



ख़्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)
Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY,
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

FACULTY OF SCIENCE

**KHWAJA MOINUDDIN CHISTI LANGUAGE UNIVERSITY,
LUCKNOW, U.P. (India)**

B.Sc. (Hons.) – BIOTECHNOLOGY

Under Choice Based Credit System (CBCS)

**Regulations, Course & Curriculum Structure
(As per NEP 2020)**

**First, Second & Third Years
(I, II, III, IV, V & VI Semesters)**

Effective from Session 2021-22



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Bachelor of Science (Honours) in Biotechnology Programme

1. Applicability

These regulations shall apply to the programme of Bachelor of Science (Honours) in Biotechnology from the session 2021-22.

2. Minimum Eligibility for Admission

An Intermediate degree under the 10+2 system with Biology group from a recognized Board/Institution, with 45% marks in aggregate for General/OBC and 40% for SC/ST candidates shall constitute the minimum requirement for admission to the programme.

3. Programme Objectives

- Bachelor course in biotechnology offers the synergism of basic concepts of biology, chemistry, biochemistry, physiology, molecular biology, microbiology, immunology, recombinant DNA technology, genomics & proteomics with technological applications.
- The main objective of this degree course is to produce graduates with enhanced skills, knowledge and research aptitude to carry out higher studies, entrepreneurship or research and development in the various health, agricultural and industrial areas.
- Develop proficiency in application of current aspects of biotechnology like biochemistry, molecular biology, immunology, recombinant DNA technology, genomics & proteomics.
- Students will be able to use state of the art techniques relevant to academia and industry, generic skills and global competencies including knowledge and skills that enable the students to undertake further studies in the field of biochemistry, immunology, molecular biology, genetic engineering, genomics & proteomics, microbiology or any other related field.
- Imparting an education that includes communication skills, the ability to work in a team with leadership quality, devoted to societal problems with an ethical attitude

4. Programme Outcomes

- Prepares the students for immediate entry to the workplace with sound theoretical, experimental knowledge in the area of health and pharmaceuticals, biochemicals, biofuels, environment related, food and dairy, cosmetics, biopolymers and related multidisciplinary fields.
- Overall, the course offers basic foundation in biotechnology which enables the students to understand the concepts in biochemistry, molecular biology, microbiology, genetic engineering and related industrial technology.
- Students will be able to design, execute, record and analyse the results of experiments in field of molecular biology, genomics, Recombinant DNA technology, biochemistry, microbiology and genetic engineering.
- Students will be able to work effectively in a group in the classroom, laboratory, industries and field based situations.
- Become efficient in using standard operating procedures and will be well versed with the regulations for safe handling and use of chemicals as well as IPR and biosafety issues related to experiments in field of biochemistry, microbiology and genetic engineering.



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5. Specific Programme Outcomes

- **Critical Thinking-** Students will demonstrate an understanding of major concepts in all disciplines of biology, biochemistry, biotechnology microbiology and bioinformatics. Understand the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life.
- **Effective Communication-** Development of various communication skills such as reading, listening, speaking in expressing ideas and views clearly and effectively.
- **Social Interaction and Ethics-** Development of scientific outlook not only with respect to science subjects but also in all aspects related to life besides following ethics
- **Environment and Sustainability-** Understand the issues of environmental contexts and sustainable development.
- **Competitive Skill-** Demonstrate an ability to appear for National level examination to pursue higher studies.
- **Career opportunities-** Demonstrate an ability to identify careers in biotechnology, domain like Healthcare Diagnostics, Pharmaceutical, Food Industry etc, and skills required to work in a biotechnology laboratory or manufacturing facility. Beside this, industries also employ biotechnological professionals in their marketing divisions to boost up business in sectors where their products would be required.
- **Entrepreneurship ventures-** such as consultancy and training centres can be opened.

6. Course Structure

The course structure of the Biotechnology programme shall be as follows-



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Year	Sem.	Course Opted	Course Name	Theory/ Practical/ Project	Credits	Cumulative Minimum Credits required for Award of Certificate/ Diploma/ Degree
1	I	Core Course 1	Biochemistry & Metabolism	Theory	4	(46) Certificate in Biotechnology
		Core Course 1 Practical	Biochemistry & Metabolism	Practical	2	
		Core Course 2	Cell Biology	Theory	4	
		Core Course 2 Practical	Cell Biology	Practical	2	
		Core Course 3	Environmental Science	Theory	4	
		Core Course 3 Practical	Environmental Science	Practical	2	
		GE 1	Generic Elective - 1	Theory	4	
		SEC 1	Molecular Diagnostics	Theory	3	
		AECC 1	Food Nutrition and Hygiene	Theory	0 (Qualifying)	
Total Credit					25	
1	II	Core Course 4	Mammalian Physiology	Theory	4	
		Core Course 4 Practical	Mammalian Physiology	Practical	2	
		Core Course 5	Plant Physiology	Theory	4	
		Core Course 5 Practical	Plant Physiology	Practical	2	
		Core Course 6	Animal Biotechnology	Theory	4	
		Core Course 6 Practical	Animal Biotechnology	Practical	2	
		GE 2	Generic Elective - 2	Theory	4	
		SEC 2	Enzymology	Theory	3	
		AECC 2	First Aid and Health	Theory	0(Qualifying)	
Total Credit					25	
2	III	Core Course 7	Genetics	Theory	4	(92) Diploma in Biotechnology
		Core Course 7 Practical	Genetics		2	
		Core Course 8	General Microbiology	Theory	4	
		Core Course 8 Practical	General Microbiology		2	
		Core Course 9	Chemistry – 1	Theory	4	
		Core Course 9 Practical	Chemistry – 1		2	
		GE 3	Generic Elective - 3	Theory	4	
		SEC 3	Industrial Fermentations	Theory	3	
		AECC 3	Human Values and Environmental Studies	Theory	0(Qualifying)	
Total Credit					25	
2	IV	Core Course 10	Molecular Biology	Theory	4	
		Core Course 10 Practical	Molecular Biology	Practical	2	
		Core Course 11	Immunology	Theory	4	
		Core Course 11 Practical	Immunology	Practical	2	
		Core Course 12	Chemistry – 2	Theory	4	
		Core Course 12 Practical	Chemistry – 2	Practical	2	
		GE 4	Generic Elective – 4	Theory	4	
		SEC 4	Basics of Forensic Science	Theory	3	
		AECC 4	Physical Education & Yoga	Theory	0(Qualifying)	
Total Credit					25	



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						(132) Degree in “Bachelor of Science Honors in Biotechnology”
3	V	Core Course 13	Bioprocess Technology	Theory	5	
		Core Course 14	Recombinant DNA Technology	Theory	5	
		Core Course 15	Medical Microbiology	Theory	5	
		Core Course 16	Food Biotechnology	Theory	5	
		AECC 5	Analytic Ability and Digital Awareness	Theory	0(Qualifying)	
		Industrial Training	Industrial Training	Project	0(Qualifying)	
Total Credit					20	
3	VI	Core Course 17	Bio Analytical Tools	Theory	5	
		Core Course 18	Genomics and Proteomics	Theory	5	
		Core Course 19	Agriculture Biotechnology	Theory	5	
		Core Course 20	Biostatistics	Theory	5	
		AECC 6	Communication Skill and Personality Development	Theory	0(Qualifying)	
		Research Project	Research Project	Project	0(Qualifying)	
Total Credit					20	
Grand Total Credit					140	



Semester I

BIOCHEMISTRY AND METABOLISM

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
- Describe the structure of proteins, including the significance of amino acid R-groups and their impact on the three-dimensional structure of proteins.
- Students will have knowledge on biomolecules, like carbohydrates, lipids, enzymes and coenzymes besides their importance and Classification, forces stabilizing their structures, write and relate the role of them with day to day life.
- Develop an understanding of various metabolisms in cell
- 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:

Introduction to Biochemistry: A historical prospective.

