD, CRD, RCBD)
6. Ability to study the microbial growth in chemostat, product formation and biomodelling in various parameters

UBT406C: Immunotechnology
3 Credits (3-0-0)

UNIT 1

The immune system: **10 Hours**

Introduction, Cells and Organs of the immune system: Lymphoid cells, phagocytes, mast cells and dendritic cells. Primary (thymus, bonemarrow and lymphatic system) and secondary Lymphoid organs(lymph nodes, spleen, MALT, CALT). Innate and adaptive immunity. Antigens, Antibodies, Complement system-complement activation,(classical, alternative and lectin pathway) regulation and biological consequences of compliment activation. Cytokines and their role in immune response. Monoclonal antibodies and applications

UNIT 2

Humoral and cell mediated immunity **10 Hours**

Introduction to humoral and cell mediated immunity. B-lymphocytes and their activation; Basic structure of immuno globulins; immunoglobulin classes (IgG, IgA, IgE, IgD and IgM) and biological activity. Antigenic determinants on immunoglobulin's- Isotype, Allotype and Idiotype. Thymus derived lymphocytes (T cells) and types, T-cell maturation and activation, mechanisms of T cell activation. Cell death and T-cell populations. Major Histocompatibility Complex and antigen presentation. Antigen presenting cells, dendritic cells, macrophages, mechanism of phagocytosis.

UNIT 3

Immunological disorders **10 Hours**

Hypersensitivity reactions and its types. Autoimmune disorders- Organ specific, Systemic Autoimmune diseases, Animal models for autoimmune diseases and treatment of autoimmune disease. Primary and secondary immunodeficiency disorders (AIDS). Transplantation Immunology: immunological basis of graft rejection, Types of transplantations.

Vaccines: Active and Passive immunization. Designing vaccines for active immunization: Live, attenuated vaccines. Inactive vaccines, subunit vaccines, recombinant vector vaccines and DNA vaccines.

UNIT 4

Immunodiagnosis **10 Hours**

Antigen-antibody reactions- Precipitation reactions, agglutination reactions, Blood typing A, B, ABO & Rh. Principal and applications of ELISA, Radio immuno assay (RIA), western blot analysis, immuno-electrophoresis, Immunofluorescence. Non-isotopic methods of detection of antigens - enhanced chemiluminescence assay. Purification and synthesis of antigens.Immuno-informatics.

Total: 40 hours

Text Books

1. Roitt's Essential Immunology by Wiley Blackwell 13th Edition 2017
2. Kuby J Immunology by, W H Freeman publishers 8th Edition, 2019

Reference Books

1. Ashim K and Chakravarthy- Immunology & Immunotechnology, Oxford University Press, 1st edition, 2006.
2. Rastogi S C Immunodiagnostics Principles and practice New Age International.2005
3. Peter Wood Understanding Immunology, Pearson Education, 3rd Edition, 2011.
4. Charles Janeway, Jr. and Paul Travers Immunobiology - the immune system in health and disease, Garland Publishing, Inc. 6th Edition, 2005
5. William E Paul Fundamental Immunology, Lippincott Williams & Wilkins,7th Edition 2012

Course Outcomes

1. Able to understand Immune system.
2. Able to Analyze the cell and humoral immune system.
3. Able to explain the immunological disorders.
4. Able to Evaluate the Transplantation immunology.
5. Able to understand the designing of Vaccines.
6. Able to understand antigen antibody reaction and application of Electrophoresis in Immunology.

UBT412C: Heat and Mass Transfer
3 Credits (3-0-0)

UNIT-I

Introduction to Heat Transfer **10 Hours**

Modes of heat transfer; Conduction – steady state heat conduction through uni-layer and multilayer plane wall sphere, cylinder; Insulation – types, critical radius, Optimum thickness of insulation. Forced and Natural convection; Significance of Dimensionless numbers (Nu, Gr, Pr, Re, Pe numbers only); Heat transfer without phase change, heat transfer in laminar and turbulent flow inside closed conducts, concepts of film heat transfer coefficients.

UNIT-II

Heat Transfer Equipments **10 Hours**

Equations and numerical problem for calculations of film heat transfer coefficients, Heat transfer with phase change - Condensation – film wise and drop wise; Boiling – types of boiling. Co current and counter current flow. Individual and overall Heat transfer coefficients, LMTD, Elementary design of double pipe heat exchanger and shell and tube heat exchanger.

