FACULTY OF ENGINEERING & TECHNOLOGY

KHWAJA MOINUDDIN CHISHTI LANGUAGE UNIVERSITY, LUCKNOW, UTTAR PRADESH

B.TECH. BIOTECHNOLOGY

Curriculum Structure

SECOND YEAR

(III & IV Semesters)

SEMESTER- III

ELEMENTARY MATHEMATICS-III

Course Objectives: The subject aims to provide the student with:

- Mathematics Fundamental necessary to formulate, solve and analyse the Engineering Problems
- An Understanding of Probability and its distributions, Measures of Central tendency and Measures of Dispersion
- An understanding of Correlation Regression, ANOVA and Statistical Quality control chart.

Course Outcomes: The student after undergoing this course will be able to :

- Solve Problems in Engineering domain related to Measures of Central tendency and Dispersion.
- Analyse and solve problems related to Correlation and Regression and Chi-Square Test, T-Test.
- Analyse and solve problems related to ANOVA and Statistical Quality control Chart.
- To learn principles of experimental design & types of statistical quality control

UNIT I

Data and classification: Data type, Classification and summarization of data. Diagrams and graphs, Measures of central tendency, Measures of dispersion, Moments, Skewness, Kurtosis

UNIT II

Probability and Distributions: Definitions of probability, Additive law of probability, Conditional probability, Multiplicative law of probability, Binomial distribution, Poisson distribution, Normal distribution.

UNIT III

Correlation, Regression and Tests: Correlation, Karl Prearson's coefficient of correlation, Rank Correlation, Lines of regression, Non –Parametric tests Sign Test, Mann Whitene Wilcoxon test.

UNIT IV

Tests of Hypothesis and ANOVA: Hypothesis tests, Student's t-test, Chi-square test, F-test, One way and two way analysis of variance.

UNIT V

Design and Quality control: Principles of experimental design and analysis, completely randomized design, Randomized block design, Latin square design, Statistical quality control, Types of quality control, Control chart for variables, Control chart for attributes.

Text Books:

1. S.P Gupta, Statistical Methods, Sultan Chand and Sons Publishers.
2. Georgr W. and William G., Statistical Methods, IBH Publication.
3. Ipsen J et al., Introduction to Biostatistics, Harper and Row Publication.
4. BS Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.

Reference Books:

1. N.TJ Baily, Statistical methods in Biology, English University Press.
2. R. Rangaswami, A text book of Agricultural Statistics, New Age Int. Publication.
3. PSS Sundar Rao, An Introduction to Biostatistics, Prentice Hall.
4. Zar J, Biostatistics, Prentice Hall, London.

TECHNIQUES IN BIOTECHNOLOGY

Course objectives:

The objective is to enrich students' knowledge about various techniques used in biological research and also their implementation in various fields of research.

Course outcomes:

- Understand the concept of electromagnetic radiation, absorption spectrum, Beer's law and Lamberts law
- Understand principle, working and applications of various spectrophotometers, microscopes, centrifuges and AAS, concept of various spectrometries and can handle them.
- Know the concepts of chromatography and concept of partition coefficient and perform various chromatographic techniques
- Explain the concept of 3D bio printing and their applications
- Students will be able to justify the need for buffers, describe how buffers are prepared, and calculate the amount of buffering agent needed when making a particular buffer

UNIT I

Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, Electron microscopy: TEM and SEM, Atomic force microscopy and con focal scanning laser microscopy. Differential interference contrast microscopy.

UNIT II

Principle and Operations of Chromatography, Thin layer chromatography, Ion Exchange Chromatography, High Performance Liquid Chromatography (HPLC), Gas Liquid Chromatography (GLC), Gel Filtration Chromatography, Affinity Chromatography**.**

UNIT III

Electromagnetic radiation and spectrum, Atomic absorption and Atomic emission spectroscopy,Principle, working and applications of UV-VIS, NMR, ESR and IR spectrometer, Principle and applications of Mass Spectroscopy, Circular Dichorism (CD) principles, Principle and applications of Positron Emission Tomography(PET), Basics of X-Ray diffraction analysis and their application in biotechnology.

UNIT IV

Theory of Electrophoresis, Factors affecting the migration of substances Gel electrophoresis, PAGE, SDS-PAGE, Agarose Electrophoresis of Nucleic Acid, Isoelectric Focusing of Protein Pulse Gel Electrophoresis and Western Blotting. Theory of centrifugation and sedimentation. Types of centrifuges, Preparative and analytical centrifugation; Density gradient centrifugation. Application of centrifugation for preparative and analytical purpose.