(10 Periods)

Amino acids & Proteins: Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.

Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions

UNIT II

(10 Periods)

Lipids: Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.

Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines,. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA



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UNIT III

(20 Periods)

Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites, enzyme specificity: types & theories, Biocatalysts from extreme thermophilic and hyperthermophilic archaea and bacteria. Role of: NAD^+ , NADP^+ , FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxal phosphate, lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions.

UNIT IV

(20 Periods)

Carbohydrates Metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. β -oxidation of fatty acids, Amino acid catabolism

PRACTICALS

1. Introduction to Glasswares /Equipments & Pipetting Method
2. Qualitative tests for Carbohydrates, proteins and lipids
3. Preparation of buffers.
4. Standardization of pH meter
5. To study activity of any enzyme under optimum conditions.
6. To study the effect of pH, temperature on the activity of salivary amylase enzyme.
7. Principles of Colorimetry: Beer's law

SUGGESTED READING

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. 6th Edition. W.H Freeman and Co.
2. Satyanarayana U. and Chakrapani U. (2008). Biochemistry, 5th Edition, Books & Allied Ltd (Elsevier)
3. Buchanan, B., Grussem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.
4. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.



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CELL BIOLOGY

Course Objectives:

- Provide in depth knowledge involving the basic concepts of cell biology including cell signaling, Cell-matrix interactions with specific emphasis on the components that make up the cytoskeleton.
- The course also includes understanding various mechanisms that govern the growth and regulation of cancer cells including the method to culture such cells.

Course Outcomes

- Students develop an understanding of the Cytoskeleton and Cell Membrane & discuss the structure of Microtubules, microfilaments & can differentiate the organisms by its cell structure.
- Understand how the proteins synthesized in the cytosol are transported to different organelles.
- Understanding how cells co-operate and communicate with each other and the role of such signaling mechanisms in Cancer, Cell death and other pathological conditions.

UNIT I

(10 Periods)

Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation.

Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport

UNIT II

(15 Periods)

Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments.

Endoplasmic reticulum: Structure, function including role in protein segregation.

Golgi complex: Structure, biogenesis and functions including role in protein secretion.

UNIT III

(20 Periods)

Lysosomes: Vacuoles and micro bodies: Structure and functions

Ribosomes: Structures and function including role in protein synthesis.

Mitochondria: Structure and function, Genomes, biogenesis.

Chloroplasts: Structure and function, genomes, biogenesis

Nucleus: Structure and function, chromosomes and their structure.

UNIT IV

(15 Periods)

Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction.

Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer.



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PRACTICALS

1. Study the effect of temperature and organic solvents on semi permeable membrane.
2. Demonstration of dialysis.
3. Study of plasmolysis and de-plasmolysis.
4. Cell fractionation and determination of enzyme activity in organelles using sprouted seed or any other suitable source.
5. Study of structure of any Prokaryotic and Eukaryotic cell.
6. Microtomy: Fixation, block making, section cutting, double staining of animal tissues like liver, oesophagus, stomach, pancreas, intestine, kidney, ovary, testes.
7. Cell division in onion root tip/ insect gonads.
8. Preparation of Nuclear, Mitochondrial & cytoplasmic fractions.

SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco



ENVIRONMENTAL SCIENCE

Course Objectives:

- Articulate the interdisciplinary context of environmental issues.
- Develop critical thinking for shaping strategies (scientific, social, economic and legal) for environmental protection and conservation of biodiversity, social equity and sustainable development.
- Acquire values and attitudes towards understanding complex environmental and social challenges, and participating actively in solving current environmental problems and preventing the future ones.
- Adopt sustainability as a practice in life, society and industry.

Course Outcomes:

After the completion of the course, students will be able:

- Understand the importance and become aware of the upcoming environmental issues and understand the importance of natural resources and can work for their conservation
- Gain knowledge about the various ecosystems existing in nature and their importance for conservation of nature.
- Learn about the biodiversity at local, national and global levels and the importance of wild life conservation.
- Gain knowledge about different types of environmental pollution, their effects and control of pollution for the benefit of mankind.
- Gain knowledge about the sustainable development, human rights and emerging environmental issues.

Unit 1 : Introduction to environmental studies & Ecosystems

(15 Lectures)

Multidisciplinary nature of environmental studies;

- Scope and importance; Concept of sustainability and sustainable development.
- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :
 - Forest ecosystem
 - Grassland ecosystem
 - Desert ecosystem
 - Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 2 : Natural Resources : Renewable and Non-renewable Resources Biodiversity and Conservation

(20 Lectures)

- Land resources and land use change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water : Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).
- Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.



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Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots

- India as a mega---biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity : Habitat loss, poaching of wildlife, man---wildlife conflicts, biological invasions; Conservation of biodiversity : In---situ and Ex---situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit 3: Environmental Pollution & Human Communities and the Environment (15 Lectures)

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management : Control measures of urban and industrial waste.
- Pollution case studies.

Human population growth: Impacts on environment, human health and welfare.

- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management : floods, earthquake, cyclones and landslides.
- Environmental movements : Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Unit 4: Social Issue (10 Lectures)

Sustainable development, Environmental ethics: Issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, Waste and reclamation.

PRACTICALS

1. Introduction to Glasswares/Equipments & Pipetting Method
2. Preparation of Buffer Solutions
3. Standardization of pH meter
4. Soil analysis: Determination of Salinity, pH, Alkalinity, Acidity
5. Water analysis: Determination of Salinity, pH, Alkalinity, Acidity
6. Determination of total solid, dissolve solid and suspended solid in an effluent

Suggested Readings:

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R. 1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999. *Global Ethics and Environment*, London, Routledge.
4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science*, 339: 36---37.
7. McCully, P. 1996. *Rivers no more: the environmental effects of dams*(pp. 29---64). Zed Books.
8. McNeill, John R. 2000. *Something New Under the Sun: An Environmental History of the Twentieth Century*.
9. Odum, E.P., Odum, H.T. & Andrews, J. 1971. *Fundamentals of Ecology*. Philadelphia: Saunders.