UNIT-III

Basics of Mass Transfer **10 Hours**

Diffusion - Fick's law of diffusion. Measurement of diffusivity, Theories of mass transfer, Mass transfer coefficients and their correlations. Liquid-Liquid, Solid-Liquid, Liquid-Gas, Solid-Liquid-Gas Mass transfer. Principles, mass transfer considerations, design equations and equipments for leaching, extraction, absorption, adsorption, crystallization and evaporation

UNIT-IV

Mass transfer Operations **10 Hours**

Distillation: Methods of distillation –Simple, Flash distillation of binary mixtures – relative volatility, fractionation of binary mixtures -McCabe Thiele method, Extractive and Azeotropic distillation, numerical. Drying: Drying rate, drying curve and calculations, drying equipment.

Total: 40 Hours

Textbooks:

1. McCabe WL, Smith JC and Harriott (2005) Unit operations in Chemical Engineering, 7th Edn., McGraw-Hill Publications, USA
2. Treybal RE (2012) Mass Transfer Operations, 3rd Edition, McGraw-Hill Publications, USA.
3. R. P. Chhabra V. Shankar (2018) Coulson and Richardson's Chemical Engineering Volume 1B: Heat and Mass Transfer: Fundamentals and Applications, 7th Edition, Butterworth-Heinemann

Reference Books:

1. Pauline Doran (2012) Bioprocess Engineering Principles, 2nd Edition, Academic Press
2. Alan S Foust, Wenzel LA, Clump CW, Maus L and Anderson LB (2008). Principles of Unit Operations, 2nd Edn., John Wiley & Sons, USA.
3. Kern (2001). Process Heat Transfer, 2nd Edn. McGraw-Hill Publications, USA.
4. Perry RH and Green DW (2008). Perry's Chemical Engineering Hand Book, 8th Edn., McGraw- Hill Publications.

Course Outcomes

1. Define the different modes of heat transfer and solve the problems
2. Determine heat flux and temperature distribution in steady state one- dimensional problems using thermal resistance concept.
3. Estimate the heat transfer rate for different types of heat exchangers.

4. Predict mass transfer rates and mass transfer coefficients.
5. Estimate the number of theoretical plates required for effective separation of liquid mixtures.
6. Determine various parameters of mass transfer operations.

UBT419C: Thermodynamics
3 Credits (3-0-0)

UNIT-I

Introduction **10 Hours**

System, surrounding & processes, closed and open systems, intensive & extensive properties, state and path functions, equilibrium state, reversible and irreversible processes. First Law of Thermodynamics: General statement of first law of thermodynamics, first law for cyclic process, Non-flow process, flow process.

UNIT-II

Second law of thermodynamics & P-V-T behaviour **10 Hours**

General statement of the second law, concept of entropy, the Carnot principle, calculation of entropy changes, Clausius inequality, entropy and irreversibility, third law of thermodynamics. P-V-T behaviour of pure fluids, equations of state and ideal gas law, processes involving ideal gas law: constant volume, constant pressure, constant temperature, adiabatic and polytropic processes. Equations of real gases, principles of corresponding states, compressibility charts.

UNIT-III

Thermodynamic Properties of Pure Fluids **10 Hours**

Derived properties, work function, Gibbs free energy, relationships among thermodynamic properties. Fundamental property relations, Maxwell's relations, Clapeyron equation, entropy-heat capacity relation, Effect of temperature on U, H & Entropy (S), relationships between Cp & Cv, Gibbs Helmholtz equation. Fugacity, fugacity coefficient, Determination of fugacity of pure gases, fugacity's of solids and liquids. Activity and activity coefficient, Thermodynamic diagrams. Properties of solutions.

UNIT-III

Thermodynamic Properties of Pure Fluids **10 Hours**

Partial molar properties, Chemical potential, Gibbs-Duhem equation & its applications, Henry's law & Raoult's law. Criteria of phase Equilibria, criterion of stability, Duhem's theorem, Vapour- Liquid Equilibria: VLE in ideal solutions, Consistency test for VLE data, calculation of activity coefficients using Gibbs - Duhem equation, Liquid-Liquid Equilibrium diagrams.

Textbooks:

1. Smith JM and Van Ness HC (2004) Introduction to Chemical Engineering thermodynamics, 6th Edition, McGraw Hill Publications, USA.
2. Stanley I. Sandler (2006) Chemical and Engineering Thermodynamics, 4th Edn., John Wiley & Sons, USA.
3. Narayanan KV (2001) A Textbook of Chemical Engineering Thermodynamics, Prentice Hall Publication, India.

Reference Books:

1. Bailey JE and Ollis DF (2010) Biochemical Engg. Fundamentals, 2nd Edition, McGraw Hill, New York, USA.
2. Rao YVC (1997) Chemical Engineering Thermodynamics, New Age International, India.
3. Segel IH (1993) Biochemical Calculations, 2nd Edn., John Wiley & Sons, USA.
4. Shuler ML and Kargi F (2001) Bioprocess Engineering, 2nd Edn., Prentice Hall International, USA. 5. Eruster L (2013) Bioenergetics, Academic Press, New York.

