

B. Sc. (Hons.) BIOTECHNOLOGY

Course Code	Course Title	Credits	L-T-P
I - SEMESTER			
MAS-303	BASIC MATHEMATICS-I	3	(3-0-0)
PHY-309	BASIC PHYSICS	3	(3-0-0)
CHEM-310	ORGANIC CHEMISTRY	3	(2-0-2)
CHEM-312	PHYSICAL CHEMISTRY	3	(2-0-2)
COMP-302	COMPUTER APPLICATION	2	(1-0-2)
GPT-301	MORAL & VALUE EDUCATION	2	(2-0-0)
CHEM-311	INORGANIC CHEMISTRY	3	(2-0-1)
	Total		19
II-SEMESTER			
MAS-331	FUNDAMENTAL STATISTICS	3	(2-0-1)
BIOL-403	LIFE SCIENCE I (BOTANY)	3	(2-0-1)
BIOL-404	LIFE SCIENCE II (ZOOLOGY)	3	(2-0-1)
MAS-304	BASIC MATHEMATICS II	3	(3-0-0)
MCE-301	CELL BIOLOGY	3	(2-0-1)
MCE-303	INTRODUCTORY BIOTECHNOLOGY	3	(3-0-0)
PHY-308	BIOPHYSICS	3	(3-0-0)
	Total		21
III-SEMESTER			
CHEM-330	ANALYTICAL CHEMISTRY	3	(2-0-1)
BCBT-401	BIOCHEMISTRY-I	3	(2-0-1)
MCE-302	MOLECULAR BIOLOGY	3	(3-0-0)
SES-415	ENVIRONMENTAL STUDIES-I	2	(2-0-0)
MBFT-351	MICROBIOLOGY-I	3	(2-0-1)
BIOL-545	ANIMAL PHYSIOLOGY	3	(2-0-1)
BIOL-546	PLANT PHYSIOLOGY	3	(2-0-1)
	Total		20
IV-SEMESTER			
SES-416	ENVIRONMENTAL STUDIES-II	2	(2-0-0)
BCBT-403	BIOCHEMISTRY-II	3	(2-0-1)
GPB-412	GENETICS	3	(2-0-1)
MBFT-401	MICROBIOLOGY-II	3	(2-0-1)
MCE-401	BASICS OF MOLECULAR GENETICS	3	(2-0-1)
BCBT-408	CHEMICAL THERMODYNAMICS	3	(3-0-0)
CBBI-501	APPLICATIONS OF BIOINFORMATICS	2	(1-0-1)
	Total		19
JSBB 400	TRAINING – I	1	(0-0-2)

CourseCode	Course Title	Credits	L-T-P
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V-SEMESTER

MCE-406	MOLECULAR BIOLOGY TECHNIQUES & INSTRUMENTATION	3	(2-0-1)
BCBT-404	ENZYMOLGY & ENZYME TECHNOLOGY	3	(2-0-1)
BCBT-405	BASIC IMMUNOLOGY	3	(2-0-1)
LNG-304	PROFESSIONAL COMMUNICATION & TECHNICAL WRITING	3	(3-0-0)
MAS-531	BIOSTATISTICS	3	(2-0-1)
MCE-402	INTRODUCTION TO PLANT BIOTECHNOLOGY	3	(2-0-1)
MCE-404	INTRODUCTION TO ANIMAL BIOTECHNOLOGY	3	(2-0-1)
JSBB-400	TRAINING – I EVALUATION	1	(0-0-1)
	Total	22	

VI-SEMESTER

MBFT-502	INDUSTRIAL MICROBIOLOGY	3	(2-0-1)
MCE-501	BIOSAFETY, BIOETHICS & IPR ISSUES	3	(3-0-0)
TE-401	FUNDAMENTAL OF TISSUE CULTURE	3	(2-0-1)
BCBT-502	INDUSTRIAL BIOTECHNOLOGY	3	(2-0-1)
BCBT-505	PLANT BIOCHEMISTRY	3	(2-0-1)
BCBT-506	ANIMAL BIOCHEMISTRY	3	(2-0-1)
MCE-403	INTRODUCTION TO ENVIRONMENTAL BIOTECHNOLOGY	3	(2-0-1)
JSBB-488	SEMINAR-I	1	(0-0-1)
	Total	22	
JSBB-500	TRAINING – II	1	(0-0-2)

VII-SEMESTER

MCE-503	BASIC NANOTECHNOLOGY	2	(2-0-0)
BCBT-605	IMMUNOTOXIN & DRUG DESIGNING	3	(3-0-0)
BAM-502	MARKETING & MANAGEMENT OF BIOTECHNOLOGICAL PRODUCTS	3	(3-0-0)
BCBT-501	BIOCHEMICAL ENGINEERING	3	(2-0-1)
MCE-603	GENETICALLY MODIFIED FOODS	2	(2-0-0)
MBFT-605	MICROBIAL TECHNOLOGY IN FOOD INDUSTRY	3	(2-0-1)
JSBB-589	SEMINAR-II	1	(0-0-1)
JSBB-500	TRAINING – II EVALUATION	1	(0-0-1)
	Total	18	

VIII-SEMESTER

JSBB-699	PROJECT	9	(0-0-18)
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B. Sc. (Hons.) Biotechnology – 1st semester

MAS 303

BASIC MATHEMATICS I

3(3-0-0)

Algebra

Theory of quadratic, Binomial-Theorem (for +ve index), Use of natural & common logarithms, exponential series, partial-fractions, Determinants of order 3, Theory of Matrices, addition, subtraction, multiplication, transpose, elementary ideas on ad joint & inverse. Solution of linear equations, inequalities, permutation & combination.

Trigonometry

Trigonometrical- functions, addition & subtraction formula, double & half angle formula laws of sines & cosines, solutions of triangles, height & distance, real & complex-numbers, hyperbolic trigonometric functions. De-Movire's Theorem.

Coordinate-Geometry: Distance between two points, Area of triangle, Straight-lines

PHY-309

BASIC PHYSICS

3(3-0-0)

Units and measurements, dimensions and dimensional analysis

Speed ,velocity, acceleration, momentum, impulse, torque, kinematics in one, two and three dimensions .

Newtons law of motion, conservation of energy and linear momentum, weight and mass of body ,Newtons law of universal gravitation , satellite and weightlessness, keplers law of planetary motion , types of force in nature .

Equilibrium and elasticity, stress, strain, hookes law elastic limit

Machines and their principle, efficiency, mechanical advantage, velocity ratio, relationship between efficiency, mechanical advantage and velocity ratio , levers and their kinds .