MOLECULAR DIAGNOSTICS

Course Objectives:

The objective of this course is to familiarize students with the various diagnostic tests for infectious non-infectious human diseases based on

- enzyme Immunoassays like ELISA, Blotting & PCR
- non-enzymatic ones like immunofluorescence, radioimmunoassay & electron microscopy

Course Outcomes:

Understand the principle, methods & application of the diagnostic assays involving biomolecules as biomarkers for diseases affecting lungs, liver, kidney & heart

Gain knowledge for identification of viral diseases like dengue, COVID-19 & non-communicable diseases like diabetes mellitus & cancer with the use of purified antigens or antibodies

UNIT I

(15 Periods)

Enzyme Immunoassays:

Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays. Enzyme immunoassays after immuno blotting. Enzyme immuno histochemical techniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in diagnostic microbiology

UNIT II

(15 Periods)

Molecular methods in clinical microbiology:

Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology

Laboratory tests in chemotherapy:

Susceptibility tests: Micro-dilution and macro-dilution broth procedures. Susceptibility tests: Diffusion test procedures. Susceptibility tests: Tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests.

UNIT III

(18 Periods)

Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies. Concepts and methods in idiotypes. Anti-idiotypes and molecular mimicry and receptors. Epitope design and applications. Immunodiagnostic tests. Immuno fluorescence. Radioimmunoassay.

UNIT IV

(12 Periods)

GLC, HPLC, Electron microscopy, flowcytometry and cell sorting.
Transgenic animals.



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1. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker
2. Bioinstrumentation, Webster
3. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic
4. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.
5. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
6. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
7. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Century-Crofts publication.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
9. Microscopic Techniques in Biotechnology, Michael Hoppert



Semester II

MAMMALIAN PHYSIOLOGY

Course Objectives:

To understand the physiological organisation and functioning of human body

Course Outcomes

- Understand the organisation of human body
- Understand the functioning of human body as different system like, neuro-muscular, digestive, respiratory, circulatory, excretory, body fluids etc.
- Understand the variation in normal physiology.

UNIT I: Digestion and Respiration

(15 Periods)

Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice

Respiration: Exchange of gases, Transport of O₂ and CO₂, Oxygen dissociation curve, Chloride shift.

UNIT II: Circulation

(15 Periods)

Composition of blood, Plasma proteins & their role, blood cells, Haemopoiesis, Mechanism of coagulation of blood.

Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat.

UNIT III: Muscle physiology and osmoregulation

(15 Periods)

Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction.

Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.

UNIT IV: Nervous and endocrine coordination

(15 Periods)

Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters

Mechanism of action of hormones (insulin and steroids)

Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions



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PRACTICALS

1. Finding the coagulation time of blood
2. Determination of blood groups
3. Counting of mammalian RBCs
4. Determination of TLC and DLC
5. Demonstration of action of an enzyme
6. Determination of Haemoglobin

SUGGESTED READING

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Herculat Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons, Inc.



PLANT PHYSIOLOGY

Course Objectives:

- The structure and functioning of Plant Cells and tissue.
- Morphology and physiology of plants.
- The course has been designed to make students aware of basic plant biotechnology techniques and their applications in plant growth and development, and large scale production of natural products from plant source.

Course Outcomes

- Study of the structure and functioning of Plant Cells and tissue
- Study of the morphology and physiology of plants
- Develop the the understanding of growth in plants.

UNIT I: Plant water relations and micro & macro nutrients (12 Periods)

Plant water relations: Importance of water to plant life, diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration, stomata & their mechanism of opening & closing.

Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, mechanism of uptake of nutrients, mechanism of food transport

UNIT II: Carbon and nitrogen metabolism (20 Periods)

Photosynthesis- Photosynthesis pigments, concept of two photo systems, photophosphorylation, calvin cycle, CAM plants, photorespiration, compensation point, Nitrogen metabolism- inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants.

UNIT III: Growth and development (18 Periods)

Growth and development: Definitions, phases of growth, growth curve, growth hormones (auxins, gibberlins, cytokinins, abscisic acid, ethylene) Physiological role and mode of action, seed dormancy and seed germination, concept of photo- periodism and vernalization

UNIT III: Biotechnological interventions (10 Periods)

Developing insect-resistance, disease-resistance, herbicide resistance; stress and senescence tolerance in plants, crop improvement in plants. Genetic manipulation of flower pigmentation, Developing quality of seed storage, Biofortification, Golden rice.



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PRACTICALS

1. Preparation of stained mounts of anatomy of monocot and dicot's root, stem & leaf.
2. Demonstration of plasmolysis by *Tradescantia* leaf peel.
3. Demonstration of opening & closing of stomata
4. Demonstration of guttation on leaf tips of grass and garden nasturtium.
5. Separation of photosynthetic pigments by paper chromatography.
6. Demonstration of aerobic respiration.
7. Preparation of root nodules from a leguminous plant.

SUGGESTED READING

1. Dickinson, W.C. 2000 Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Esau, K. 1977 Anatomy of Seed Plants. Wiley Publishers.
3. Fahn, A. 1974 Plant Anatomy. Pergmon Press, USA and UK.
4. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.
5. Mauseth, J.D. 1988 Plant Anatomy. The Benjamin/Cummings Publisher, USA.
6. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4th edition, W.H. Freeman and Company, New York, USA.
7. Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing Co. Ltd.
8. Taiz, L. and Zeiger, E. 2006 Plant Physiology, 4th edition, Sinauer Associates Inc .MA, USA



ANIMAL BIOTECHNOLOGY

Course Objectives:

- To acquaint students with the gene transfer methods & applications of genetic engineering in creating transgenic animals.
- The course will provide complete exposure as how biotechnology is used in overcoming animal diseases besides introduction & applications of stem cells technology.
- Also the course will provide awareness about gene therapy in medicine

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 for recombinant DNA technology in production of therapeutic proteins
- Know how transgenic animals, cryopreservation, apoptosis, animal cloning, cell transformation, DNA microinjection.
- Use of stem cell & gene therapy in medicine alongwith problems & ethical issues.

UNIT I

Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer. **(10 Periods)**

UNIT II

Introduction to transgenesis. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases need help of Biotechnology – Foot-and mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis. **(10 Periods)**

UNIT III

Animal propagation – Artificial insemination, Animal Clones. Conservation Biology – Embryo transfer techniques. Introduction to Stem Cell Technology and its applications. **(20 Periods)**

UNIT IV

Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics. **(20 Periods)**



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SUGGESTED READING

1. Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic Press, California, USA.
2. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers.
3. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA.
4. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA.
5. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA- genes and genomes- A short course. III Edition. Freeman and Co., N.Y., USA.



ENZYMOLGY

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 enzymes, immobilisation of enzymes
- Differentiate between equilibrium and steady state kinetics and analyzed simple kinetic data and Estimate important parameter (K_m , V_{max} , K_{cat} etc).

Course Outcome

- Learn about nature of enzymes, enzyme purification & classification
- 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 including biosensors & bioreactors with their applications in industry & healthcare
- Familiarise with Allosteric, Isoenzymes, Multienzymes & Ribozymes with their examples

UNIT - I

(20 Periods)

Isolation, crystallization and purification of enzymes, test of homogeneity of enzyme preparation, methods of enzyme analysis.