Course Outcomes

1. Explain the fundamental concepts of the laws of thermodynamics and apply the first law of thermodynamics to solve engineering problems.

2. Understand the second law of Thermodynamics and apply in engineering problems and solve the problems related to properties of fluids.
3. Estimate the thermodynamic properties, such as enthalpies, entropies, Gibbs energies, fugacity coefficients, and activity coefficients of pure fluids as well as fluid mixtures.
4. Analyze and find properties such as Pressure, Volume and Temperature for equations of states. Calculate entropy for the processes, and various types of energies such as internal energy, enthalpy, Helmholtz free energy and Gibbs free energy.
5. Predict equilibrium compositions of mixtures under phase.
6. Generate Vapor Liquid Equilibrium data for ideal and non-ideal solutions and check for their consistency by various methods.

UBT418C: Molecular Biology

3 Credits (3-0-0)

UNIT 1

Introduction **12 Hours**

Genes and their location. Information flow in biological systems: central dogma, updated central dogma. Signalling (signal transduction)-molecular mechanism. Reverse genetics, Genetic code-its features, codon and anticodon.

UNIT 2

Transcription **10 Hours**

Mechanism of transcription in prokaryotes and eukaryotes, Bacterial RNA polymerase, structure and function of RNA polymerases (prokaryotes & eukaryotes), general transcription factors, post transcriptional processing, transcription inhibitors, Si RNA, antisense RNA technology.

Translation:

Protein synthesis: Initiators, Elongation factors, termination codons, Mechanism of translation, Structure and function of prokaryotic and eukaryotic ribosomes, Post translational modification. Differences between prokaryotic and eukaryotic protein synthesis, inhibitors of translation.

UNIT 3

Gene Expression in Prokaryotes **10 Hours**

Regulation of gene expression in prokaryotes: Operon model-structure and function, galactose and lactose operon, tryptophan Operon-regulation by attenuation mechanism; positive versus negative regulation, cyclic AMP effect/catabolite repression.

Gene Expression in Eukaryotes:

Regulation of eukaryotic gene expression, hormonal regulation- peptide and steroid hormones, transcriptional control, super secondary structures-Helix turns Helix. Zinc fingers and Leucine Zippers. Gene silencing-methylation, chromatin modification

UNIT 4

Transposons and Oncogenes **10 Hours**

Transposons-replicative and non replicative mechanisms, Insertion sequences, AC/DS elements, transposition in maize (Mc Clintock's work), cut and paste transposition, Oncogenes and protooncogenes,v-onc, tumour suppressor genes, , retroviruses and its life cycle.

Genetic Recombination:

Genetic recombination in bacteria- transformation, transduction and recombination, Mechanism of recombination-homologous (Holliday model), site specific recombination, double strand break repair model

Total: 42 hours

Text Books

1. David L. Nelson and Michael Cox, "Lehninger Principles of Biochemistry" –7th Edition, 2017
2. James D Watson "Molecular Biology of the Gene", , Pearson Edu.Pub. 5th Edition, 2008

Reference Books

1. David Freifelder "Essentials of Molecular Biology" Narosa Pub.House 2nd Edition, 2008
2. Alberts *et al* "Molecular Biology of the Cell" CBS Pub, 4th Edition, 2002.
3. NPTEL Source material

Course Outcomes

1. Emphasize on the basic aspects of molecular biology; the key areas and apply the knowledge in information flow in biological systems, reverse genetics and genetic code.
2. Classify and compare the mechanism of DNA repair processes, replication.

3. Acquire working knowledge on the mechanism of transcription, translation and post translational processes stepwise and their applications in the research.
4. Identify the various mechanism of gene regulation in prokaryotes and eukaryotes.
5. Identify the steps of transposition and concept of oncogenes.
6. Identify, describe and classify the molecular mechanism of genetic recombination.

UBT410L: Immunotechnology Lab

1 Credit (0-0-2)

LIST OF EXPERIMENTS IN IMMUNOTECHNOLOGY LABORATORY

1. Agglutination Technique: Blood group identification and Rh factor
2. Laboratory diagnosis of diseases-Widal test (Tube agglutination) and VDRL
3. Ouchterlony Double Diffusion (ODD)
4. Radial Immunodiffusion (RID)
5. Countercurrentimmunoelectrophoresis (CCIEP)
6. Rocket immunoelectrophoresis (RIEP)
7. Western blot (IgG Purification)
8. ELISA/DOT Blot.
9. Quantitative precipitinassay (QPA).
10. Separation of lymphocytes fromperipheralblood.

Reference Books

1. Frank C Hay and Olwyn westwood Practical Immunology john Wiley and sons Ltd, 4th Edition,2008
2. R K Sharma and S P S Sangha Basic Techniques in Biochemistry and Molecular biology, I K International, 2009
3. K. R. Aneja, "Experiments in Microbiology, Plant Pathology and Biotechnology" – 5th Edition, New age International Pub. 2017.