Pressure in fluids and their laws, Pascals law, atmospheric pressure, gauge press, measurement of press, simple barometer, buoyancy and Archimedes principle, principle of floatation and it has applications. hydrometer and lactometer . Surface tension, capillary, equation of continuity, bernoullis equation, viscosity.

Thermometry, relationship between the scales of temperature, absolute scale of temperature and clinical thermometer, specific heat, latent, conduction, convection, radiation

Rectilinear propagation and reflection of light, formation of image of a point object by a plane mirrors, colours

Sound, pitch, frequency, wavelength, velocity of sound echoes

Electricity, simple cell, relationship between current charge, potential, ohm's law resistance, series and parallel combination

Electrical power, watt and KWH, household electricity.

UNIT I: chemistry of carbohydrates

UNIT II: amino acid and protein

UNIT III: Benzene and its homologous, structure of benzene, aroma, nomenclature and aromatic compounds

UNITIV: General introduction of alkaloids

UNITV: General introduction of terpenes

UNIT VI: introduction to analytical chemistry and its branches

UNITVII: General principles of analytical chemistry, volumetric analysis, concept of gram equivalents and method of expressing concentration of solution, preparation of primary and secondary standard solutions. Neutralization (acid –base), titration permagnometry, gravimetric analysis: principles of methodology estimate of calcium

UNIT VIII thermometric analysis the gravimetric analysis, types, instrumentation, application

UNIT IX Polarimetry

UNIT X Potentiometric titration, electrode system, ion selective membrane electrodes, application of potentiometric titrations

PRACTICALS

1. Qualitative analysis of organic compounds
2. Volumetric determination of Fe by KMnO_4 solution
3. Polarimetric analysis
4. Estimation of protein by kjeldal method
5. Estimation of calcium volumetrically.

Ionic equilibrium: concepts of acids and their related strength, buffer solution and its pH, hydrolysis of salts, acids –base indicators oswalds and quinonoides theory, solubility product

Chemical kinetics: order and molecularity, differential rate laws and integrated rate laws equations for zero, 1st, 2nd and 3rd reactions (derivations included) significance of rate constant and its evaluation, time for definite fractional change of reaction, determination of order

Electro chemistry: reversible and irreversible cells, EMF of a cell and free energy, nernst equation, equilibrium constant, standard electrode potential, types of reversible electrodes, applications of EMF measurements, determination of solubility product, pH, dissociation constant of acids, hydrolysis constant solubility, soluble salts

Practicals:

Analysis of inorganic mixture, redox and acid base titration. Preparation and standardization of primary and secondary standard solution, pH, buffers, chemical kinetics and partition coefficient.

Introduction to windows: Start menu and accessories, windows explorer, my computer. Introduction to networking of computers.

Internet-internet, TCP/IP, IP address, Basic C and C++,Oracle.

Information networks: Internet, world wide web, web browsers, HTTP, HTML and URLS,
EMB.

My country and my people, the many Indians, being and becoming Indian, nationalism and internationalism

Some life issues – love, sex and marriage, men and money – value of time, meaning of work, human communication, human suffering, addition, ecology, women issues

Understanding ones neighbor, neighborhood groups: their structure and their functions patterns of social interactions of group dynamics. Preparation for a career, choice of vocation, motivation of study and research, and the present educational system: curriculum and syllabus, teaching methods, examination and work experience

Definition of value education, moral and ethics, laws and morale based on ten commandments and two great commandments

Discovery of self, self – awareness, growth of intellect – mans spiritual life emotions, will respect the rights of life, liberty, property, truth reputation

Sin, origin of sin, manifestation of sin, the result of sin, the remedy of sin, sin as an act, sin as a state, sin as a nature.

Periodic table: Mendeleef periodic table, modern periodic table and table. Long and extended form of periodic table, its main features, merits and demerits.

Periodic properties:

Atomic and ionic radii: classification of atomic radii (1) covalent radii (2) metallic radii (3) vander-waal radii, ionic radii. classification of ionic radii (1) size of anions, size of cations, crystal coordination number, radius ratio, size of anions, factors influencing magnitude of ionic radii. Periodic variation of atomic and ionic radii.

Ionization energy: introduction, successive ionization energies. Factors influencing ionization energy (nuclear charge, size of atom, ion. shielding effective nuclear charge, principal quantum number, half and full filled orbitals) trend of ionization energy in the periodic table

Electronic affinity: first and second electron affinity. Factors effecting magnitude of electron affinity. Periodic variation

Radioactivity: introduction of radioactivity, radioactive emission (α , β and gamma rays). Half-life period, average life period, radioactive equilibrium. Group displacement law, atomic and induced radioactivity.

Nuclear chemistry: nuclear fusion and nuclear fission reactions.

Mass defect, binding energy.

B. Sc. (Hons.) Biotechnology – 2nd semester

MAS 331

FUNDAMENTAL STATISTICS

3 (2-0-1)

Definition & applications of Statistics, Testing of Hypothesis: Concept of Hypothesis, Degrees of freedom, Level of significance Measures of central – tendency, Measures of dispersion, standard error of mean. Coefficient of variation Probability: Definition & applications, numerical- problems.

Simple-correlation between two variables (definition, properties & numericals).

Regression- Lines : Definition & uses, Method of least square, Concept of regression- coefficient.

BIOL- 403

LIFE SCIENCE-I (BOTANY)

3(2-0-1)

1. Origin of Life: History of earth, theories of origin of life nature of the earliest organism.

2. Varieties of Life: Classification, Five kingdoms, viruses (TMV, HIV, bacteriophage), Prokaryotes (Bacteria-cell structure, nutrition, reproduction), Protista, fungi, Plantae and animalia.

3. Chemicals of life: (Biomolecules)-Carbohydrates, lipids amino acids, proteins, nucleic acids, identification of biomolecules in tissues.

4. Histology: Meristems (apical, intercalary, lateral) and their function simple tissues (parenchyma, collenchyma, sclerenchyma) Complex tissue(xylem and phloem); Tissue systems (epidermal, ground, vascular); primary body and growth(root,stem and leaf); secondary growth.

Animal Epithelial tissue, connective tissue, muscle tissue and nervous tissue and their function in body.

5.Nutrition: Autotrophic(photosynthesis) Pigment systems, Chloroplast, light absorption by chlorophyll and transfer of energy, two pigment systems, photosynthetic unit, phosphorylation and electron transfer system, Calvin-Benson Cycle(C3), Hatch Slack Pathway(C4), Crassulacian Acid Metabolism(CAM), factors affecting photosynthesis; Mineral nutrition in plants.