Enzyme classification (rationale, overview and specific examples) Zymogens and their activation (Proteases and Prothrombin).

Enzyme substrate complex: concept of E-S complex, binding sites, active site, specificity, Kinetics of enzyme activity, Michaelis-Menten equation and its derivation,

Different plots for the determination of K_m and V_{max} and their physiological significance, factors affecting initial rate, E, S, temp. & pH. Collision and transition state theories, Significance of activation energy and free energy.

UNIT – II

(15 Periods)

Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition types of inhibition, determination of K_i , suicide inhibitor.

Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency: proximity, orientation, distortion of strain, acid-base, nucleophilic and covalent catalysis. Techniques for studying mechanisms of action, chemical modification of active site groups, specific examples-: chymotrypsin, Isozyme, GPDH, aldolase, RNase, Carboxypeptidase and alcohol dehydrogenase.

Enzyme regulation: Product inhibition, feed backcontrol, covalent modification



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UNIT – III

(13 Periods)

Allosteric enzymes with special reference to aspartate transcarbomylase and phosphofructokinase. Qualitative description of concerted and sequential models. Negative co-operativity and half site reactivity. Enzyme - Enzyme interaction, Protein ligand binding, measurements analysis of binding isotherm, cooperativity, Hill and scatchard plots, kinetics of allosteric enzymes. Isoenzymes– multiple forms of enzymes with special reference to lactate dehydrogenase. Multienzyme complexes. Ribozymes. Multifunctional enzyme-eg Fatty Acid synthase.

UNIT – IV

(12 Periods)

Enzyme Technology: Methods for large scale production of enzymes. Immobilized enzyme and their comparison with soluble enzymes, Methods for immobilization of enzymes. Immobilized enzyme reactors. Application of Immobilized and soluble enzyme in health and industry. Application to fundamental studies of biochemistry. Enzyme electrodes. Thermal stability and catalytic efficiency of enzyme, site directed mutagenesis and enzyme engineering

SUGGESTED READING

1. Biochemistry, Lubert Stryer, 6th Edition, WH Freeman, 2006.
2. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M.Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 28th Edition, McGrawHill, 2009.
3. Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley andSons, 1995.
4. Biochemistry by Mary K.Campbell & Shawn O.Farrell, 5th Edition, Cenage Learning,2005.
5. Fundamentals of Enzymology Nicholas Price and Lewis Stevens Oxford University Press 1999
6. Fundamentals of Enzyme Kinetics Athel Cornish-Bowden Portland Press 2004
7. Practical Enzymology Hans Bisswanger Wiley–VCH 2004
8. The Organic Chemistry of Enzyme-catalyzed Reactions Richard B. Silverman Academic Press 2002



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Semester III

GENETICS

Course Objectives:

- Genetics is the study of heredity and genes. The aim of this course is to strengthen the Mendelian principles along with other molecular genetics topics like recombination, pedigree analysis, transposons.
- This course will help students to venture in to the different areas of biomedical sciences.

Course Outcomes

- To communicate the pivotal role of Mendelian concepts in the development of the science of genetics and also the fact that nature is full of examples that deviate from Mendelian laws starting from linkage groups.
- 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.

UNIT I

(12 Periods)

Introduction: Historical developments in the field of genetics. Organisms suitable for genetic experimentation and their genetic significance.

Cell Cycle: Mitosis and Meiosis: Control points in cell-cycle progression in yeast. Role of meiosis in life cycles of organisms.

Mendelian genetics : Mendel's experimental design, monohybrid, di-hybrid and tri hybrid crosses, Law of segregation & Principle of independent assortment. Verification of segregates by test and back crosses, Chromosomal theory of inheritance, Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy, multiple allele, pseudo-allele, essential and lethal genes, penetrance and expressivity.

UNIT II

(18 Periods)

Non allelic interactions: Interaction producing new phenotype complementary genes, epistasis (dominant & recessive), duplicate genes and inhibitory genes.

Chromosome and genomic organization: Eukaryotic nuclear genome nucleotide sequence composition – unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, middle repetitive sequences- VNTRs & dinucleotide repeats, repetitive transposed sequences- SINES & LINEs, middle repetitive multiple copy genes, noncoding DNA.

Genetic organization of prokaryotic and viral genome.

Structure and characteristics of bacterial and eukaryotic chromosome, chromosome morphology, concept of euchromatin and heterochromatin. packaging of DNA molecule into chromosomes, chromosome banding pattern, karyotype, giant chromosomes, one gene one polypeptide hypothesis, concept of cistron, exons, introns, genetic code, gene function.



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UNIT III

(15 Periods)

Chromosome and gene mutations: Definition and types of mutations, causes of mutations, Ames test for mutagenic agents, screening procedures for isolation of mutants and uses of mutants, variations in chromosomes structure - deletion, duplication, inversion and translocation (reciprocal and Robertsonian), position effects of gene expression, chromosomal aberrations in human beings, abnormalities– Aneuploidy and Euploidy.

Sex determination and sex linkage: Mechanisms of sex determination, Environmental factors and sex determination, sex differentiation, Barr bodies, dosage compensation, genetic balance theory, Fragile-X-syndrome and chromosome, sex influenced dominance, sex limited gene expression, sex linked inheritance.

UNIT IV

(15 Periods)

Genetic linkage, crossing over and chromosome mapping: Linkage and Recombination of genes in a chromosome crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Crossing over at four strand stage, Multiple crossing overs Genetic mapping.

Extra chromosomal inheritance: Rules of extra nuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting.

Evolution and population genetics: In breeding and out breeding, Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, systems of mating, evolutionary genetics, natural selection.

PRACTICALS

1. Permanent and temporary mount of mitosis.
2. Permanent and temporary mount of meiosis.
3. Mendelian deviations in dihybrid crosses
4. Demonstration of - Barr Body -*Rhoeo* translocation.
5. Karyotyping with the help of photographs
6. Pedigree charts of some common characters like blood group, color blindness and PTC tasting.
7. Study of polyploidy in onion root tip by colchicine treatment.

SUGGESTED READING

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
4. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co.



GENERAL MICROBIOLOGY

Course Objectives:

- Introducing the microbial world with specific reference to the metabolic, physiological and morphological characteristics of microbes besides their classification.
- Course will provide practical knowledge about different types of bacteria, virus and fungi found in environment and Control of Microorganisms

Course Outcomes

- To expose students to the pioneers in microbiology and introducing their contributions.
- To detail the prokaryotic cell and related organelles and their functions.
- Students would be able to understand characteristics of viruses, classification and life cycles of viruses
- To introduce the concept of microscopy and to elaborate of few basic microscopy techniques.
- To elaborate on microbial nutrition and methods of determining growth curve.
- To introduce the basic principles of sterilization methods.

UNIT I

(10 Periods)

Fundamentals, History and Evolution of Microbiology.

Classification of microorganisms: Microbial taxonomy, criteria used including molecular approaches, Microbial phylogeny and current classification of bacteria.