UNIT V

Principles of 3-D printing, 3-D Bioprinting of tissues, organs and bacteria. Ideal material properties for bioprinting, Biosensors: Principles and definition, characteristics of Ideal biosensors, Biochemical components of biosensors: Enzyme based biocatalyst sensors, Bioaffinity systems, Immunosensors. Principle and working of Flow Cytometry and cell sorter

Text Books/Reference Books

1. Wilson, K, Walker, J., Principles and Techniques of Practical Biochemistry. 5th Ed. - Cambridge University Press,. Cambridge 1999.
2. Sabari Ghosal & Anupama Sharma Awasthi., Fundamentals of Bioanalytical Techniques and Instrumentation, PHI learning Second edition (2018)
3. Bioanalytical Techniques by A. Shourie and S S Chapadgaonkar. TERI Press. 2015
4. Immunoassay and Other Bioanalytical Techniques. Jeanette M. van Emon. CRC press. 2006
5. 3D Bioprinting in Regenerative Engineering: Principles and Applications, Ali Khademhosseini & Gulden Camci-Unal, CRC Press (2018)

MICROBIOLOGY AND IMMUNOLOGY

Course objectives:

- Introducing the microbial world with specific reference to the metabolic, physiological and morphological characteristics of microbes besides their classification, preservation & and control control of Microorganisms
- To familiarize students with the Immune system, hypersensitivity and vaccination, Immune Effector Mechanisms, hybridoma technology and various Immunotechniques and immunodiagnosis.

Course Outcomes:

- Students would be able to understand characteristics, classification and life cycles of viruses
- To elaborate on microbial nutrition and methods of determining growth curve.
- Understand immune response in our body, both innate and adaptive, to different pathogens, tissue injury and cancer.
- Understand what happens if our immune system overreact to foreign substances (hypersensitivities and allergies)
- Understand what happens if our body recognize self as non-self (autoimmunity)
- Understand the biology of different vaccines against infectious agents and cancer and solutions to produce better vaccines

UNIT I

Morphology and Ultra structure of bacterial cell, Classification of bacteria, Culture media, Isolation of microbes and its identification, culture techniques, Preservation of cultures, Methods for the control of microbes. Enumeration of bacteria. Microbial growth kinetics.

UNIT II

Basic features of transduction, conjugation and transformation, Viruses: Classification and structure of viruses, Viral reproduction: lytic and lysogenic cycle, Overview of biological nitrogen fixation, Bacterial photosynthesis and electron transport system.

UNIT III

Introduction to immune system: Innate and Adaptive immunity, Humoral and Cell mediated immune response, Cells and Molecules of the immune system, Primary and Secondary lymphoid organs, T &B cell maturation and its activation , Characteristics and types of Antigens, Haptens, adjuvants and Epitopes, Antibodies: Structure, functions and characteristics of different classes of antibodies. Monoclonal antibodies.

UNIT IV

Antigen and antibody interactions, precipitation reactions , Serological techniques: ELISA, RIA and western blotting, RT-PCR & Antigen/Antibody Tests for COVID-19, Structure and Function of MHC molecules, Exogenous and Endogenous pathways of antigen processing and presentation, Overview of Complement system and cytokines, immune tolerance.

UNIT V

Applications of microbiology and Immunology: Mirobiology of domestic water and waste water. Microbes in bioremediation, Microbes of industrial use, Immunity against: Bacterial disease- tuberculosis, typhoid, Protozoan disease- Malaria, Amebieosis and Viral diseases - AIDS, Dengue, Chikungunya, COVID-19, Vaccines, Hypersensitivity and Immunotherapy

Reference Books:

1. Microbiology by Pelczar (W C Brown publication)
2. Genral Microbiology by stainer (Mac Millan Publication)
3. Microbiology by Pawar and Dagniwala (Himalaya publishing House).
4. Immunology and immunotechnology by Ashim K. Chakravarty (Oxford university Press)
5. Immunology by C. Fatima 3. Immunology by Kuby (Free man publication)

BIOCHEMISTRY

Course Objectives:

- To make students aware and to give them the basic knowledge of different macromolecules like carbohydrates, nucleic acids protein which are the basis of existence of the cell.
- To acquaint students with the concept of bioenergetics and various metabolic processes taking place inside the human body.
- Students can apply the reaction mechanisms in the domains of metabolism, enzyme technology, structural biology, molecular biology and bioinformatics

Course Outcomes:

- Describe the structure and function of DNA and RNA in the cell
- Students will have knowledge on structure and function of biomolecules like DNA and RNA in the cell, carbohydrates, lipids, enzymes and besides their importance and classification, forces stabilizing their structures, write and relate the role of them with day to day life.
- Describe the structure of proteins, including the significance of amino acid R-groups and their impact on the three-dimensional structure of proteins.
- Know the formation and the breakdown of different biomolecules and the places where it took place
- Various physiological and pathological aspects of by products of metabolic pathways and their regulations and relate with various industrial processes.

UNIT I

Water - Structure, unusual properties, non-covalent interactions, role in biological processes. Ionization of Water, pH scale, Weak Acids, and Weak Bases. Buffers and buffering mechanism, Henderson Hasselbalch equation. Buffering against pH Changes in Biological Systems: Phosphate buffer, Bicarbonate buffer, Protein buffer, Amino acid Buffer & Hemoglobin Buffer System.