Heterotrophic-Forms of heterotrophic nutrition, elementary canal in Humans, nervous and hormonal control of digestive systems, fate of absorbed food materials; Nutrition in humans, Reference values.

6.Energy Utilization: (Respiration) –Structure of mitochondria, cellular respiration, relationship of carbohydrate metabolism to other compounds, Glycolysis, fermentation, formation of acetyl co-A, Krebs cycle, Electron Transport System and Oxidative Phosphorylation, ATP, factors affecting respiration.

7.Transport : Plant water relationship Properties of water diffusion, osmosis, imbibitions movement of water in flowering plants, uptake of water by roots, ascent of water in xylem. Apoplast, symplast theory, transpiration structure of leaf and stomata in

plants opening and closing mechanism of stomata factors affecting transpiration, significance of transpiration, general characteristics of blood vascular system, development of blood systems in animals, composition of blood, circulation in blood vessel, formation of tissue fluids, the heart, function of mammalian blood, the immune system

Coordination and control: Plant movement (tactic, tropic and Nastic) , Plant growth substances(auxins, cytokinins, gibberellin, ABA and Etylene) , Phytochrome and effect of light on plant development , vernalization and flowering. Nervous system , parts of nervous system, sensory receptors, structure and function of receptors, endocrine system, role of hormones in growth and development in humans.

Homeostasis: Control system in biology, control of blood glucose level, temperature regulation in endothermic animals, the liver and its importance.

Reproduction: Asexual reproduction - apomixis and other means of natural vegetative reproduction (bulb, corm, rhizome, stolon, runner, tuber, tap root ,tillers), advantage and disadvantage of natural asexual reproduction. Artificial propagation- cutting , grafting budding , layering, micro propagation through tissue culture ,advantage and disadvantage of micro propagation .

Sexual reproduction-life cycle of flowering plants, the parts of a flower(dicot and monocot), microsporogenesis, in vitro pollen culture, microgametogenesis, isolation of sperms, palynology, scope of palynology, development of ovule, types of ovule, megasporogenesis, megagametogenesis, embryo sac, seed formation, structure of seed and its importance. Review of sexual reproduction in vertebrates, human intervention in reproduction.

Continuity in Life: Chromosomes, cell cycle, mitosis, meiosis, techniques to study mitosis and meiosis.

Hereditary and Variation: Mendel's work, chromosomal basis of inheritance, modified dihybrid ratio, gene interaction, Linkage, gene mapping, sex determination, cytoplasmic inheritance, variation and mutation.

Economical Importance Plants: Cereals (wheat, rice, maize), Beverages (tea, coffee, cocoa), Fibers (jute, linen, cotton), wood (pines, cedar, teak, sisam), rubber (Para robber), spices (turmeric, black pepper, cloves, coriander), medicinal plants (Ephedra, Taxus, Cinchona, Fox glove, Belladonna, Ravolfia, neem, Hemp).

Real numbers, coordinate line & planes, straight lines, function.

Limits, properties, derivatives, differentiation of sine & cosine, continuity, properties of continuous functions, differentiation of algebraic, trigonometric, logarithmic & exponential functions, product of functions, function of a function.

Derivative as a rate change, maxima & minima of a single variable.

Integral of a real function, integration by substitution, integral of trigonometric & Transcendental function.

Vector in a plane, vector function, sum & difference of vectors of vectors, dot & cross-product.

CELL BIOLOGY

MCE 301

3 (2-0-1)

Unit 1. An introduction to cell biology: History of cell biology. Development of cell theory. Modern cell biology.

Unit 2. Diversity of cell size and shape: Structure of prokaryotic cells (bacteria, fungi, virus, cyanobacteria, mycoplasma etc.). General organization of eukaryotic cells, cell shape, cell size, cell volume and cell number.

Unit 3. Organization of cell: Cell wall, plasma membrane, their structural organization and functions. Membrane bound cell organelles - nucleus, endoplasmic reticulum, golgi apparatus, mitochondria, chloroplast, lysosomes, peroxisomes and vacuoles. Non-membrane bound cell organelle- ribosome. Cytoskelton- microtubules, intermediate filaments and microfilaments.

Unit 4. Cell growth and division: Cell cycle, kinds of cell division, amitosis, mitosis, meiosis, comparison between mitosis and meiosis, crossing over, significance of cell division.

Practicals

Microscopy- simple and compound microscope

Preparation of stains

Grams staining

Study of cell division - different stages of mitosis

Differential staining of blood cells

Hanging drop method for motility of bacteria

INTRODUCTORY BIOTECHNOLOGY

MCE 303

3 (3-0-0)

Unit 1. Introduction: Historical development of biotechnology. Basic concepts of biotechnology. Definition and descriptions of some important terminology in biotechnology.

Unit 2. Branches of biotechnology: Study of various branches of Biotechnology including Plant, Animal, Medical, Industrial, Environmental, Marine Biotechnology, Bioinformatics, etc.

Unit 3. Biotechnology in India: Biotechnology and developing world- concerns and consequences. Role of biotechnology in Indian industry. Impact on agricultural sector.

Unit 4. Biotechnology and other disciplines: Biotechnology- an interdisciplinary pursuit, a three component central core, product safety. New trends in biotechnology.

Unit 5. Applications and scope of biotechnology: Practice of biotechnology in medicine, industry, agriculture, live stock improvement and environment. Future perspectives.

1. Concepts of biophysics and classification, living body as a thermodynamic system, biological effects of radiation, radiation hazards in man.

2. Biological effects of light, biophysics of vision, interaction of UV light with living system, interaction of microwaves in living system.

3. Chronobiology, cybernetics, biomagnetism and magneto biology, bioacoustics – the ear.

4. Influence of gravity, g-force, acceleration and deceleration, influence of barometric pressure and vibration, elementary idea of thermodynamics.

B. Sc. (Hons.) Biotechnology – 3rd semester

CHEM-330

ANALYTICAL CHEMISTRY

3(2-0-1)

Introduction to Analytical chemistry and its branches.

General principle of analytical chemistry: Volumetric analysis.

Concept of gram equivalents and method of expressing , Concentration of solution preparation of primary and secondary, Standard solution Neutralized (Acid-Base), Titration, Permagnometry. Gravimetric analysis & methodology. Estimate of calcium.

Thermometric analysis: The gravimetric Analysis – types, Instrumentation, Application.

Polarimetry.

Potentiometer titration: Electrode system, Ion selective membrane

Electrodes, Application of potentiometer titrations

Chemical structure of proteins and their properties, cellular membrane and their transport phenomenon.