Microbial Diversity: Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms eg. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses.

UNIT II

(10 Periods)

Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms, methods of isolation, Purification and preservation.

UNIT III

(20 Periods)

Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria.

Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.

UNIT IV

(20 Periods)

Control of Microorganisms: By physical, chemical and chemotherapeutic Agents

Water Microbiology: Bacterial pollutants of water, coliforms and non coliforms. Sewage composition and its disposal.

Food Microbiology: Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods. Fermented Foods.



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PRACTICALS

1. Isolation of bacteria & their biochemical characterization.
2. Staining methods: simple staining, Gram staining, spore staining, negative staining, hanging drop.
3. Preparation of media & sterilization methods, Methods of Isolation of bacteria from different sources.
4. Determination of bacterial cell size by micrometry.
5. Enumeration of microorganism - total & viable count.

SUGGESTED READING

1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). *Introductory Mycology*. 4 th edition. John and Sons, Inc.
2. Jay JM, Loessner MJ and Golden DA. (2005). *Modern Food Microbiology*. 7th edition, CBS Publishers and Distributors, Delhi, India.
3. Kumar HD. (1990). *Introductory Phycology*. 2nd edition. Affiliated East Western Press.
4. Madigan MT, Martinko JM and Parker J. (2009). *Brock Biology of Microorganisms*. 12th edition. Pearson/Benjamin Cummings.
5. Pelczar MJ, Chan ECS and Krieg NR. (1993). *Microbiology*. 5th edition. McGraw Hill Book Company.
6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). *General Microbiology*. 5th edition. McMillan.
7. Tortora GJ, Funke BR, and Case CL. (2008). *Microbiology: An Introduction*. 9 th edition. Pearson Education.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). *Prescott, Harley and Klein's Microbiology*. 7th edition. McGraw Hill Higher Education



CHEMISTRY I

Course Objectives:

- To Understand the relationship between concentration, volume and moles.
- To acquire knowledge about desalination of brackish water and treatment of municipal water.

Course Outcome:

- To examine and describe the difference between dilute, concentrated and saturated solutions. Investigate solubility in water and the effect of temperature on solubility.
- Develop innovative methods to produce soft water for industrial use and potable water at cheaper cost.

Unit I

(16 Periods)

Need for wave mechanical picture of atomic structure [Photoelectric effect, de Broglie concept of matter waves], Derivation of Schrodinger wave equation as an example Particles moving in one-dimensional potential well

Chemical Bonding- Orbital concepts in bonding, Valence bond and Molecular Orbital theory, M.O.diagrams of homonuclear and heteronuclear diatomic molecules, Weak Interactions-Hydrogen bonding and Vander Waal's interactions

Unit II

(12 Periods)

Introduction to bonding, Types of bonds with examples & factors affecting the bond formation, Biologically relevant coordination Compounds, Chelation & its applications, Oxidation & Reduction reactions, Nucleophilic addition & substitution reactions, Elimination reactions, Factors affecting these reactions

Unit III

(12 Periods)

Solutions and its types, solubility & factors affecting solubility, solvation energy, mole concept, Normality, Molarity, Molality Equivalent & molecular mass, Preparation of Standard Solutions, Expression for concentration of solutions, solvents and its classification, Solvents other than water, Dilution factor, serial dilution, Solute-solvent interactions in solutions

Unit IV

(16 Periods)

Properties of Water, Sources and nature of impurities, water treatment processes-Lime -soda, zeolite, ion-exchange resin, reverse osmosis, Role of Water in Biomolecular Structure and Function, Lowry-Bronsted and Lewis Concepts of acids & bases, Strong and Weak Acids and Bases - Ionic Product of Water - pH, pKa & pKb, Hydrolysis of Salts, Buffers & its Types, Henderson equation for Acidic and Basic buffers, Buffer action, Buffer capacity, pH of Buffer Solution, isoelectric pH

PRACTICALS

1. Preparation of a sample of p-nitroacetanilide
2. Preparation of Tris(Thiourea) Copper (I) Sulphate
3. Estimation of OD in given polluted and sample water
4. Determination of the partition coefficient of acetic acid between n-butanol and water



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SUGGESTED READING

1. Physical chemistry, P. Atkins and J. Ded paul, International student edition, oxford university press
2. Principles of physical chemistry, B.R. Puri, L. R. Sharma & M.S. Pathania, Shoban Lal Nagin Chan & Co., Jalandhar
3. Organic chemistry, R.T. Morrison & R.N. Boyd, Prentice hall of India (P). Ltd. New Delhi
4. A text book of organic chemistry, Arun Bahl & B.S. Bahl, S. Chand publishers New Delhi
5. Concise inorganic chemistry, J.D. Lee, Chapman & Hall, London
6. Inorganic chemistry, J.E. Huyee, E.A. Keiter & R.L. Keiter



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INDUSTRIAL FERMENTATIONS

Course objectives:

- Understand the basic skills applied in fermentation biotechnology and use of biological resources as input to biobased processes which are economically and environmentally sustainable
- To give an insight and advanced learning of application of fermentation technology in research development in various field.

Course outcomes:

- Learn the history of fermentation process, types of fermentation, examples of fermentation industry and production of primary and secondary metabolites.
- Familiarize with microbial analysis of industrial production of food viz. cheese, bread etc., antibiotics, enzymes and biopharmaceuticals so that students can perform these things while they go to any industry further

UNIT I

(12 Periods)

Introduction to fermentation technology: Interaction between Bio-chemical engineering, Microbiology and Biochemistry. History and development of fermentation industry: Introduction to submerged and solid state fermentation, Microbial culture selection for fermentation processes

UNIT II

(15 Periods)

Microbial products of pharmacological interest, steriod fermentations and transformations. Over production of microbial metabolite, Secondary metabolism – its significance and products. Metabolic engineering of secondary metabolism for highest productivity. Enzyme and cell immobilization techniques in industrial processing, enzymes in organic synthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in food technology/organic synthesis.

UNIT III

(13 Periods)

Purification & characterization of proteins, Upstream and downstream processing, solids and liquid handling. Distribution of microbial cells, centrifugation, filtration of fermentation broth, ultra centrifugation, liquid extraction, ion-exchange recovery of biological products. Experimental model for design of fermentation systems, Anaerobic fermentations.

UNIT IV

(20 Periods)

Production of industrial chemicals, biochemicals and chemotherapeutic products. Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, Biofuels: Biogas, Ethanol, butanol, hydrogen, biodiesel, microbial electricity, starch conversion processes; Microbial polysaccharides; Microbial insecticides; microbial flavours and fragrances, newer antibiotics, anti cancer agents, amino acids.



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SUGGESTED READING

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
5. Salisbury, Whitaker and Hall. Principles of fermentation Technology



Semester IV

MOLECULAR BIOLOGY

Course Objectives:

- Introducing and strengthening the basic molecular processes that are common to all living organisms.
- DNA replication and regulation in prokaryotes and eukaryotes
- Transcription in prokaryotes and eukaryotes
- Translation in prokaryotes and eukaryotes
- Post translation and transcriptional mechanism
- Gene expression in prokaryotes using Lap operon and in Eukaryotes by Trp operon.