UNIT II

Carbohydrates – classification, structure and functions of monosaccharides, disaccharides and polysaccharides. Ring structure and mutarotation, stereo isomers and structural isomers. Metabolism – Glycolysis & oxidation of Pyruvate, TCA cycle, Gluconeogenesis, Pentose Phosphate Pathway, Oxidative phosphorylation, Disorder/ diseases of carbohydrate metabolism.

UNIT III

Fats and lipids – Classification, structure and function: Simple, Compound & Derived lipids, Essential fatty acids. Fatty acid synthesis, origin of acetyl-Co A for fat synthesis, Elongation & desaturation of Fatty Acids. Activation & transport of fatty acid from cytosol to mitochondria for oxidation. Oxidation of saturated & unsaturated fatty acids. β, α, ω oxidation. Formation and utilization of ketone bodies. Disorder/ diseases of lipid metabolism.

UNIT IV

Amino acids and proteins - Classification & structure of amino acids. Essential amino acids. Peptide bond formation, Ramachandran plot, Primary, secondary, tertiary & quaternary structure of proteins. Biosynthesis of amino acids from intermediates of Citric Acid Cycle & other major pathways. Biodegradation of amino acids: Deamination, transamination. Urea Cycle, Glucose-Alanine cycle. Disorder/ diseases of amino acids metabolism.

UNIT V

Purines and pyrimidines – Structure and properties. Metabolism of Nucleotides: Purines & Pyrimidines synthesis : de Novo & salvage pathway, Conversion of nucleoside monophosphates to nucleoside triphosphates, Formation of deoxyribonucleotides. Catabolism & salvage of Purine and Pyrimidine nucleotides. Disorder of purines and pyrimidines metabolism

Text books:

1. Principles of Biochemistry: A.L. Lehninger, Nelson and Cox, McMillan Worth Publishers.
2. Harper's Biochemistry-Rober K. Murray, Daryl K. Grammer, McGraw Hill, Lange. Medical Books. 25th edition.
3. Biochemistry : S.C. Rastogi – Third Edition ; Tata McGraw Hill Education Pvt. Ltd. New Delhi**.**

Reference books:

1. Biochemistry: Stryer, W. H. Freeman
2. Biochemistry: Voet and Voet, John Wiley and Sons, Inc. USA
3. Biochemistry: Zubey, WCB.
4. Biochemistry: Garrett and Grisham, Harcourt.

ENVIRONMENTAL BIOTECHNOLOGY

Course Objectives:

- This course introduces students to environmental concerns. Students are expected to learn about the environment, the factors affecting it, environmental ethics, and its protection through lectures, presentations, documentaries, and field visits.
- Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
- Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.

Course Outcomes:

- Knowledge of the environment and the role of human beings in shaping the environment
- Understand various components of the environment and interfaces
- The benefit of environmental biotechnology helps us avoid using hazardous pollutants and wastes that affect natural resources and the environment.
- Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
- Appreciate environmental issues' ethical, cross-cultural, and historical context and the links between human and natural systems.

UNIT I

Introduction to environmental biotechnology and its scope, concept of green biotechnology, the concept of microbial ecology and application, Indian Scenario of Natural Resources, Conservation of natural resources. Role of biotechnology in environmental monitoring & protection

UNIT II

Microbial Ecology with relevant to Environmental Biotechnology, Microbial Principles of Biodegradation, Biodetoxification and other processes relevant to Environmental Applications, Bioremediation Technologies: Concepts, methods and applications, Bioremediation of soil & water contaminated with oil spills, heavy metals, and detergents, Degradation of lignin and cellulose using microbes.

UNIT III

Phyto-remediation. Degradation of pesticides and other toxic chemicals by microorganisms- degradation of aromatic and chlorinates hydrocarbons and petroleum products. Treatment of municipal waste and Industrial effluents. Bio-fertilizers. Role of symbiotic and symbiotic nitrogen fixing bacteria in the enrichment of the soil.

UNIT IV

Production of value-added products from waste – Single Cell Protein (SCP), ethanol, methane and hydrogen, amino acids, vitamins -Enzyme production from wastes – Biodegradable plastics - Bioindicators – Biomarkers –Biosensors

UNIT V

Sustainable development, Environmental ethics: Issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, Waste, and reclamation. Environmental significance of genetically modified microbes, plants and animals

Text/ Reference Books:

SUGGESTED READINGS

1. Chatterji. A.K., 2003. Introduction to Environmental Biotechnology. Prentice Hall of India Pvt. Ltd., New Delhi.
2. Miller Jr. G. T., 2004. Environmental Science. Tenth Edition. Thompson Brooks/Cole. United States.
3. Kumar H.D, 1998. A text book on biotechnology. II Edition, Affiliated east west press Pvt. Ltd., New Delhi.
4. Ecology. Odum. Pub. Oxford &IBH
5. Environmental Engineering. Peany et.al. Pub. McGrawHill

COMMUNICATION SKILLS

Course Objectives:

The objectives of this course are:

- To provide an overview of Prerequisites to Business Communication.
- To put in use the basic mechanics of Grammar.
- To provide an outline to effective Organizational Communication.
- To underline the nuances of Business communication.
- To impart the correct practices of the strategies of Effective Business writing.