Course Outcomes

1. Ability to understand the principle of agglutination reaction and identify the blood group of sample.
2. Apply the knowledge of immunology to identify the antigen and antibody.
3. Apply the concept of antigen antibody reaction to laboratory diagnosis of diseases.
4. Ability to analyse the antibody titre in samples.
5. Apply the knowledge of immunodiffusion to identify the antigens
6. Ability to the principle of purification for antibody purification.

UBT413L -Biostatistics Lab
1.5 Credits (0-0-3)

LIST OF EXPERIMENTS

1. Procedure for creating Data file, Diagram and Graphs.
2. Procedure and calculation of Mean, Median, Mode, Standard Deviation and Variance.
3. Procedure and calculation of t, Z and F test.
4. Calculation of Chi-square test.
5. ANOVA- one-way analysis
6. ANOVA- two-way analysis.
7. Experimental Research Design – CRD- Analysis.
8. Experimental Research design – RBD- Analysis.
9. Experimental Research design – Latin square- Analysis.
10. Calculation of Regression and correlation.
11. Multiple Regression Analysis.
12. Placket-Burman Design for media optimization.
13. Response Surface Methodology for media optimization.

Reference Books

1. Marcello Pagano & Kimberlee Gauvreu, "Principles of Biostatistics" -Thompson Learning Pub, 2nd Edition, 2006.
2. Ronadd N Forthofer and Eun Sul Lee, "Introduction to Biostatistics" -Academic Press, 2014.
3. Agarwal B L., "Basic Statistics"-New Age International Pub, 5th Edn, 2009
4. Norman T J Bailey, "Statistical methods in Biology" -Cambridge Press, 3rd Edition, 2000.

Course Outcomes

1. Able to collect data, interpretation, prepare graphs
2. Able to know about central tendency and measures of dispersion
3. Able to calculate probability distributions (t, f, chi square)
4. Able to state hypothesis and calculate ANOVA(one way and two way)
5. Able to calculate correlation and regression analysis
6. Able to design experiments and Analysis(CRD,RCBD,LSD,PB ,RSM)

UBT408L: Molecular biology Laboratory

1.5 Credits (0-0-3)
LIST OF EXPERIMENTS

1. Study of standard practices in Molecular Biology Lab
2. Standard Operating Procedure for Centrifuge
3. Standard Operating Procedure for Gel documentation unit
4. Study of absorption spectra (proteins./ any biomolecule)
5. Agarose gel electrophoresis
6. Isolation of genomic DNA (plant / animal / microbial sources)
7. Isolation of plasmid DNA from *E. coli.*
8. Estimation of DNA by diphenylamine method.
9. Estimation of RNA by orcinol method.
10. Purity analysis of nucleic acids by UV-Vis Spectrophotometer.
11. PAGE - demo expt.

REFERENCE BOOKS:

1. Sadasivam and Manickam, "Biochemical Methods", 2nd Edition, New age international Publishers, 2017.
2. Sambrook & Russell, "Molecular Cloning", 3rd Edition, Cold Spring Harber Lab, 3rd Edition 2002.

COURSE OUTCOMES:

1. Able to Know the significance of understand the standard practices in Molecular biology lab Able to analyze the concentration and purity of DNA
2. Able to conduct and analyze agarose gel electrophoresis.
3. Able to perform absorption spectra and understand SOP for various lab equipments
4. Able to conduct observations and experiments including Genomic DNA/plasmid DNA /RNA/protein.
5. Demonstrate the knowledge of quantification and purity analysis of biomolecules.
6. Gain knowledge in demonstration of PAGE

QUESTION PAPER PATTERN FOR CIE AND SEE:

CIE:

5. Question paper consists of two parts viz., part A and part B.
6. Part A is compulsory and will consist of 10 questions each one mark or 5 questions of each two marks or a combination of one and two marks totaling to 10 marks.
7. Part B consists of 2 units. Two questions from each unit uniformly covering the syllabus of the unit under consideration. Each question will carry 15 marks and should not have more than 3 sub divisions. Any one full question to be answered from each unit.
8. Each CIE test will be for a total of 40 marks then reduced to 20 marks.

SEE:

5. Question paper consists of two parts viz., part A and part B.
6. Part A is compulsory and it consist of 20 questions of each one mark or 10 questions of each two marks or a combination of one and two marks totaling to 20 marks.
7. Part B consists of 4 units. Two questions from each unit uniformly covering the syllabus of the unit under consideration. Each question will carry 20 marks and should not have more than 4 sub divisions. Any one full question to be answered from each unit.
8. The SEE will be for a total of 100 marks then reduced to 50 marks