Course Outcomes

- 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.
- Understanding the mechanisms that regulate the regulation of gene expression in both prokaryotes and eukaryotes.
- Learn about the molecular events that happen during the replication of DNA prior to the cell division.

UNIT I: DNA structure and replication

(15 Periods)

DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA polymerases, replication, Bi-directional replication, The replication complex: Pre-priming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

UNIT II: DNA damage, repair and homologous recombination

(10 Periods)

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanism.

UNIT III: Transcription and RNA processing

(17 Periods)

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.



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UNIT IV: Regulation of gene expression and translation (18 Periods)

Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation., Posttranslational modifications of proteins.

PRACTICALS

1. Preparation of solutions for Molecular Biology experiments.
2. Isolation of chromosomal DNA from bacterial cells.
3. Isolation of Plasmid DNA by alkaline lysis method
4. Agarose gel electrophoresis of genomic DNA & plasmid DNA
5. Preparation of restriction enzyme digests of DNA samples
6. Demonstration of AMES test or reverse mutation for carcinogenicity

SUGGESTED READING

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.



IMMUNOLOGY

Course Objectives:

- The objective of this course is to familiarize students with the Immune system, hypersensitivity and vaccination, Immune Effector Mechanisms, hybridoma technology and various Immunotechniques and immunodiagnosis.
- The course will provide technical knowledge as to how different diseases are caused and various responses mediated by living cells to combat pathogen attack.
- The course will provide sound knowledge of how immune system deals with various pathogens, different processes and cell types involved in prevention of disease.
- Along with this the students will become aware about concept, synthesis and action mechanism of vaccines.

Course Outcomes:

- 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

(20 Periods)

Immune Response - An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses, T-lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination.

UNIT II

(15 Periods)

Regulation of immunoglobulin gene expression – clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity.

UNIT III

(13 Periods)

Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing. Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition. Autoimmune diseases, Immunodeficiency-AIDS, COVID-19

UNIT IV

(12 Periods)

Vaccines & Vaccination – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization. Introduction to immunodiagnostics – RIA, ELISA, RT-PCR & Antigen/Antibody Tests for COVID-19, Immunotherapy



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PRACTICALS

1. Differential leucocytes count
2. Total leucocytes count
3. Total RBC count
4. Haemagglutination assay
5. Haemagglutination inhibition assay
6. Separation of serum from blood
7. Double immunodiffusion test using specific antibody and antigen.
8. ELISA.

SUGGESTED READING

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6 th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.



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CHEMISTRY II

Course Objectives:

- To provide a broad and fundamental knowledge of the polymers and their chemical, physical and mechanical behaviour and knowledge of conducting polymers, bio-degradable polymers.
- To acquire knowledge about the methods of chromatographic separation; applications and uses of the different chromatographic techniques in the isolation of active constituents from medicinal plants.

Course Outcome:

- Substitute metals with conducting polymers and also produce cheaper biodegradable polymers to reduce environmental pollution.
- Demonstrate the fundamentals of different chromatographic techniques and their application.
- Demonstrate the principle of chromatographic techniques used in isolation, purification, identification analysis of natural products from medicinal plants.

Unit I

(16Periods)

Isomerism and its types, Optical & geometrical isomerism, Tautomerism & its applications, Conformations & Configurations of a molecule, Difference between Configuration and Conformation, Chirality, Asymmetric Carbon Atom, Configuration & projection formula

Unit II

(16 Periods)

Equilibrium constant, Le-Chatelier principle, Types of Titration, Acid –base titrations-Strong Acid Vs Strong Base, End Point, Equivalence Point, indicators in titrations, Solubility product & applications, ionic product, Condition for precipitation, Digestion of Precipitate. Co-Precipitation and Post-Precipitation, Washing, Drying and Ignition of Precipitate, Hydrolytic reactions

Unit III

(12 Periods)

Classification of polymers, types of polymerization, application of industrially important polymers (Natural rubber, Buna, Nylon, Terylene, PVC, PVA), Use of organometallic compounds in polymerization and their environmental toxicity, Biopolymers and their types, important biopolymers and their uses.

Unit IV

(16 Periods)

Methods of Separation: Precipitation, Filtration, Distillation and Solvent Extraction.

Chromatography: Definition, Principles, Types, Introduction to Paper Chromatography, Thin Layer Chromatography, Column Chromatography and its Applications.

Colorimetry: Principle, Beer-Lambert's Law, Measurement of Extinction, Derivation of $E = kcl$, Limitations of Beer-Lambert's Law, Filter Selection.

Tracer technique: Applications of radioisotopes in biotechnology, autoradiography.



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PRACTICALS

1. Estimation of commercial caustic soda. Determination of the amount of sodium carbonate and sodium hydroxide present together in the given commercial caustic soda
2. Preparation of Bakelite
3. To separate the mixture of amino acids by paper chromatography and calculate the R_f value

SUGGESTED READING

7. Physical chemistry, P. Atkins and J. DePaul, International student edition, Oxford University Press
8. Principles of physical chemistry, B.R. Puri, L. R. Sharma & M.S. Pathania, Shoban Lal Nagin Chan & Co., Jalandhar
9. Organic chemistry, R.T. Morrison & R.N. Boyd, Prentice hall of India (P). Ltd. New Delhi
10. A text book of organic chemistry, Arun Bahl & B.S. Bahl, S. Chand publishers New Delhi
11. Concise inorganic chemistry, J.D. Lee, Chapman & Hall, London
12. Inorganic chemistry, J.E. Huysen, E.A. Keiter & R.L. Keiter



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BASICS OF FORENSIC SCIENCE

Course Objectives:

The objective of this course is to understand the principles, techniques & applications of forensic science with the use of DNA fingerprinting

Course Outcomes:

Knowledge of various aspects of DNA fingerprinting in solving paternity disputes, personal identification, criminal cases & issues in cyber security.

Unit I

(15 Periods)

Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, causes of crime, role of modus operandi in criminal investigation. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.

Unit II

(15 Periods)

Classification of fire arms and explosives, introduction to internal, external and terminal ballistics. Chemical evidence for explosives. General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink various samples.

Unit III

(15 Periods)

Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification,

Unit IV

(15 Periods)

Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security.

SUGGESTED READING

1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
2. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).
3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).
4. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997).
6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).



Semester V

BIOPROCESS TECHNOLOGY

Course Objectives:

- The objective of this course is to understand the basic skills applied in fermentation technology and use of biological resources as input to biobased processes which are economically and environmentally sustainable.
- Develop the understanding of industrial aspects of bioprocess technology.