Intermediary metabolism: Concept of anabolism and catabolism, metabolism of carbohydrates, lipids and amino acids and their interrelationship.

Biological oxidation: Electron-transport system, oxidative phosphorylation, free energy changes in biochemical reactions, energy rich compounds

Metabolism of nucleic acids and proteins

Metabolic regulation of various animal hormones

Practical:

1. Proximate composition of food and biological samples i.e., moisture, fat, proteins, carbohydrates
2. Determination of constituent of milk protein, fat, lactose.
3. Determination of ascorbic acid, acidity/ citric acid in fruit and vegetables
4. Determination of sugar in urine and blood.
5. Determination of cholesterol in blood and biological sample.

MOLECULAR BIOLOGY

MCE 302

3 (3-0-0)

Unit 1: Introduction: Development of molecular biology. Historical perspectives. Concepts in molecular biology.

Unit 2: Structure and properties of nucleic acids: Structure of nucleotides, DNA double helix, helical conformations and DNA topology. Types of DNA and RNA- A, B, Z forms of DNA, mRNA, tRNA, rRNA, hnRNA, snRNA. Physical and chemical properties of DNA.

Unit 3: DNA protein interaction: Molecular aspects of protein-nucleic acid binding. DNA binding motifs in proteins- Helix- turn - helix, Zinc finger motifs, Leucine zipper, HMG box, etc.

Unit 4: Gene organization: Gene structure and architecture, gene clusters, split genes, overlapping genes, pseudogenes, operon, open reading frames, transposons, oncogenes. Range of genome size. C value and gene numbers. Reassociation kinetics, Repetitive DNA - satellite DNA.

Unit-I The Multidisciplinary Nature of Environmental Studies

Definition, Scope and importance: Need for public awareness

Unit-II Ecosystem

Concept of an ecosystem, Structure and function of an ecosystem, Procedures, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction types, characteristics features, structure and function of the following ecosystem:

- (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem
(d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit-III Social Issue and the Environment

From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain harvesting, watershed management, Resettlement and rehabilitation of people its problems and concerns. Case studies, Environmental ethics: Issues and possible solutions. Wasteland reclamation: Consumerism and waste products: Environment ethics, issues and possible solutions, Wasteland reclamation, Consumerism and waste products, Environment Protection Act. Air (Prevention and Control of Pollution) Act: Water (Prevention and Control of Pollution) Act: Wildlife protection Act. Forest Conservation Act: Issues involved in enforcement of environmental legislation: (Public awareness).

History, scope and development of microbiology

Concept of eukaryotic and prokaryotic cells

General characteristics, structure and reproduction of bacteria, actinomycetes, algae, fungi, protozoa, mycoplasma, rickettsia, chlamydia and viruses.

Control of microorganisms by physical and chemical agents

Practicals:

Preparation of media and reagents, their sterilization

Culture techniques

Staining techniques (simple, differential, special) in bacteria

BIOL 545**Animal Physiology****3 (2-0-1)**

Unit 1: Physiological process in animals with special reference to man. Functional anatomy of the digestive & respiratory systems. Physiology of digestion, gland in the alimentary canal & their secretions. Physiology of respiration, mechanism of breathing.

Unit 2: Physiology of blood circulation The blood, plasma & tissue fluid, blood corpuscles, hemoglobin, Blood groups & clotting of blood.

Unit 3: Physiology of Nervous System. Link between environment & central nervous systems. Nerve Impulse & reflex action.

Unit 4: Endocrine system of various glands & their secretions.

Practical

1. Study of frog/human blood film.
2. Haemolysis: effect of isotonic, hypotonic & hypertonic solution on
3. Erythrocyte.
4. Preparation of haemin crystals.
5. Study of blood group.
6. Study of secretions of pituitary, thyroid, adrenal, pancreas, testes & ovary
7. From prepared slides.

BIOL 546**Plant Physiology****3 (2-0-1)**

Unit 1: Water relation-Movement of water across membranes Ascent of sap, Transpiration, Translocation of organic substances

Unit 2: Study of macro & microelements nutrition. Mechanism of photosynthesis, factors regulating photosynthesis. Carbon fixation in C₃, C₄ plants. CAM, structure & function of chloroplast.

Unit 3: Mechanism of respiration, respiratory substrates & ETC (electron transport chain). ATP synthesis & utilization, structure of mitochondria as the power house of cell.

Unit 4: Nitrogen metabolism & assimilation. Vernalisation & Photoperiodism. Elementary knowledge of stress physiology.

Practical

1. Demonstration of osmosis
2. Demonstration of osmotic potential of a cell
3. Stomatal studies
4. Measurement of rate of transpiration
5. Nutrients deficiency symptoms in plants
6. Measurement of rate of photosynthesis in an aquatic plant
7. To demonstrate that light and CO₂ are essential for photosynthesis
8. To demonstrate that O₂ is consuming during respiration
9. To demonstrate that CO₂ is liberated during respiration
10. Seed viability test
11. Test for starch and sugar

B. Sc. (Hons.) Biotechnology – 4th semester

Sub: Environmental Studies-II

Course Code: SES-416

Credit: 2(2-0-2)

Unit-I Renewable and non-renewable resources.

Natural resources and associated problems.

- a) **Forest resources:** Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forests and tribal people.
- b) **Water resources:** Use and over utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
- c) **Mineral resources:** Use and exploitation environmental effects of extracting and using mineral resources, case studies.
- d) **Food resources:** World food problems, changes caused by agriculture and overgrazing effects of modern agriculture, fertilizer-pesticide of problems, water logging salinity, case studies.
- e) **Energy resources:** Growing energy needs, renewable and non-renewable energy source, use of alternate energy sources, case studies.
- f) **Land resources:** Land as a resource, and degradation, man induced landslides, soil erosion and desertification.

Unit-II Biodiversity and its Conservation

Introduction-Definition, genetic species and ecosystem diversity, Biographical classification of India, Value of biodiversity, consumptive use, productive use social ethical, aesthetic and option values, Biodiversity at global national and local levels, India as a mega-diversity nation: Hot-spots.

Unit I: Protein Chemistry: Structure of proteins, methods for determining the 3D structure of a protein – X-ray diffraction, NMR, Mass spectrometry, protein homology among species, protein denaturation and folding, assisted folding, edman degradation, glycoprotein, lipoproteins, proteoglycans, phosphor proteins, chromoprotein, bacterial and viral protein (HIV, HBV, toxins, etc.)

Unit II: Biomembranes: Molecular constituents of membranes, movement of molecules through membranes, energetics of membrane transport system, biosignalling, voltage gated ion channels, transporters and group translocation with examples.