Course Outcomes:

The students will be able to

- Discuss the importance of effective communication in business Effective Communication in Business
- Be effective communicators and participate in group discussions with confidence. Also be able to make presentations in a professional context.
- Write resumes, prepare and face interviews confidently.
- Make the transition smoothly from campus to corporate.
- Identify key principles of effective public speaking
- Discuss the usefulness of visual aids and identify common presentation tools.
- Create formal reports and proposals

UNIT I

Introduction to Communication: Need for effective communication, Functions of Communication and Induction to the students

The Fundamentals of Communication: Communication Cycle, Levels of communication; Flow of communication; Communication networks; General and Technical Communication.

UNIT II

Barriers to Effective Communication: Miscommunication; Noise; Types of barriers; Communication across Culture, case Studies and Overcoming measures.

Non-verbal Communication and Body Language: Forms of Non-verbal communication; Kinesics; Proxemics; Chronemics and Effective use of body language.

Grammar and Vocabulary: Tenses, Determiners, prepositions, conjunctions, Model Auxiliaries, concord, active and passive voice, Homonyms, Homophones, Acronyms (general abbreviations).

UNIT III

Presentation Skills: 4Ps (Planning, Preparation, Practice, Presentation), Outlining; Effective use of A/V aids and Modes of Delivery

Listening Skills: Hearing Vs listening, process of listening, types, Barriers to Listening, Qualities of a Good Listener and Active Vs Passive Listening

Telephone Skills : Telephonic Communication: Do's and Don'ts

UNIT IV

Speaking Skills: Introducing yourself, Describing a person, place, situation and event, Giving instruction, Making inquiries – at a bank, post-office, air-port, hospital, reservation counter and role play

Writing Skills: Basics of Writing, Paragraph Writing, Precise Writing, Memos, Advertisements, Paraphrasing and Summarizing

Study Skills: Taking/making notes from reference Materials, Comprehending and Describing-Graphs and charts

UNIT V

Letter Writing: Informal Letter,(Formal)Business Letters: Essential and Occasional Parts of a letter, layout, Characteristic and Letter of Inquiry, Complaint and Adjustments, orders and replies of it

Report Writing: Format ,Structure and Types, Technical Reports, Description and Proposal

Reading Skills: Skimming and Scanning, Intensive and Extensive Reading, Poor habits of reading and The SQ3R Method

Computer Assisted Language Learning: Effective e-mail messages and power-point presentation

Text Books/ Reference Books:

1. Muralikrishna C., Sunita Mishra "Communication Skills for Engineers" 2nd edition, Pearson, New Delhi 2010
2. Vyas Manish A., Yogesh L. Patel, "Tasks for the English Classroom", MacMillan, New Delhi, 2012.
3. Achar Deeptha, Charul Jian and et al, English for Academic Purposes,Book-1&2 University Granthnirman Board, Gujarat, 2011
4. Michael vince, 'Advanced Language Practice', Macmillan Education, oxford,2003
5. Eisenbach Iris, "English for Materials Science and Engineering", Springer Fachmedien Wiesbaden GmbH 2011
6. Lougheed Lin, "Business Correspondence: A Guide to Everyday Writing', Longman, Pearson Education, Inc,2003

TECHNIQUES IN BIOTECHNOLOGY LAB

1. Demonstration of basic techniques involved in general instrumentation or basic concept of precision and accuracy
2. Study of Beer-Lambert's law-using Colorimeter/UV-Visible spectrophotometer.
3. To study principle and working of laboratory microscope.
4. Separation of amino acids using thin layer chromatography.
5. To study and analysis of DNA sample by agarose gel electrophoresis.
6. To study and analysis of protein sample by SDS- PAGE
7. To analyze the isolated plant pigments using paper chromatography.
8. To study the separation of biological compounds using various membrane separation.

Reference book:

1. Wilson and Walker, "Principles and Techniques of Practical Biochemistry" 4 Edn., Cambridge Knew pros 1997.
2. Biotechniques: Theory & Practice: Second Edition by SVS Rana, Rustogi Publications.
3. Biochemical Methods of Analysis: Saroj Dua And Neera Garg: Narosa Publishing House, New Delhi.
4. Bioanalytical Techniques : ML Srivastava; Narosa Publishing House, New Delhi.

MICROBIOLOGY& IMMUNOLOGY LAB

1. Preparation of nutrient agar slants, plates and nutrient broth and their sterilization.

2. Isolation of microbes from soil samples and their determination.

3. Inoculation of agar slants, agar plate and nutrient broth
3. Culture of microorganisms using various techniques.

4. To determine the blood group of given blood sample.

5. To perform antigen-antibody binding studies by immune-electrophoresis.

6. To perform single radial immunodiffusion and double immunodiffusion.

Practical/ References Books

1. Lab Manual in microbiology by P Gunasekaran (New Age Int. Pub.).

BIOCHEMISTRY LAB

1. Preparation of solutions: 1)percentage solutions, 2) molar solutions, 3) normal solutions
2. Distinguish reducing and non-reducing sugars
3. Qualitative estimation of proteins
4. Estimation of abnormal constituents of urine.
5. Estimation of glucose by titration method
6. Quantitative estimation of carbohydrates
7. Separation of amino acids by chromatography
8. Agarose Gel Preparation

Reference books

1. Wilson and Walker, “Principles and Techniques of Practical Biochemistry”, 4 Edn., Cambridge Knew pros 1997.
2. Plummer DT, “An Introduction to Practical Biochemistry”, III Edn., Tata McGraw hill.

ENVIRONMENTAL BIOTECHNOLOGY LAB

1. Introduction to Glassware/Equipments & Pipetting Method
2. Preparation of Buffer Solutions
3. Standardization of pH meter
4. Sample collection method of soil and determination of pH
5. Isolation of microbes from soil/wastewater
6. Determination of total dissolved solid and suspended solid in an effluent
7. An industrial visit related to environmental biotechnology

SUGGESTED READINGS

1. Jayanta Kumar Patra, Gitishree Das, Swagat Kumar Das, Hrudayanath Thatoi 2020. A Practical Guide to Environmental Biotechnology, Springer Nature publications

COMMUNICATION SKILL LAB

Course Objective:

- To improve the communication ability
- To enhance the general conversation skills in different socio- cultural scenario
- To strengthen their professional skills
- To expose the students to various spoken skills.

Course Outcome:

- Better pronunciation and accent
- Ability to use functional English
- Competency in analytical skills and problem solving skills

List of Experiments

1. Competency Test: Computer based Test
2. Interpersonal Communication : Ice Breakers, Jumble story
3. Listening Skill: Practice and Test
4. Reading Skill: practice and Test
5. Speaking Practice: Role Play and Communicative Activities
6. Letter Writing : Practice and Test
7. Functional Grammar Practice and Test
8. Technical Report Writing
9. E-mail Writing
10. Presentation Practice

Semester –IV

Bioprocess Engineering –I

Course Objectives:

- To provide the basic concepts and principles of bioprocess engineering.
- To give an ability to analyze fluid property and apply knowledge to estimate the heat and mass transfer.
- To give an ability to apply the knowledge of bioprocess engineering on engineering applications.

Course Outcomes:

- Understand the concept of fluid and its properties.
- Understanding the flow of fluid and analyzing the dimensions of quantities.
- Explaining the modes of heat transfer through various state of matter.
- Explaining the mode of mass transfer through various state of matter.
- Relate the skill of mass transfer and its application

Unit I:

Fluid Properties: Viscosity, Newton's Law of viscosity, Kinematic Viscosity, Rheological Diagram, Euler Equation and its application, Derivation of Bernoulli Equation from Euler Equation, Applications of Bernoulli's Theorem, Pascal's Law, Hydrostatic Law. Measurement of Pressure: Definition of Gauge and & Absolute Pressure, Barometer, Various Manometers (Peizometer, U-tube manometer, Single column manometers, U-tube & Inverted U-tube differential manometers) & their industrial applications. (10)

Unit II:

Flow Measuring Equipment: Head Flow Meters, Nozzel Meter, Orifice Meter, Venturi Meter, Area Flow Meters, Rotameter, Pitot Tube & Applications of these equipments. Pipe fittings, major and minor losses in pipe flow, Calculation of Pressure Drop in a Pipe, Equivalent Length & 'K' factor, Methods of finding dimensional numbers - methods of governing equations, Method of force ratios and Buckingham's π method. Reciprocating pump & its applications. Centrifugal Pumps and its applications. (10)

Unit III:

Conduction and Convection Introduction. Basic concepts of conduction in solids, liquids and gases, One and two dimensional heat conduction. Critical and optimum insulation thickness. Introduction to unsteady state heat transfer. Principles of convection, Equations of forced and free convection, Heat flow due to conduction & convection .Radiation: Basic laws of heat transfer by radiation, black body and gray body concepts, solar radiations, combined heat transfer coefficients by convection and radiation. Heat Transfer Equipments: Double pipe, Shell & tube and Plate type heat exchanger, Evaporator, Condenser (8)

Unit IV :
Diffusion: Fick's Law, steady state diffusion: Rectangular, cylindrical, spherical (1-D); diffusion with reaction, both at surfaces, and in the bulk medium.Transient conduction and diffusion: Basics of Fourier analysis, unsteady state conduction and diffusion (1-D), transient conduction/diffusion with generation/reaction.(6)

Unit V :
Mass transfer coefficients, Mass transfer in fluidized bed reactor, flow past solids and boundary layers, Simultaneous heat and mass transfer system .Mass transport in Biomedical and Biological Engineering: Haemodialysis, Diffusion and uptake of ligands by cells, oxygen transport in tissue and capillaries.(6)

Reference/Recommended Books:

1. Introduction of Fluid Mechanics by Robert W.Fox and Slan T. McDonald, John willey & sons, Ny. 4TH Ed.
2. Unit Operation in Chemical Engg., McCabe Smith Vth Ed.
3. Foust A. S. et.al., "Principles of Unit Operations" John Wiley (1980)
4. Holman, J.P.: "Heat Transfer" 9 th ed. McGraw Hill (1989).
5. Treybal, R "Mass Transfer Operations", 3rd ed. New York: McGraw-Hill, (1980).

GENETICS & MOLECULAR BIOLOGY

Course Objectives:

- To strengthen the Mendelian principles along with other molecular genetics topics like recombination, pedigree analysis, transposons.
- To gain knowledge of DNA replication and regulation in prokaryotes and eukaryotes
- To learn transcription & translation in prokaryotes and eukaryotes & their regulation
- Post transcriptional and translational mechanism

Course Outcomes:

- Understanding of genetics will provide a perception of how forward genetics has been used to understand the basis of continuity of information transfer that is applicable to not only to the simple life forms but also to humans.
- To understand the molecular basis of genotype to phenotype correlation.
- Learn and understand the important discoveries that are made in the field of molecular biology.
- Understand the detailed structure of the double helical nature of DNA as proposed by scientists like Watson and Crick.
- To learn different levels of organizations that regulate the condensation of DNA that leads to the compact metaphase chromosome.
- To learn key molecular events that occur during the transcription and translation processes that leads the protein synthesis from specific genes.

UNIT I

Fundamental principles of genetics, gene interaction, multiple alleles, complementation, linkage, recombination and linkage mapping, extra-chromosomal inheritance, chromosomes basis of heredity, Sex determination, sex linked, sex limited and sex, influenced inheritance.

UNIT II

Genome organization: Genome organization in prokaryotes and eukaryotes - special features of eukaryotic gene structure and organization, genome organization in mitochondria and chloroplast, DNA content and C-value paradox. Methods to measure DNA content variation - Various types of DNA sequences (simple sequences, repetitive sequences, nonsense sequences, tandem gene clusters, satellites)

UNIT III

Gene structure, DNA & RNA as a genetic material, packaging of DNA as chromosome, central dogma of molecular biology, DNA replication, DNA repair. Linkage and recombination, crossing over and genetic mapping, gene mapping by two point and three point test crosses, Cell cycle regulation and apoptosis.

UNIT IV

Genetic mutation, micro-deletion, Genetic syndrome, Techniques to detect mutation, Transcription in prokaryotes and eukaryotes, genetic code, reverse transcription, mRNA processing. Role of sigma factor in transcription, role of promoters and enhancers, mechanism and regulation of transcription in prokaryotes and eukaryotes.

UNIT V

DNA replication process in prokaryotes & Eukaryotes, Activity of DNA polymerases and topoisomerases, Reverse transcriptase, Translation in prokaryotes and eukaryotes Basic principles of gene cloning and r-DNA technology, genetic code, properties of genetic code, wobble hypothesis, Molecular chaperones

Text books:

1. Genetics a conceptual approach, 2nd Edition Benjamin A. Pierc WH freeman and, company, New York.
2. Benjamin Levin – Genes VIII, 8 th ed.

Reference books:

1. Albert B, Bray Denis et al.: Molecular Biology of The Cell, latest ed.
2. Watson, Hopkins, Roberts et al.: Molecular Biology of the Gene, 4 th ed.
3. Genetics- Strickberger, 2nd.
4. Baltimore- Molecular Biology of the Cell.

Cell & Molecular Biology 8th edition by De Robertis, LWW Publisher (Wolters Kluwer)

ENZYME ENGINEERING

Course Objectives:

- To provide a detailed knowledge about enzymes, their chemical nature, kinetics, classifications, factors affecting the coenzymes and cofactors, velocity affecting velocity of enzymes, theories of enzyme action, enzyme regulation, inhibitions, isolation, purification & characterization of of enzymes, immobilisation of enzymes
- Differentiate between equilibrium and steady state kinetics and analyzed simple kinetic data and estimatee important parameter (Km. Vmax, Kcat etc).

Course Outcomes:

- Introduce the term “enzyme” , history and classification
- Learn about proteinaceous and non proteinaceous enzymes, their purification
- Learn about enzyme catalysis, Michaelis-Menton's constant.
- Familiarise on mechanism of enzyme action-theories of enzyme action.
- Learn how to define velocity/enzyme activity/rate of a reaction and specific activity
- Familiarise on factors affecting enzyme activity & enzyme Inhibitions
- Acquire knowledge about techniques & application of immobilized enzymes
- Learn about enzyme based biosensors & bioreactors with their applications in industry & healthcare

UNIT I

Introduction to enzymes: Holoenzyme, apoenzyme, prosthetic group. Interaction between enzyme and substrate-lock and key model, induced fit model. Features of active site, activation energy, enzyme specificity and types. IUB system of classification and nomenclature of enzymes. Kinetics of single substrate reactions; Derivation of Michaelis -Menten equation, turnover number; determination of Km and Vmax (LB plot, ED plot), Importance of Km & Vmax; Numerical related to enzyme kinetics, Multi-Substrate reaction mechanisms.

UNIT II

Factors affecting the velocity of enzyme catalyzed reaction- enzyme concentration, temperature, pH, substrate concentration, inhibitors and activators. Enzyme inhibition: irreversible; reversible (competitive, uncompetitive and non competitive inhibition); Substrate and Product inhibition, Allosteric regulation of enzymes, concerted & sequential model; Deactivation Kinetics.

UNIT III

Extraction of crude enzyme from plant, animal and microbial source; some case study. Purification of enzymes by the help of different methods. Methods of characterization of enzymes; criteria of purity. Unit of enzyme activity - definition and importance. Development of enzyme assays.

UNIT IV

Enzyme Immobilization: Adsorption, Matrix entrapment, Encapsulation, Cross linking, Covalent binding and their examples; Advantages and disadvantages of different immobilization techniques. Structure & stability of immobilized enzymes, kinetic properties of immobilized enzymes- partition effect, diffusion effect. Overview of applications of immobilized enzyme systems.

UNIT V

Enzyme Biosensors: elements of biosensors, three generations of biosensors, Types of biosensors: calorimetric, potentiometric, amperometric, optical and piezoelectric. Design of enzyme electrodes and their applications as biosensors in industry, health care and environment. Design of Immobilized Enzyme Reactors- Stirred tank reactors(STR), Continuous Flow Stirred Tank Reactors (CSTR), Packed- bed reactors (PBR), Fluidized-bed Reactors (FBR); Membrane reactors.

Text books:

1. Fundamentals of enzymology by Nicolas C. price and Lewis stevens. Oxford University Press
2. Enzymes by Trevor palmer, East west Press
3. Enzyme Technology by Messing

Reference books:

1. Enzymes: Dixon and Webb. (IRL Press)
2. Enzyme technology by Chaplin and Bucke. Cambridge Univerity Press
3. Biochemical engineering fundamentals, second edition. James E Bailey, David F., Ollis, McGraw Hill Intl. Edition

ANIMAL BIOTECHNOLOGY

Course Objectives:

- To make students aware of various tissue culture techniques and their application in biotechnology for commercial purpose and to acquaint students with applications of genetic engineering like transgenic animals.
- The course will provide complete exposure as how animal cells are isolated, cultured and genetically manipulated in laboratory.
- Also the course will provide information how cell suspension cultures can be utilized for molecular farming for commercially synthesizing products such as vaccines, hormones, proteins, enzymes, etc.

Course Outcomes:

- Understand principles of animal culture, media preparation and can explain *in vitro* fertilization and embryo transfer technology.
- Students will have an insight in applications or recombinant DNA technology in production of therapeutic proteins and can describe commercial production of drugs, vaccines, enzymes and can apply them in research work.
- Know how transgenic animals, cryopreservation, apoptosis, animal cloning, cell transformation, DNA microinjection, production of vaccines is done.
- Isolate genomic and plasmid DNA from cells.
- Students can purify proteins of interest from animal cell samples and perform assay of DNA or protein samples for their concentration and purity

Unit I

Basic cell culture techniques, Types of cell culture media; Ingredients of media; Physiochemical properties; CO_2 and bicarbonates; Buffering; Oxygen; Osmolarity; Temperature; Surface tension and foaming; Balance salt solutions; Antibiotics growth supplements; Types of Primary Culture.

Unit II

Cell line development; Characterization and Maintenance of cell lines. Common cell culture contaminants. Cryopreservation of cell lines. Expressing cloned proteins in animal cells. Over-production and processing of chosen proteins: the need to express in animal cells

Unit III

Application of animal cell culture for *in vitro* testing of drugs; Testing of toxicity of environmental pollutants in cell culture; Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins. Cell culture products.

Unit IV

Cell culture reactors; Scale-up in suspension; Scale and complexity; Mixing and aeration; Rotating chambers; Perfused suspension cultures; Fluidized bed reactors for suspension culture; Scale-up in monolayers; Multisurface propagators; Multiarray disks, spirals and tubes; Roller culture; Microcarriers; Perfused monolayer cultures;

Unit V

In-vitro fertilization and Embryo transfer: In-vitro fertilization in humans; Selection of sperm, Selection of Ova, Super ovulation strategy; embryo transfer; Artificial insemination Application of Embryo transfer technology, Biotechnology in fertility control

Texts/Reference Books:

1. B. Hafez and E.S.E Hafez, Reproduction in farm animals, 7th Edition, Wiley Blackwell, 2000
2. G.E. Seidel, Jr. and S.M. Seidel, Training manual for embryo transfer in cattle (FAO Animal Production and Health Paper-77), 1st Edition, W.D. Hoard and sons FAO, 1991
3. I. Gordon, Laboratory production of cattle embryos, 2nd edition, CAB International, 2003.
4. Louis-Marie Houdebine, Transgenic Animals: Generation and Use 5th Edition, CRC Press, 1997.
5. R . Ion Freshney : Culture of Animal cell ; 6th edition 2010' Wiley –Blackwell.
6. John R.W. Masters, Animal Cell Culture: A Practical Approach 3rd edition, 2000.

INDUSTRIAL SOCIOLOGY

Course Objective

The objectives of this course are:

- To enable potential managers to understand the influence of the wider societal context on the operations within their organizations
- to provide you with an understanding of the ways in which the process of industrialization has shaped societies
- to foster the development of the following skills: comprehension; application; analysis; and synthesis of information.
- To understand the nature of relations among workers, and between workers and management.

Course Outcome

The students will be able to

- To understand work and industry
- To understand the Problems faced by Labour in Organized and Unorganized Sector.
- To learn about the revolution of industrialization and the policies framed for the smooth working of the industries using Science, Technology & Innovation (STI)
- To understand the grievance procedures followed in industries and the code of discipline followed by the industry.
- Understanding the future of industrialization in India

Unit	Topic
I	Industrial Sociology: Nature, Scope and Importance of Industrial Sociology. Social Relations in Industry, Social Organisation in Industry- Bureaucracy, Scientific Management and Human Relations. .
II	Rise and Development of Industry: Early Industrialism – Types of Productive Systems – The Manorial or Feudal system. The Guild system, The domestic or putting-out system, and the Factory system. Characteristics of the factory system. Causes and Consequences of industrialization. Obstacles to and Limitations of
III	Industrialization in India. Industrial Policy Resolution- 1956.Science. Technology and Innovation Policy of India 2013.
IV	Contemporary Issues: Grievances and Grievance handling Procedure. Industrial Disputes: causes, Strikes and Lockouts. Preventive Machinery of Industrial Disputes: Schemes of Workers Participation in Management- Works Committee, Collective Bargaining, Bi-partite & Tri-partite Agreement, Code of Discipline, Standing Orders. Labour courts & Industrial Tribunals.
V	Visualizing the future: Models of industrialization- Collectivist, anarchist, free market, environmentalist, etc. Cultural issues, consumer society and sociological concerns.

Bioprocess Engineering Lab-I

1. To find the thermal conductivity of liquid / gases
2. To determine the local velocity pressure with the help of pilot tube
3. To find out the thermal conductivities of Metal rod
4. To study the characteristics of a centrifugal pump.
5. To determine the viscosity of a given viscous liquid by capillary tube flow method.
6. To differentiate between laminar and turbulent flow using Reynolds experiment.
7. To determine velocity through orifice meter, venture meter
8. To determine the overall heat transfer coefficient in Parallel flow heat exchanger/counter flow heat exchanger
9. To determine the drying characteristics of given sample
10. To determine the minimum fluidization velocity in a fluidized bed and verify experimentally

GENETICS & MOLECULAR BIOLOGY LAB

1. How to calculate genetics and allelic frequencies numeric problem analysis.
2. Isolation of Plasmid DNA
3. Isolation of Plant DNA
4. Estimation of DNA content in the given sample by spectrophotometer
5. Determination of Tm of DNA.
6. Isolation of bacterial genomic DNA.
7. Purification of DNA through Electrophoresis & visualization under UV transilluminator.
8. Polyacrylamide gel electrophoresis of DNA.
9. PCR amplification of DNA and visualization by gel electrophoresis.
10. Isolation and study of polytene chromosome in Drosophila.

ENZYME ENGINEERING LAB

1. Determination of enzyme activity.
2. Isolation of alpha amylase from plant source
3. Production of commercially important enzymes from microbial sources
4. Characterization of enzymes-effect of pH , temperature and inhibitors on enzyme activity etc.
5. Identification of Enzyme by different assay
6. Purification of enzymes by different methods

Reference books

5. “An Introduction to Practical Enzyme Engineering”, Tata McGraw-Hill.
6. R. Eisenthal and M.J. Dansen, “Enzyme Assays –A Practical Approach”, IRL Press, Oxford University Press, Oxford, 1993

ANIMAL BIOTECHNOLOGY LAB

1. Introduction to media, other relevant reagents and equipments required for various cell lines.
2. Basic and sophisticated methods of handling animal cells in culture.
3. Freezing and reviving the cell lines and maintaining them in culture.
4. Extraction of culture and preparing the samples for DNA/RNA/PROTEIN.
5. Staining of animal cells and counting in microscope.