Course Outcomes:

- An introduction to fermentation process. Learn the history of fermentation process, types of fermentation, and examples of fermentation industry.
- Design of a fermenter. Understand basic design of a fermenter. Important parts and materials required for aseptic operation and containment practice in a fermenter.
- Types of Culture & fermenter operation. Covers the basic concepts of microbial growth kinetic in different bioreactor operational modes.
- Understand the process development, upstream and downstream processing & relate the skill of mass transfer and its application
- Understand the techniques involved in the extraction and purification of high quality fermentation products.
- Effluent treatment. Understand the importance of proper waste treatment plant for fermentation industry

UNIT I

(10 Periods)

Introduction to bioprocess technology. Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology. Types of microbial culture and its growth kinetics– Batch, Fedbatch and Continuous culture.

UNIT II

(20 Periods)

Design of bioprocess vessels- Significance of Impeller, Baffles, Sparger; Types of culture/production vessels- Airlift; Cyclone Column; Packed Tower and their application in production processes. Principles of upstream processing – Media preparation, Inocula development and sterilization

UNIT III

(15 Periods)

Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control.

UNIT IV

(15 Periods)

Introduction to downstream processing, product recovery and purification. Effluent treatment. Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins.



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SUGGESTED READING

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.



RECOMBINANT DNA TECHNOLOGY

Course Objectives:

The course has been designed to make students aware of

- DNA manipulative enzymes and Gene cloning vectors
- Screening and selection of recombinants
- Techniques used as Polymerase chain reaction (PCR), Site directed mutagenesis (SDM), Nucleic acid sequencing
- Application of r-DNA techniques

Course Outcomes:

- Get proper knowledge about the DNA manipulative enzymes: Restriction enzymes and DNA ligases, and Gene cloning vectors.
- Gain knowledge about In vitro construction of recombinant DNA molecules, passenger and vector DNA, and Transformation
- Learn about the basics of Electrophoretic techniques, Polymerase chain reaction (PCR), Site directed mutagenesis (SDM), Nucleic acid sequencing: Blotting techniques.
- Knowledge of Application of r-DNA technique in human health, Production of Insulin, Production of recombinant vaccines: Hepatitis B, Production of human growth hormone.

UNIT I

(15 Periods)

Molecular tools and applications- restriction enzymes, ligases, polymerases, alkaline phosphatase. Gene Recombination and Gene transfer: Transformation, Episomes, Plasmids and other cloning vectors (Bacteriophage-derived vectors, artificial chromosomes), Microinjection, Electroporation, Ultrasonication, Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT- (Reverse transcription) PCR.

UNIT II

(20 Periods)

Restriction and modification system, restriction mapping. Southern and Northern hybridization. Preparation and comparison of Genomic and cDNA library, screening of recombinants, reverse transcription,. Genome mapping, DNA fingerprinting, Applications of Genetic Engineering Genetic engineering in animals: Production and applications of transgenic mice, role of ES cells in gene targeting in mice, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines (one example each).

UNIT III

(10 Periods)

Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis, Gene shuffling, production of chimeric proteins, Protein engineering concepts and examples (any two).

UNIT IV

(15 Periods)

Genetic engineering in plants: Use of *Agrobacterium tumefaciens* and *A. rhizogenes*, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors.



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SUGGESTED READING

1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ. (2009). Biotechnology-Appling the Genetic Revolution. Elsevier Academic Press, USA.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington
4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.



MEDICAL MICROBIOLOGY

Course Objectives:

Introducing the normal microbial world of human body with that of disease causing microbes like gram positive & gram negative bacteria & viruses.

Course Outcomes:

Course will provide knowledge of different diseases caused by bacteria, virus and fungi

UNIT I

(18 Periods)

Introduction: Normal microflora of human body, nosocomial infections, carriers, septic shock, septicemia, pathogenicity, virulence factors, toxins, biosafety levels.
Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy of gram positive bacteria: *S.aureus*, *S.pyogenes*, *B.anthraxis*, *C.perferinges*, *C.tetani*, *C.botulinum*, *C.diphtheriae* *M.tuberculosis*, *M. leprae*.

UNIT II

(15 Periods)

Morphology, pathogenesis, symptoms, laboratory diagnosis, preventive measures and chemotherapy caused by gram negative bacteria: *E.coli*, *N. gonorrhoea*, *N. meningitidis*, *P. aeruginosa*, *S. typhi*, *S. dysenteriae*, *Y. pestis*, *B. abortus*, *H. influenzae*, *V. cholerae*, *M. pneumoniae*, *T. pallidum* *M. pneumoniae*, *Rickettsiaceae*, *Chlamydiae*.

UNIT III

(12 Periods)

Diseases caused by viruses- Picornavirus, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses, Reoviruses, Pox virus, Herpes virus, Papova virus, Retro viruses (including HIV/AIDS), Hepatitis viruses, Dengue virus & COVID-19.

UNIT IV

(15 Periods)

Fungal and Protozoan infections. Dermatophytoses (*Trichophyton*, *Microsporun* and *Epidermophyton*) Subcutaneous infection (*Sporothrix*, *Cryptococcus*), systemic infection (*Histoplasma*, *Coccidoides*) and opportunistic fungal infections (*Candidiasis*, *Aspergillosis*), Gastrointestinal infections (Amoebiasis, Giardiasis), Blood-borne infections (Leishmaniasis, Malaria)

SUGGESTED READINGS

1. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.
2. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier. .
3. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.



FOOD BIOTECHNOLOGY

Course objectives:

- To impart an insight into the classification, ingredients and additives of food.
- Providing latest information of food processing and preservation techniques.
- The students will acquire knowledge about the production of fermented food and beverages.

Course outcomes:

- Students will be able to recognize sources of microorganisms and food borne illness.
- Know causes of food spoilage, Spoilage of fruit, Vegetables, Dairy product
- Basic knowledge of food Preservation –Chemical Method, Physical method and apply them in food industries further.
- Gain knowledge about industrial awareness on quality control and good practices in manufacturing processes in industry.

Unit I

(20 Periods)

Probiotic Foods and its Preservation:

Role and significance of microorganisms in foods, Probiotics and health benefits of fermented milk and foods products. Single-Cell Protein. Food preservation by various methods including Irradiation, Effect of Irradiation on Food quality and storage ability. Miscellaneous Food Preservation Methods: High-Pressure Processing, Pulsed Electric Fields, Aseptic Packaging, Manothermosonication (Thermo-ultra-sonication).

Unit II

(15 Periods)

Indicators of Food Safety and Quality:

Indicators of Food microbial quality, product quality and food safety. Fecal Indicator Organisms, Predictive Microbiology/Microbial Modeling. The Hazard Analysis Critical Control Point System (HACCP System), Microbiological Criteria. Food borne intoxicants and mycotoxins.

Unit III

(20 Periods)

Nutraceuticals and Health Foods

Classification of Nutraceuticals, Health foods: Source, Chemical constituents, uses, actions and commercial preparations of, following health foods, Alfalfa, Bran, Angelica, Chamomile, Corn oil, Fenugreek, Feverfew, Garlic, Ginseng, Ginkgo, Honey, Hops, Safflower oil, Soyabean Oil, Turmeric. Concept and examples of Adaptogens

Unit IV

(15 Periods)

Quality Control of Herbs

Quality control of herbal drugs as per WHO, AYUSH and Pharmacopoeial guidelines-Extractive values, ash values. Determination of heavy metals, insecticides, pesticides and microbial load in herbal preparations.