Unit III: Sensory systems: Olfaction, taste, vision, hearing and touch with their biochemical mechanisms.

Unit IV: Physiochemical properties of nucleic acids: Hydrogen bonding, bond length, tautomerism and its significance in nitrogen bases, DNA denomination, and factor responsible for hypochromicity. Renaturation of DNA, annealing, walloce's rule, hybridization, ionization, enzymatic of nucleic acids, effect of acids and alkalis on nucleic acids, DNA super coiling and nucleic acid mutations.

Practicals:

1. Fractionation of egg proteins.
2. Detection of alpha – amylase activity in saliva.
3. Determination of sugar/glucose I urine (Benedict's Tritrimetric method).
4. Identification of blood constitution.
5. Extraction of total nucleic acid from plant tissues.
6. Extraction of RNA from yeast.
7. Assay of protein by Biuret's method.

Mendels law of heritability, mono, di hybrids ratios

Linkage: types, linkage maps, linkage groups, coefficient of coincidence, coefficient of interference

Crossing over, cytological basis of crossing over, factors effecting crossing over, estimation of recombination frequency from f₂ data.

Practicals:

Simple and compound microscope, cell culture. Monohybrid and dihybrid ratios, test cross, back cross, epistatic interactions, practice of mitotic and meiotic cell division, study of special chromosomes, probability, chi square and crossing over, two point test, cross linkage analysis, three point test, cross linkage analysis.

Plant Microbe association symbiotic associative and symbiotic nitrogen fixation, Azolla and Mycorrhiza Biodegradation of agricultural chemicals: pesticide, herbicides and agricultural organic wastes Carbon, nitrogen, phosphorous and sulphur cycles Microbes in human welfare, Biofertilizers, pesticide, waste treatment Rumen microbiology and silage production.

Practicals:

1. Microbial analysis of soil water and air.
2. Microbial analysis of fresh foods, fermented foods and vegetables.

BASICS OF MOLECULAR GENETICS

MCE 401

3 (2-0-1)

Unit 1. Introduction: Basic concepts in molecular genetics. Prokaryotic and Eukaryotic genome. Concept of gene and central dogma.

Unit 2. Transcription: Mechanism of transcription in prokaryotes and eukaryotes. Transcription of protein coding genes- mRNA. Post transcriptional modifications - 5_ capping, poly A tailing and mRNA splicing in eukaryotes.

Unit 3. Translation: Introduction to protein synthesis. The nature of genetic code. Mechanism of translation in prokaryotes and eukaryotes. Post translational modification of proteins.

Unit 4. Regulation of gene expression: Gene regulation in prokaryotes - *lac* and *trp* operons as model systems. Gene regulation in eukaryotes – Transcriptional level control, RNA processing level control, translational level control, post translational level control.

Unit 5. Gene mutation: Mutagenesis. Causes of mutation – spontaneous and induced. Types of mutagens - physical and chemical. Classification of mutations. Molecular basis of gene mutation.

Practicals

Structural elucidation of nucleotides and nucleic acids.
Study of DNA and RNA models
Extraction of proteins from plant tissues
Estimation of proteins by Lowry and Bradford methods

INTRODUCTION TO THERMODYNAMIC TERMS (system, surrounding, boundaries etc) open and closed loop systems, isolated systems, thermodynamic variables, extensive and intensive properties –2l

Thermodynamic process – isothermal, adiabatic process, isobaric, isochoric, cyclic, cyclic and irreversible process 2l

Laws of thermodynamics –thermal equilibrium, zero law, first law, second law of thermodynamics, energy concept, law of conservation of energy, concept of enthalpy, entropy –3L.

Reactive systems, degree of reaction, reaction equilibrium, laws of mass action, gibbs function change heat of reaction, fugacity + reactivity, construction, enthalpy of formation. Laws for reaction systems –3L

Air cycle, otto cycle, work done in cycles, thermal efficiency –3l

Refrigeration – introduction to principles of vapour compression cycle –2l

Unit 1

Bioinformatics and Internet: Internet Basics, FTP, www, connecting to Internet, Electronic mail, internet resources.

Unit 2

The NCBI data model: Introduction, Seq-id, Sequence, collection of sequence, annotation of sequence, describing sequence.

Unit 3

GenBank Sequence Database: Introduction to structure, Primary and secondary database,

Unit 4

Sequence Alignment And Database Searching : FASTA , BLAST ,

Unit 5

Multiple Sequence Alignment

Unit 6

Phylogenetic Analysis: Fundamental of Phylogenetic model, Tree interpretation, Tree building and tree evaluation, Phylogenetic software.

Unit 7

Introduction to Structure , PDB , MMDB , Structure file format , visualizing structure information , Structure viewers , structure similarity searching , Advanced structure modeling.

Unit 8

Comparative Genome Analysis: Introduction, application, genome analysis and annotation.

Practicals:

1. Understanding Linux Operating System and Commands.
2. Introduction to NCBI.
3. Using Entrez to search Literature Databases.
4. Retrieving DNA sequence from GenBank and analyzing various formats of the data stored.
5. Retrieving Protein sequence from GenPept (NCBI) and Expasy.
6. Analyzing Protein Sequences.
7. Analyzing DNA sequence.
8. Sequence alignment using BLAST (Basic Local Alignment Search Tool).
9. Sequence alignment using FASTA.
10. Multiple sequence alignment using ClustalW.

B. Sc. (Hons.) Biotechnology – 5th semester

MOLECULAR BIOLOGY TECHNIQUES AND INSTRUMENTATION

MCE 406

3 (2-0-1)

Unit 1. Molecular biology techniques: Cell fractionation. Isolation and purification of genomic DNA. Polymerase Chain Reaction. Nucleic acid blotting. DNA sequencing techniques.

Unit 2. Instrumentation in biotechnology: Working principles, instrumentation and applications of pH meter, centrifuge, colorimeter, spectrophotometer, autoclave, distillation unit, lyophilizer, flame photometer.

Unit 3. Methods for separation of macromolecules: Chromatography- column, thin layer, paper, ion exchange, gel filtration, affinity. Electrophoresis- agarose gel electrophoresis and polyacrilamide gel electrophoresis.

UNIT 4. Microscopy: Principles and applications of microscopy - simple, compound, phase contrast and electron microscopy. Yeast-2 Hybrid system, MS, tandem MS and MS imaging

Practicals

Measurement of hydrogen ion concentration of a given solution
Separation techniques-centrifugation and electrophoresis
Study of working principles and operation of some important equipments used in biotechnology
laboratory viz., spectrophotometer, pH meter, centrifuge, electrophoresis apparatus (AGE and PAGE), PCR machine, Distillation unit, autoclaves etc.

Unit 1: Introduction of enzymes: General properties and significance, classification and nomenclature. Terms and definition in enzymology: enzyme activity, specific activity, turnover number, active site, isoenzyme, marker enzyme Multienzyme complex, extracellular enzymes, extremozymes, abzymes, ribozymes, induced enzyme etc

Unit 2: Factor affecting enzyme activity: pH, Temperature, substrate concentration etc. Isolation, purification and localization of enzyme, techniques involved in enzyme assays.

Unit 3: Enzyme kinetics: steady rate kinetics, Derivation of Michaelis-Menten equation using steady state/equilibrium kinetics, plots of Lineweaver- Bruke etc. mechanism of substrate and multi-substrate enzyme catalyzed reaction.

Unit 4: Regulation of enzyme activity: Covalent modification, enzyme inhibition and kinetics. Allosteric enzyme: feed back inhibition, allosteric model concerted and sequential, co-operativity.

Unit 5: Mechanism of enzyme action and concept of active site: Vis-a-vis lysozyme, chymotrypsin, alcohol dehydrogenase, glyceraldehyde 3 phosphate dehydrogenase, proteases.

Unit 6: Enzyme Technology: Commercial production of enzymes, preference of extracted enzymes over whole organism, immobilization of enzymes, example of enzyme engineering, application of enzyme(therapeutic uses, analytical uses, manipulated uses etc.), uses of enzyme in solutions, enzyme reactors, biphasic system, Bi and poly functional enzymes, solvent engineering.

Practical:

1. Determination of protein
2. Determination of salivary amylase
3. Activity of effect of salt on salivary amylase
4. Detection of effect of pH on enzyme activity
5. Determination of Acid/Alkaline phosphatase
6. Determination of enzyme kinetics
7. Separation of protein by PAGE
8. Identification of extra cellular enzymes like protease, oxidase, urease, catalase and lipase

Unit I: Basic terminology: Infection, pathogen, antigen, antibody, bacterial and viral antigens, haptens, adjuvants, immunogens interferons, epitopes, paratopes, lymphokines

Specific and non-specific immune response: cellular basis of immunity, humoral and cell mediated immunity, biochemistry of immunoglobulins (structure, types, property and function),

cells of immune system: cells involved in adaptive immune response i.e. B and T cells,
cells involved in innate immune response- macrophages, dendritic cells, phagocytes, mast cells granulocytes, etc.

Unit II: Organs of immune system: primary lymphoid and secondary lymphoid organs, their structure and function. Major Histo Compatibility complex (MHC class I and class II), their structure and function. Chemistry of antigen-antibody interactions, precipitation and agglutination.

Unit III: Structure of T-cell receptors and their comparison with analogous antibody molecule. Natural Killer cell, Their structure and function. Superantigens and Antibody dependent cell mediated cytotoxicity (ADCC).

Unit IV: Immunodeficiency diseases: Primary B and T cell deficiency diseases, Autoimmunity, Hypersensitivity. Principles of RIA, ELISA and immunoelectrophoresis (Rocket immunoelectrophoresis), use of monoclonal antibodies in immunodiagnosis and immunotherapy.

Practical:

1. To prepare blood smear.
2. Separation of serum and plasma from blood.
3. Qualitative tests of important constituents of plasma and serum.
4. Separation of plasma proteins (i.e. Fibrinogen, globulin, and albumin).
5. Determination of E.S.R. of any blood sample.
6. Preparation of antigen from blood.
7. Determination of the blood group.
8. Determination of the haematocrit value of the blood sample.
9. Use of widal kit for rapid quantitative slide test.
10. Determination of density of blood.
11. Determination of bleeding and clotting time of blood.
12. Preparation of haematin crystals.

Language:

1. Concerned (Subject, Verb Agreement)
2. Antecedents (Noun, Pronoun Agreement)
3. Modifiers (Adjectives, Adverbs, Participle)
4. Prepositions (Usage)
5. Inflection (Noun, Verb)
6. Determiners (General, Specific)
7. Word enrichment (Antonyms, Synonyms, Homonyms, Acronyms, Orthography)
8. Voice

Communications:

1. Kinds
2. Different Speeches (Welcome Speech, Voice of thanks)

Technical Writing:

1. Importance
2. Objectives
3. Audience
4. Methods
5. Essentials (Documentation, Visuals, Sentences, Punctuation)
6. Process
7. Curriculum Vitae
8. Interview
9. Letter (Components, Format, 5 Kinds)
10. Memos (Administrative, Business)
11. Report (Format, Style, Periodical and Miscellaneous Reports)

Speech:

1. Stress
2. Intonation
3. Accent
4. Rhythm

MAS 531

Biostatistics

3(2-0-1)

1. Elementary idea of probability, Normal distribution, Binomial distribution, Poisson distribution.
2. Correlation and regression analysis: Types of correlation- simple, partial and multiple correlation and regression.
3. Tests of significance: t-test, F-test, Chi-square test (2x2) Contingency table.
4. Hypothesis: Testing of Hypothesis, level of significance, confidence level, degree of freedom, acceptance region, rejection region.
5. Analysis of variance: Definition and assumptions one way two way classification (problem based)

INTRODUCTION TO PLANT BIOTECHNOLOGY

MCE 402

3 (2-0-1)

Unit 1. Introduction to plant biotechnology: Definition. History and development of plant biotechnology. Modern trends in plant biotechnology.

Unit 2. Gene transfer in plants using *Agrobacterium*: Ti plasmids, transfer of T-DNA, construction of binary and co-integrate vector systems. *Agrobacterium* mediated leaf disc transformation.

Unit 3. Direct gene transfer in plants: Physical (Particle gun delivery, electroporation, microinjection, macroinjection, electroinjection, fiber mediated DNA delivery, Laser induced DNA uptake, Sonication) and Chemical methods of gene transfer (Poly ethylene glycol, Poly vinyl alcohol, Calcium phosphate)

Unit 4. Applications of plant biotechnology: Improving agronomic traits - genetic manipulation of plants for salt resistance, herbicide resistance, fungi and virus resistance, insect and other pest resistance. Modification of production traits - delayed fruit ripening, improving seed storage proteins.

Practicals

Safety aspects and precautions to be taken in Biotechnology Laboratory

Preparation of reagents, stock solutions and buffers for plant DNA isolation.

Study of Labwares used for isolation of DNA

Isolation of genomic DNA from plant tissues by CTAB method.

Purification of crude DNA samples.

INTRODUCTION TO ANIMAL BIOTECHNOLOGY

MCE 404

3 (2-0-1)

Unit 1. Introduction to animal biotechnology: Definition, history, importance and scope of animal biotechnology. Applications of animal biotechnology.

Unit 2. Gene manipulation of animals: Animal viral genome, animal cloning vectors. Gene transfer methods in eukaryotic systems - retroviral vector method, DNA microinjection method, engineered embryonic stem cell method. Selection of clones by using different methods.

Unit 3. Transgenic animals: Production of transgenic mice, rabbits, fish, sheep, goat, cattle, pig, etc.

Unit 4. Application of animal biotechnology: Transgenic animals as bioreactors-recombinant proteins produced by animal bioreactors. Transgenic animals as models of human diseases. Xenotransplantation. Embryo transfer technologies in cattle and its application.

Practicals

Handling of laboratory animals - mice, rabbits etc.
Isolation and purification of DNA from blood samples
Isolation and enumeration of bacterial population from meat samples
Development of Cell Lines from Egg Embryo
Screening of UV mutation in *E. coli*

B. Sc. (Hons.) Biotechnology – 6th semester

Course Title: Industrial Microbiology

Course Code: MBFT 502

Credits: 3(2-0-1)

Theory

Production of amino acids

Production of vinegar

Manufacture of various chemicals: Lactic acid, citric acid

Industrial production of therapeutic compounds: penicillin, vitamins, vaccines

Microbial transformation of steroids

Production of microbial enzymes

Microbial deterioration of materials: textile, paper, paint and painted surfaces etc.

Production of vaccines

Use of microorganisms in bioassays

Practical

Demonstration of fermentor its parts and maintenance

Screening for antibiotic production

Screening for enzyme production

Assay of antibiotics

BIOSAFETY, BIOETHICS AND INTELLECTUAL PROPERTY RIGHTS IN BIOTECHNOLOGY

MCE 501

3 (3-0-0)

Unit 1. The legal and socioeconomic impact of biotechnology, public education of the process

of biotechnology involved in generating new forms of life for informed decision making, biosafety regulation and national and international guidelines, r-DNA guidelines, experimental protocol approvals, levels of containment, regulatory bodies in biotechnology, biosafety committee.

Unit 2. Ethical issues, moral values on experimental animals, ethical implications of biotechnological products and techniques.

Unit 3. Intellectual property rights, WTO, TRIPS, International conventions, patents and copy rights, patent claims, methods of applications of patents.

Unit 4. Legal implications, biodiversity and farmers right. Beneficial application and development of research focus to the need of the poor, identification of directions for yield effect in agriculture, aquaculture etc.

Fundamentals of Tissue Culture

Code: TE- 401

Credits- 3 (2-0-1)

Plant Tissue Culture: A historical view, organization of tissue culture laboratory, aseptic techniques, media formulation, clonal propagation vs tissue culture, totipotency, growth differentiation and morphogenesis in tissue culture, various types of aseptic cultures and culture techniques.

Animal Tissue Culture: Basic techniques, organ culture, media formulation for animal cell, initiation of cell culture, evolution & maintenance of cell lines, Suspension culture & Immobilized culture.

Application of tissue culture techniques: Somoclonal and gametoclinal variation, protoplast fusion and somatic hybridization, cybridization, haploid and monoploid production, secondary transformation, production of metabolites, artificial seeds, preservation of genetic resources, cryopreservation, application of tissue culture for plant improvement.

Practicals:

- Laboratory equipments used in Plant Tissue culture
- Plant Growth Hormones
- Media preparation
- Preperation and Sterilization of explants
- Callus induction
- Meristem culture

Application of biotechnology in pharmaceutical, food & beverages, leather, paper, textile, detergent and chemical industries.

Biotechnology industry and medicine: Antibiotics, therapeutic application, Developing recombinant proteins for medical and therapeutic use, drug designing, new drug targets and vaccine development- Insulin, anti-haemophilic factor, human serum albumin, engineered enzymes.

Food and beverage industry: Xylanase, emulsifiers, high intensity sweetener, edible mushrooms, foods from microbes, role of biotechnology to improve food quality and food production.

Fermentation, cultures of microorganisms, solid or semisolid cultures, batch culture, continuous culture, fedbatch culture. Metabolic pathways in microorganisms, glycolysis or EMP pathways, entner-doudoroff pathways, the pentose phosphate pathways.

Practical:

1. Estimation of casein protein in milk.
2. Qualitative determination of different constituents of baking powder.
3. Estimation of glucose by anthron method.
4. Determination of vitamin-C in sample.
5. Estimation of lipid.
6. Determination of colour and pigments.
7. Methylene blue reduction test of milk.

Unit I: Metabolism of carbohydrates: metabolism of carbohydrate in plants, plant acid, plant respiration.

Unit II: chloroplast and pigments: Chloroplast morphology, structure and biochemical anatomy of chloroplast, chlorophyll and photosynthetic pigments.

Unit III: Photosynthesis: photosynthesis in plants, including bacterial photosynthesis, C₃ and C₄ pathways, CAM photomorphylation, photosystems, chemiosmotic coupling, etc. photorespiration, relationship between photosynthesis, photorespiration, and crop productivity, photoperiodism, photomorphogenesis. Environmental and agricultural aspects of photosynthesis.

Unit IV: Nitrogen metabolism: Metabolism of N-compounds in plants (seedlings and leaves), nitrogen cycle, nitrate and nitrite reduction, denitrification, symbiotic and non symbiotic nitrogen fixation, nitrogen organization, function and regulation, assimilation of fixed nitrogen by plants, nitrification.

Unit V: Plant microbe interaction: Chemo autotrophy in rhizobia, nitrifying bacterial, metabolism of lipids in plants, phosphorus solubilising bacteria, biochemical changes in infected plants.

Unit VI: Plant nutrients: Biochemical roles of inorganic ions in plants (both macro and micronutrients), symptoms of nutrient deficiency in plants, assimilation of (P, S, Ca) their metabolism, stress physiology, uptake of nutrients in stress condition, transport phenomenon in plants.

Practical:

1. Analysis of plants and plant product for various constituents.
2. Extraction and identification of sugars from plants fruits and vegetables.
3. Extraction and determination of amino acid and protein.
4. Determination of lipids, phospholipids, cholesterol in food, fruits and vegetables.
5. Determination of various plants nutrients

Unit:1 Biochemistry of Blood and Body fluids-Biochemical composition of blood groups, path way of blood clotting, physiological function of blood, buffering action of blood, kinds other body fluids and their chemistry.

Unit: 2 Biochemistry of Body tissue-Connective tissue, collagen, elastin muscle protein, muscle construction,

Unit: 3 Biochemistry of Fat in adipose tissue , steroids-structure and biochemical function cholesterol-Structure and biochemical synthesis, plasma lipids, transport of lipids, lipo-protein, chylomicrons, VLDL, HDL, LDL, and Lp(a), free fatty acids, nonesterified fatty acids.

Unit: 4 Anti-oxidant-Generation of free radicals, damage produced by reactive-oxygen species (ROS), free-radicals, and scavenging enzyme system.

Unit: 5 Animal Hormones-Origin, site of action, biochemical mechanism of hormone action, feed-back mechanism of hormonal secretion.

Practical:

1. Identification of blood constituents.
2. Action of salivary amylase.
3. Action of digestive enzymes on proteins.
4. Determination of constituents of milk protein, fat, lactose.
5. Determination of sugar in urine and blood.
6. Determination of cholesterol in blood and biological sample.

INTRODUCTION TO ENVIRONMENTAL BIOTECHNOLOGY

MCE 403

3 (3-0-0)

Unit 1. Introduction to environmental biotechnology: Importance of biotechnology in environmental protection. Biodiversity, ecosystem and population diversity. Environmental hazards.

Unit 2. Biomass utilization: Bioremediation, bioleaching, biodegradation, biostimulation, bioaccumulation, bioaugmentation, biomagnification.

Unit 3. Biotechnological methods of pollution detection: Bioassay, biosensors and biological indicators. Sewage and soil waste management.

Unit 4. Global environment issues: Ozone depletion, green house effect, acid rain, sea level rise, global warming.

B. Sc. (Hons.) Biotechnology – 7th semester

FUNDAMENTALS OF NANOTECHNOLOGY

MCE 503

2 (2-0-0)

Nanotechnology: an overview

Nanomaterial, their chemistry and synthesis

Carbon nano tube and their applications

Study of analyzing tools for nanostructures (STM, TEM, AFM)

Applications of nanotechnology in semi conductors, composites, ceramics, catalysis and photocatalysis, biosensor development, drug delivery and gene therapy, NEMS and MEMS, environmental biotechnology

Health and safety issue, ethical, legal and societal implications

Unit1: History of drug discovery & Molecular biology for drug:-early and recent history of drug discovery, enzymes/receptor as drug target. molecular biology for drug discovery(recombinant proteins and monoclonal antibodies as drug). Molecular basis of disease processes. Target identification and validation.

Unit2: Organic synthesis for drug discovery:-target oriented organic synthesis and retro synthetic analysis. diversity oriented organic synthesis and evolving synthetic analysis, solid phase synthesis for drug discovery (parallel is split pool strategy) combinatorial chemistry and high through put screening(HTS).

Unit3: Combinatorial chemistry for drug discovery:-combinatorial biocatalysis for drug discovery, synthesis of Berge's in derivatives. Drug discovery in cancer research/new target based drugs in clinical trials.

Unit4: Introduction of pharmacogenomics:-microbial genomics for new antibiotics, immunotoxin drug(eg ricin, a plant toxin).drug designing for blocking enzyme activity through blocking hormones receptor through inhibition of nucleic acid synthesis against heterogenous target.

Marketing & MANAGEMENT of Biotechnology Products

Course Code: BAM-502

Credits: 3(3-0-0)

Concept of Marketing

Customer Satisfaction and Buyer Behavior.

Marketing Mix

Analyzing Consumer Markets of Biotechnological products.

Pricing-strategies and methods of pricing of Biotechnological products

Identifying Markets Segments and Selecting Target Markets for Biotechnological products.

Positioning the Market Offering Through the Product Life Cycle

Distribution Channel

Promotion of Biotechnological Products.

Unit-1: Bioreactors definition, classification of chemical reactors, residence time, bioreactors design and their functions, types of bioreactors. Application of bioreactors in bio-fertilizer production, alcohol production, antibiotic production, plant cell culture, animal cell culture, waste management.

Unit-2Control of bioprocess parameters in bioreactors, temperature, pressure, oxygen supply, agitation, nutritional, on/off control, PID control, control of heating of bioreactors, flow measurement control, chemical and electrical methods of foam control, off-line control parameters (measurement of properties analysis of cell population and composition), use of computer technology in bioprocess control system.

Unit-3 Engineering principles: transport phenomenon in bioprocess, mass transfer principles, mass transfer coefficient in gasses and liquids, heat transfer principles, coefficient of heat transfer, applied enzyme catalysis, biomass production in cell cultures.

Unit-4 Upstream and downstream processing: media formulation, sterilization of equipments, gas compressor types and principles of compression, air filtration, solid and liquid handling. Industrially fermented broth (filtration and ultra-filtration), centrifugation, solvent extraction, chromatographic separation, liquid extraction of biopolymers and antibiotics ion exchange recovery of antibiotics and proteins.

Practical:

1. To estimate dimensionless mixing time in a batch reactor.
2. To study the pH control system of bioreactor.
3. To understand the functioning of bioreactor and to carry out its blank sterilization.
4. To study the operation of a bioreactor.
5. To study the dissolved oxygen in bioreactor.

GENETICALLY MODIFIED FOODS

MCE 603

3 (3-0-0)

Unit 1. Introduction to GM foods: History and development of GM food / crops. Currently existing GM foods/ crops.

Unit 2. Cultivation of GM crops: Growing of GM food crops. Countries cultivating GM food crops.

Unit 3. Debate on GM foods around the world. Criticisms against GM foods. Biosafety concerns and regulators of GM foods. GM food criteria in India. GM food labelling and GM labelling. Consumer acceptance and market forces.

Unit 4. Economical and political effects of GM foods. Future developments.

Course Title: Microbial Technology in Food Industry

Course Code: MBMT 605

Credits: 3(2-0-1)

Theory

- Food as a substrate for microorganisms
- Primary Sources of Microorganisms in Foods
- General principles underlying spoilage of foods and different methods of preservation of foods
- Starter Cultures
- Fermented milk product and other food: types, production and defects.
- Fermented beverages: Brewing, malting, mashing, hops & primary and secondary fermentation
- New protein foods – SCP, mushroom, food yeasts, algal proteins
- Quality and safety assurance in food and dairy industry

Practical:

- Familiarity with bacteria and fungi important in food industry
- Evaluation of milk sample by Direct Microscopic Count
- Starter Activity test
- Microbiological analysis of Dahi
- Isolation and identification of microorganisms involved in food spoilage (vegetable, fruit)
- Enumeration of microorganisms in different food products (fruit juice, sugar etc)