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SUGGESTED READING

1. Indian Herbal Pharmacopoeia, K. M. Varghese Co.Bombay.
2. S.S.Agrawal, Herbal drug technology, Universities press
3. Frazier, W.S. and Weshoff, D.C., 1988. Food Microbiology, 4th Edn., McGraw Hill Book Co., New York.
4. Mann &Trusswell , 2007. Essentials of human nutrition. 3rd edition .oxford university press.
5. Jay, J.M., 1987. Modern Food Microbiology, CBS Publications, New Delhi.
6. Lindsay, 1988. Applied Science Biotechnology. Challenges for the flavour and Food Industry. Willis Elsevier.
7. Roger, A., Gordon, B. and John, T., 1989. Food Biotechnology



Semester VI

BIO-ANALYTICAL TOOLS

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.
- Develop the understanding of modern techniques: Basics of nanotechnology and overview of nanoscale materials and Biosensors

Course Outcomes:

- To introduce the concept of microscopy and to elaborate of few basic microscopy techniques
- Understand the concept of electromagnetic radiation, absorption spectrum, Beer's law and Lambert's law
- Familiarize the working principles of electrophoresis and UV/Vis and fluorescence spectroscopic techniques and application of the knowledge to get basic structural information of DNA & proteins
- Learn to apply important chromatographic techniques to purify biomolecules
- Understanding of Centrifugation and Electrophoresis-Principles and applications
- Knowledge and understanding of Nanomaterials & Biosensors

UNIT I

(10 Periods)

Simple microscopy, phase contrast microscopy, fluorescence and electron microscopy (TEM and SEM), pH meter, absorption and emission spectroscopy

UNIT II

(15 Periods)

Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared), centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles.

UNIT III

(15 Periods)

Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, partition, affinity and ion exchange chromatography, gas chromatography, HPLC.

UNIT IV

(20 Periods)

Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno-electrophoresis, isoelectric focusing, Western blotting. Introduction to Biosensors and Nanotechnology and their applications.



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SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.



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GENOMICS & PROTEOMICS

Course Objectives:

The course has been designed to make students aware of

- Genome sequencing
- genome databases, Genome analysis
- Proteomics and Metabolomics

Course Outcomes:

- Get knowledge of Genome sequencing and Sequencing technology.
- Gain knowledge about Major genome databases, Genome analysis and Comparative genomics Functional genomics
- Learn about basic proteomics technology
- Have knowledge of Applications of genomics and proteomics

UNIT I

(15 Periods)

Introduction to Genomics, DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods, Computer tools for sequencing projects: Genome sequence assembly software.

UNIT II

(10 Periods)

Managing and Distributing Genome Data: Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases.

UNIT III

(20 Periods)

Introduction to protein structure, Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions. Determination of sizes (Sedimentation analysis, gel filtration, SDS-PAGE); Native PAGE, Determination of covalent structures – Edman degradation.

UNIT IV

(15 Periods)

Introduction to Proteomics, Analysis of proteomes. 2D-PAGE. Sample preparation, solubilization, reduction, resolution.

Reproducibility of 2D-PAGE. Mass spectrometry based methods for protein identification. *De novo* sequencing using mass spectrometric data.



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SUGGESTED READING

1. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006.
2. Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing, 1987.
3. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, B.R. Glick, J.J. Pasternak and C.L. Patten, 2010.
5. Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989.
6. Principles of Gene Manipulation 6th Edition, S.B.Primrose, R.M.Twyman and R.W. Old. Blackwell Science, 2001.
7. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
4. Russell, P. J. (2009). *iGenetics- A Molecular Approach*. III Edition. Benjamin Cummings.
5. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
6. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John Wiley & Sons.



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AGRICULTURE BIOTECHNOLOGY

Course Objectives:

- To give the details of plant cells and its functions
- To provide the basics of agrobacterium and applications of plant biotechnology
- The concept of Genetically modified organisms.
- Direct and indirect gene transfer methods in plants
- Transgenic plants: herbicide, pest and disease resistant, abiotic stress resistant, nutritional enhancement and traits for improved quality- Detection of GMOs – regulations and biosafety.

Course Outcomes:

- Students learn about the setup of plant tissue culture lab their maintenance and preparation of tissue culture media (Both and solid and liquid media).
- In this student learn practically about surface sterilization techniques.
- Students practically handles the Induction of Root and Shoot and maintenance of callus.
- Students acquire knowledge in strain improvement which will be a demo experiment.
- Students handle practically in production of haploids.

UNIT I

(15 Periods)

Agriculture and Agricultural Biotechnology, Clonal Germplasm: Micro propagation, In vitro production of pathogen and contaminant free plants

UNIT II

(13 Periods)

Biotechnology- Methods of Crop Improvement: Genetic Engineering of Crop Plants, Transgenic Plants, Molecular Markers, QTL Mapping

UNIT III

(20 Periods)

Microbes in Agriculture and Food: Applied Microbiology in the future of mankind, moving frontiers of applied microbiology, microbial enzymes and their applications in food processing and agro-chemical industries, agro-waste utilization, biodegradable polymers and their applications, microbial polysaccharides; Production and utilization of essential amino-acids, chemicals from micro-algae.

UNIT IV

(22 Periods)

Metabolite Production: Production of Secondary Metabolites, Production of foreign compounds in transgenic plant, Achievements and recent developments of genetic engineering in agriculture
Biofertilizers and Bioremediation: Microbial Biopesticides, Biofungicides, Herbicides, and
Agricultural antibiotic Biotechnology in Agriculture: Ethical Aspects and Public Acceptance, Animal farming

Reference Books:

1. Biotechnology by B.D.Singh, Kalyani Publication
2. Biotechnology – Fundamentals and applications by S.S.Purohit, Student Edition
3. Agricultural Biotechnology-Arie Altman, CRC Press
4. Biotechnology- An Introduction by Susan R. Barnum, Vikas Publishing House



ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)
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U.P. STATE GOVERNMENT UNIVERSITY,
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

BIOSTATISTICS

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.

UNIT I

(12 Periods)

Types of Data, Collection of data; Primary & Secondary data, Classification and Graphical representation of Statistical data. Measures of central tendency and Dispersion. Measures of Skewness and Kurtosis.

UNIT II

(18 Periods)

Probability classical & axiomatic definition of probability, Theorems on total and compound probability), Elementary ideas of Binomial, Poisson and Normal distributions.

UNIT III

(18 Periods)

Methods of sampling, confidence level, critical region, testing of hypothesis and standard error, large sample test and small sample test. Problems on test of significance, t-test, chi-square test for goodness of fit and analysis of variance (ANOVA)

UNIT IV

(12 Periods)

Correlation and Regression. Emphasis on examples from Biological Sciences.

SUGGESTED READING

1. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA
2. Glaser AN (2001) High YieldTM Biostatistics. Lippincott Williams and Wilkins, USA
3. Edmondson A and Druce D (1996) Advanced Biology Statistics, Oxford University Press.
4. Danial W (2004) Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc.