Shri Vile Parle Kelavani Mandal's

MITHIBAI COLLEGE OF ARTS, CHAUHAN INSTITUTE OF SCIENCE &

AMRUTBEN JIVANLAL COLLEGE OF COMMERCE AND ECONOMICS (AUTONOMOUS)

NAAC Reaccredited 'A' grade, CGPA: 3.57,

Granted under RUSA, FIST-DST & -Star College Scheme of DBT, Government of India,

Best College, University of Mumbai (2016-17)

Affiliated to the

UNIVERSITY OF MUMBAI

Program: T.Y. B.Sc.

Course: BIOTECHNOLOGY

Semester : V & VI

Credit Based Choice System (CBCS) with effect from the Academic year 2020-21

PROGRAMME SPECIFIC OUTCOMES (PSO'S)

On completion of the B.Sc- Biotechnology, the learners should be enriched with knowledge and be able to-

PO1: understand immunological methods and their application in different fields

PO2: conceptualize the regulation of major metabolic pathways and control

PO 3:understand advances in cell biology with special reference to progenitor cells, their importance in control of diseases, therapies and future applications

PO 4: Gains an in-depth knowledge of manufacturing principles and practices associated with dairy food products

PO 5: Learn the applications of molecular biology and recombinant DNA technology in various fields

PO 6: Understand the need to implement integrated applications of biotechnology for sustainable development as ecofriendly alternatives

PO 7: Understand the relevance of plant tissue culture techniques in production of secondary metabolites

PO 8: Understands the importance of the DNA forensics, molecular diagnostics, cloning techniques in the fields of breed development, disease resistant live stock and wildlife conservation.

Preamble

Biotechnology is, in essence, the deciphering and use of biological knowledge. It is highly multidisciplinary since it has its foundations in many disciplines, including biology, microbiology, biochemistry, molecular biology, genetics, chemistry and chemical and process engineering. It may also be viewed as a series of enabling technologies

Biotechnology has been revolutionized by a range of new molecular innovations. Areas of human health, environment and food now heralding a new age of biotechnology. The field of biotechnology, combined with educational resources, industrial infrastructure and the pervasive influence of biological substances in everyday life, has set the stage for unprecedented growth in products, markets, and expectations.

Considering these breakthroughs in biotechnology the syllabus is essentially formulated to provide well-balanced and comprehensive overview of this growing field. The curriculum aims to provide a platform for students to enable them to recognize the need for applying biotechnology for the potential and benefit of mankind particularly in developing countries and emphasizing on the scientific and technological knowledge required to establish research and development of high excellence in this field.

Evaluation Pattern

The performance of the learner will be evaluated in two components. The first component will be a Continuous Assessment with a weightage of 25% of total marks per course. The second component will be a Semester end Examination with a weightage of 75% of the total marks per course. The allocation of marks for the Continuous Assessment and Semester end Examinations is as shown below:

a. **Details of Continuous Assessment (CA)**

25% of the total marks per course:

Continuous Assessment	Details	Marks
Component 1 (CA-1)	TEST/ASSIGNMENT/ QUIZ	15 marks
Component 2 (CA-2)	TEST/ASSIGNMENT/ QUIZ	10 marks

b. **Details of Semester End Examination**

75% of the total marks per course. Duration of examination will be two and half hours.

Question Number	Description	Marks	Total Marks
Q1.	Module I	15	15
Q2	Module II	15	15
Q3	Module III	15	15
Q4	Module IV	15	15
	Module I+II+ III+IV	15	15
		Total Marks	**75**

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HOD Approved by Vice –Principal Approved by Principal

Program: Bachelor of Science (Biotechnology)				**Semester : 5**	
Course: Immunology				**Course Code: USMABT501**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks)**	**Term End Examinations (TEE) (Marks)**
4	**4**	**-**	**4+2**	**25**	**75**

Learning Objectives:

- To introduce students to the basic concepts in immunology involving types of membrane receptors, antigen recognition, antigen processing mechanisms and mediators involved in immune response
- To provide students with the knowledge of different immunological methods and its application in medical diagnostics

Course Outcomes:

At the end of the course the student will be gain knowledge of:

CO1:The concepts of the components and mechanisms of immune responses and its role.
CO2:The basic principles of immunological methods and understand their application in different fields

Outline of Syllabus: (per session plan)

Module	**Description**	**Duration**
1	Membrane receptors for antigen	15 hours
2	Overview of immune responses	15 hours
3	Mediators of the immune responses	15 hours
4	Immunological methods and applications	15 hours
	Total	60 hours
PRACTICALS		60

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UNIT	**DESCRIPTION**	**NO OF HOURS**
Module 1	**Membrane receptors for antigen** **T-Cell Receptor** Structure and Role of TCR TCR-CD3 Complex T-Cell Accessory Membrane Molecules **B-Cell Receptor** Structure and role of BCR B-Cell – Co-receptor Complex **Major Histocompatibility Complex**	15

	Organization and Inheritance of the MHC Classes of MHC	
Module 2	**Overview of immune responses** Antigen recognition Effector functions **Antigen Processing and Presentation** Self-MHC Restriction of T Cells Role of Antigen-Presenting Cells Processing and Presentation Pathways: The Cytosolic Pathway The Endocytic Pathway Presentation of Non -peptide Antigens	15
Module 3	**Mediators of the immune responses** **Complement system** The functions of complement Pathways of complement activation Biological consequences of complement activation **Cytokines** Properties of Cytokines Cytokine Secretion	15
Module 4	**Immunological methods and applications** Precipitation Reactions Agglutination Reactions Radioimmunoassay Enzyme-Linked Immunosorbent Assay Western Blotting Immunoprecipitation Immunofluorescence Flow Cytometry	15

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

PRACTICAL I

1. Determination of antigen identity by Ouchterlony's method.
2. Detection of Typhoid using Widal test.
3. Determination of human blood group by ABO and Rh antigen
4. Enzyme-Linked Immunosorbent Assay
5. Western Blott technique
6. Complement fixation test
7. Coomb's test
8. Cytokine-based therapies in clinical use

Suggested Readings

- Kuby Immunology, Kindt, J. T., Osborne, A. B. and Goldsby, A. R., 6th edition, 2007, W.H. Freeman and company

- Delves, Peter J.; Martin, Seamus J.; Burton, Dennis R.; Roitt, Ivan M. (2011). Roitt's Essential Immunology. Hoboken, NJ: Wiley-Blackwell.

Program: Bachelor of Science (Biotechnology)				**Semester : 5**	
Course: Biochemistry				**Course Code: USMABT502**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks)**	**Term End Examinations (TEE) (Marks)**
4	**4**	**-**	**4+2**	**25**	**75**

Learning Objectives:

The course is an extension of the second year coursework which dealt with catabolism of carbohydrates and lipids. The coursework this year extends to make the student understand the biosynthesis of carbohydrates and lipids in plant animals and bacteria. The course also introduces the learners to the organization, significance, functions, mechanism and the disorders of endocrine system. It also helps the learners to understand the regulation of metabolic pathways by the endocrine messengers.

Course Outcomes:

After completion of the course, the student will have a detailed understanding of:

CO1 :Overview of the biochemical events in carbohydrate and lipid biosynthesis and its regulation

CO2: The functions of group I and group II hormones, their mechanisms of action and the disorders associated with abnormal endocrine functions of the various glands

CO3; Relationship between regulation of major metabolic pathways and endocrine control

Outline of Syllabus: (per session plan)

Module	**Description**	**No of Hours**
1	**Carbohydrate metabolism**	**15**
2	**Lipid Metabolism**	**15**
3	**Endocrinology-I**	**15**
4	**Endocrinology-II:**	**15**
	Total	**60**
PRACTICALS		60

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UNIT	**DESCRIPTION**	**NO OF HOURS**
Module 1	Carbohydrate metabolism Biosynthesis of Starch and Sucrose and Regulation Biosynthesis of Glycogen and Regulation	15

	Synthesis of Cell Wall Polysaccharides: Bacterial Peptidoglycan Conversion of Galactose to Glucose, Galactosemia	
Module 2	Lipid Metabolism Biosynthesis of Fatty Acids (even and unsaturated) and its regulation Biosynthesis of Triacylglycerol Biosynthesis of Membrane Phospholipids: Glycerophospholipids (Bacteria and eukaryotes) and sphingolipids Cholesterol Biosynthesis, Regulation and Transport	15
Module 3	Endocrinology-I: Endocrine Hormones: Introduction Classification of hormones based on chemical nature and mode of action Group I hormones: Mechanism of action Storage, release, transport, functions and disorders of - Thyroid hormones –TSH, T3 and T4 Adrenal cortex hormones – Glucocorticoids and mineralocorticoids Hormones of Gonads – Androgen, estrogen, progesterone.	15
Module 4	Endocrinology-II: Storage, Release, transport, functions and disorders of – Hypothalamic hormones, Anterior Pituitary hormones – GH & stimulating hormones (hCG, LH, FSH, TSH) Posterior pituitary hormones – ADH and oxytocin Pancreatic hormones – Insulin and Glucagon Adrenal medulla hormones – epinephrine and norepinephrine	15

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

PRACTICAL I

1. Estimation of glucose by GOD-POD method
2. Study of starch granules
3. Estimation of starch by Willstater's method
4. Estimation of cholesterol
5. Separation of fatty acids by TLC
6. Separation of sugars by paper chromatography
7. Study of working of a Glucometer
8. Estimation of glucose in urine by Benedict quantitative method

Suggested Readings

1. Lehninger, Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and company, NY

2. Biochemistry, U Satyanarayana 2nd edition Books and Allied pvt Ltd
3. Fundamentals of Biochemistry. 3rd Edition, Donald Voet & Judith Voet, John Wiley and Sons, I. USA
4. Harper's Illustrated Biochemistry, Twenty-Eighth Edition, Robert K. Murray, et.al. The McGraw-Hill Companies, Inc
5. Guyton, Text book of Medical Physiology, Saunders Publishers, 12th edition, 2010.
6. Textbook of Biochemistry with Clinical Correlations, 7th Edition, Thomas M. Devlin, January 2010,
7. Textbook of Medical Physiology Guyton, A.C and Hall 11th edition J.E Saunders

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Program: B.A./ B.Sc . / B.Com(2021-22)				**Semester:**	
Course: Cell Biology				**Course Code:** USAMBT508	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
4	3		4+1.5	25	75

Learning Objectives:

- To make the student understand cell structure and function and movements and build an idea how eukaryotic cells movement works at the molecular level and the outcomes in embryo development
- To provide an overview of regulation of cellular processes, signaling and proliferation in eukaryotic cells.
- To introduce some of the major ideas and experimental approaches in cell and molecular biology with reference to cancer, cancer cell behavior as well as the stem cells and their future applications in biotechnology and regenerative medicine

Course Outcomes:

After completion of the course, learners would be able to:

CO 1 : how cell movement and cell-cell communication occur and the cell adhesion between cell takes place and homeostasis

CO 2 :the structure of membranes and intracellular compartments and relate these to function. Cellular matrix, importance and mechanisms of signal transduction

CO 3 :omics of cells and the processes that control eukaryotic cell cycle and onset of cancer as the failure of cell death or apoptosis

CO 4: Student will understand advances in cell biology special reference to progenitor cells, their importance in control of diseases, therapies and future applications

Outline of Syllabus: (per session plan)

Module	**Description**	**No of Hours**
1	Cell dynamics	15
2	Cell membranes and dynamic properties	15
3	Cells – abnormalities (cancer) technologies	15
4	Pregenitor cells and future prospects	15
	Total	60
PRACTICALS		30

Unit	Topic	No. of Hours/Credits
Module 1	**Cell Dynamics** **Cell movement: Mechanisms and regulation of cell migration:** Role actin polymerization, small GTPases Rho, Rac and Cdc42.Directing cell motility, Group migration, sheet migration: movement during embryogenesis and wound healing. **Cell adhesion**: Intercellular junctions, composition and Roles **Cell polarity:** polarity in epithelia, Spindle position, symmetric and asymmetric division. Role of cytoskeletal elements. **Tissue homeostasis:** Turnover and maintenance of cells, Apoptosis. Cellular asymmetry and homeostasis	**15**
Module 2	**Cell membranes and dynamic properties** **Biological Membrane Structure and Function** Sanger and Nicholson model, lipids and proteins and their role determine membrane identity **Membrane Trafficking-** overview of the endomembrane system and membrane trafficking, membrane carriers, processes - secretory and endocytic pathways , **Membrane Transporters and Ion Channels-** Membrane transport and transport proteins -Ion channel gating and channel permeability and selectivity - defects in processes leads to disease **Cell recognition and Extracellular Matrix:** Composition, molecules that mediate cell adhesion, **Signaling From Membranes -**general principles of signaling-signal termination; receptors (G-protein-coupled receptors) - membranes in organization of signaling pathways**.**	**15**
Module 3	**Cells – abnormalities (cancer) technologies** Analysis and integration of individual Tumor formation and progression: Causes of cancer. Multi-step progression and the multiple-hit hypothesis. - cellular changes and the stages in cancer progression- DNA repair, drug metabolism Translocations and cancer-Predisposition to cancer. e.g. in retinoblastomas and breast cancers-Tissue invasion and metastasis and Angiogenesis **Molecular basis of tumours** Tumour suppressor proteins p53 and RB - Epigenetic, chromatin and	**15**

	gene regulation changes in cancer - Relationship between oncogenes and signal transduction pathways Pathway crosstalk and relationship to tumourogenesis, Apoptosis and its relationship to cancer• Cancer diagnosis, cures and possible therapies.	
Module 4	**Pregenitor cells and future prospects** Introduction, definitions of stem cells Potency and overview of different stem cell types (embryonic, fetal, adult/tissue and cancer); stem cell properties and examples Induced Pluripotent Stem (IPS) Cells, Embryoid body formation; Mesenchymal Stem Cells: Haematopoietic stem cells, Tissue-specific stem cells: original generation; their properties; potential for use for disease modelling /toxicology/drug testing and cell therapy	**15**

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

PRACTICAL I
(If applicable)

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

Suggested Readings

1. The Molecular Biology of Cell (5th edition)- by Bruce Alberts
2. Molecular Biology (7th edition)- by Lodish
3. Lehninger, Principles of Biochemistry by – David L Nelson and Michael Cox. Watson, J. D. (2008).
4. Krebs, J. E., Lewin, B., Kilpatrick, S. T., & Goldstein, E. S. (2014). Lewin's Genes XI.Burlington, MA: Jones & Bartlett Learning.

Program: B.Sc Biotechnology (2021-22)				Semester: 5	
Course: Industrial Biotechnology				Course Code: USMABT504	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
4	3		2.5+1.5	25	75

Learning Objectives:

This course aims to enable students to enter industry with an appropriate level of understanding of the dairy, brewery and food sector products, processes and the need for downstream processing for product manufacturing.

Course Outcomes:

After completion of the course, learners would be able to:

CO1.Gain an in-depth understanding of the manufacturing principles and practices associated with dairy food products

CO2. Possess a comprehensive knowledge of the science and technology involved in various fermentation processes

CO3. Develop an understanding of the process control, upstream and downstream processing stages in an industry

CO4. Demonstrate a level of comprehension of Food technology concepts and apply critical thinking and problem-solving skills to address challenges in the food industry.

Outline of Syllabus: (per session plan)

Module	Description	No of Hours
1	Dairy technology	**15**
2	Fermentation technology	**15**
3	Downstream processing	**15**
4	Food technology	**15**
	Total	**60**
PRACTICALS		

Unit	Topic	No. of Hours/Credits
Module 1	**Dairy technology** **Milk**: Principle components, structural elements. **Processing of Milk:** Pasteurization **Methods for determining quality of milk:** Methylene blue and Resazurin reductase test, Phosphatase test **Fermented milk products:**	**15**

	Cheese: Starter culture Types of cheese Production process **Butter:** Starter culture Types of butter Production process **Yogurt:** Types and Production process	
Module 2	**Fermentation technology** **Wine** Raw materials Processing in wine making Fermentation Ageing, storage, clarification, packaging **Beer Brewing** Types of Barley beers Raw Materials for brewing Brewing Process Fermentation Laagering and packaging **Acetic Acid Fermentation** Alcoholic fermentation Acetic acid fermentation Recovery and purification **Fermented vegetables** Basic vegetable fermentation techniques Production of some important Fermented vegetables	**15**
Module 3	**Downstream processing** **Recovery and purification methods of fermentation products** **Removal of microbial cells and solid Matters**-Floatation, Precipitation, Filtration, Centrifugation **Isolation of product**- Cell disruption methods **Product Purification**- Chromatography **Product polishing** – Crystallization, drying	**15**
Module 4	**Food technology** **Principles of food preservation** Control of microorganisms in food Physical methods of food preservation Chemical methods **Food Adulteration and food safety** Types of adulterants Detection methods of food adulterants in common food items - spices, tea-coffee, grains Aspects of food safety- HACCP, AGMARK	**15**
TOTAL		60

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

PRACTICAL I
(If applicable)

1. Microbiological analysis of milk
2. Determination of efficiency of Pasteurization
3. Determination of titrable acidity
4. Detection of food adulterants
5. Isolation of spoilage causing organism from food.
6. Estimation of alcohol content in the sample.
7. Determination of TDT, TDP of spoilage causing organism.
8. Determination of MIC of a preservative.

Suggested Readings

Text Books:

1. Adam M, Dick M. Food microbiology-An introduction
2. Prescott and Dunn's ''Industrial Microbiology' (1982) 4th edition, McMillan Publishers
3. Okafor Nduka (2007) ''Modern Industrial Microbiology and Biotechnology'', Science Publications Enfield, NH, USA.
4. Stanbury P. F., Whitaker A. & Hall S. J., (1997), "Principles of Fermentation Technology", 2nd edition, Aditya Books Pvt. Ltd, New Delhi.
5. Food processing and preservation – Subbulakshmi, G. Shobha, A. Udipi, New Age International (P) Ltd., 2006.

Reference Books:

1. Food Microbiology, An introduction, Thomas J. Montville, Karl R. Matthews, Kalmia E. Kniel, Washington, DC
2. Sambamurthy K and Aushotosh Kar, 2006. Pharmaceutical biotechnology

Program: B.Sc. Biotechnology (2020-21)	**Semester: V**
Course: MOLECULAR BIOTECHNOLOGY	**Course Code: USMABT 505**
Teaching Scheme	**Evaluation Scheme**

Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA) (Marks - 25)	Semester End Examinations (SEE) (Marks- 75 in Question Paper)
04	04		02 +02	25 Marks	75 Marks

Learning Objectives:

i. Give an idea of various approaches in conducting genetic engineering that can be applied in career in biological research as well as in biotechnology industries.

ii. Introduce the students to various methods used in genetic engineering and gene cloning through tools of molecular biology

iii. To Impart knowledge of various applications of recombinant DNA technology in the fields like forensic sciences and diagnostics

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Get the knowledge of mobile genetic elements in prokaryotes and eukaryotes

CO2: Learn the principles of recombinant DNA technology and its applications for understanding and application in future research.

CO3: Learn the applications of molecular biology and recombinant DNA technology in various fields so that the students should be able to take up careers in the field of Biotechnology

Outline of Syllabus: (per session plan)

Module	Description	No of Hours
1	**Transposable Elements, Genomic Libraries**	**15**
2	**Tools in molecular biology**	**15**
3	**Applications of r- DNA technology**	**15**
4	**Molecular Diagnostics**	**15**
Total		**60**
PRACTICALS		

Unit	Topic	No. of Hours
Module 1	**Transposable Elements, Genomic Libraries** **Transposons in prokaryotes and eukaryotes**- IS elements, compo site and non-composite transposons, Mu, Eukaryotic transposones. Induction of mutations due to Transposones Genetic mapping in bacteria and Bacteriophages	**15**

	Genomic Libraries- Construction and screening of genomic DNA li braries, cDNA libraries, complementation of mutations	
Module 2	**Tools in molecular biology** Detection of nucleic acids – Methods of labelling of probes- radioactive, non radioactive labelling, applications Isolation and amplification of specific nucleic acid sequences – PCR and types, primer designing, contamination, mis – priming, PCR product cleanup, applications Methods of DNA sequencing, Isolation of human genes by chromosome jumping and chromosome walking.	**15**
Module 3	**Applications of r- DNA technology** Method and applications of DNA fingerprinting, Molecular markers – mini and microsatellites, RNAi, ZNF, marker assisted selection Analysis of DNA polymorphism and Identification: RFLP, RAPD, AFLP techniques and applications.Methods of DNA sequencing, Isolation of human genes by chromosome jumping and chromosome walking. Human genome mapping and applications DNA barcoding, genome editing and applications	**15**
Module 4	**Molecular Diagnostics** Introduction to Molecular Diagnostics: History, Areas and future prospects. Characteristics and analysis of nucleic acids and proteins - Methods of extraction of nucleic acids and proteins, Blotting and Hybridization techniques in recombinant DNA technology – FISH, GISH, DNA microarray, Y chromosome analysis, Mitochondrial genome Molecular Diagnostics for diseases, forensic studies, Gene therapy - types, applications. Genetic Counseling, Genetic testing – diagnostic and carrier testing, case studies, Ethical, Social and legal issues to molecular genetic testing	**15**

PRACTICAL I
(If applicable)

i. Study of mobile genetic elements
ii. Extraction of genomic DNA from bacteria
iii. Isolation of plasmid bearing culture and extraction of plasmid DNA and demonstration of its presence
iv. Transformation of bacteria using plasmid DNA
v. Screening of transformants using Replica plate technique
vi. Construction of restriction map and problems
vii. Sequencing of DNA by Sanger's method
viii. Study of RFLP and RAPD techniques
ix. Study of Southern blotting technique

Suggested Readings

1. i-Genetics by Peter Russell 5th Edition
2. Biotechnology-Fundamentals and Applications by S.S.Purohit, 3rd edition
3. Molecular Biotechnology – Glick, B.R, Pasternak, J.J Patten, 4th Edition ASM press
4. Advanced Biotechnology – R.C. Dubey, S. Chand Publications
5. Genetic Engineering (2002) – Sandhya Mitra, McGraw Hill Publication
6. Biotechnology (2002) – S. S. Purohit, Agrobios Publishers
7. Genetic Engineering (2009) – Smita Rastogi and Neelam Pathak, Oxford Higher Education

Program: Bachelor of Science (Biotechnology)	**Semester : 6**
Course : Medical Biotechnology	**Course Code: USMABT601**
Teaching Scheme	**Evaluation Scheme**

Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE) (Marks)	Term End Examinations (TEE) (Marks)
4	**4**	**-**	**4+2**	**25**	**75**

Learning Objectives:

- To provide the conceptual basis for understanding microorganisms and viruses and mechanisms of their pathogenicity.
- To develop diagnostic skills, including the practical application and interpretation for the diagnosis of infectious diseases

Course Outcomes:

At the end of the course the student will be gain knowledge of:

CO1: The underlying science of human health and disease including opportunities for promoting and protecting health

CO2 :Assess treatment strategies including the appropriate use of antimicrobial agents and common mechanisms of antimicrobial action and resistance.

CO3 :Explain interventions employed to prevent diseases including infection control measure and vaccines

Outline of Syllabus: (per session plan)

Module	Description	Duration
1	Bacteriology	15 hours
2	Virology	15 hours
3	Principles of antimicrobial therapy	15 hours
4	Medical diagnostics and therapeutics	15 hours
	Total	60 hours
PRACTICALS		60

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UNIT	DESCRIPTION	NO OF HOURS
Module 1	**Bacteriology** Infections of the respiratory tract Infections of the gastrointestinal tract Infections of the urogenital tract	15
Module 2	**Virology** Virus: introduction, structure and growth Viral replication Viral diversity Overview of bacterial viruses Overview of plant viruses Overview of animal viruses Subviral entities	15
Module 3	**Principles of antimicrobial therapy** Antibacterial agents Antifungal agents Antiparasitic agents Antiviral agents	15

	Interactions between microbes and drugs Interactions between drugs and hosts	
Module 4	**Medical diagnostics and therapeutics** **Diagnostic methods** Phenotypic methods Genotypic methods Immunologic methods **Therapeutics** Human interferons Leptin Monoclonal antibodies	15

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

PRACTICAL I

1. Study of respiratory tract infections
2. Study of gastrointestinal tract infections
3. Study of gastrointestinal tract infections
4. Study of antibiotic sensitivity test using agar cup method
5. Study of antibiotic sensitivity test using paper disc method
6. Study of antibiotic sensitivity test using ditch method
7. Study of synergistic action of two drugs

Suggested Readings

1. Bernard R. Glick Terry L. Delovitch Cheryl L. Patten (2014) Medical Biotechnology ASM press, Washington DC
2. Talaro, K. P., & Chess B. (2012). Foundations in Microbiology (8th ed.) McGraw-Hill, New York
3. Patricia M. Tille (2013) Bailey & Scott's Diagnostic Microbiology (13th Edition) Elsevier
4. Goering, R. V., & Mims, C. A. (2008). Mims' medical microbiology. Philadelphia, PA: Mosby Elsevier.Page Break

Program: Bachelor of Science (Biotechnology)				Semester : 6	
Course : Environmental Biotechnology				Course Code: USMABT602	
Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE) (Marks)	Term End Examinations (TEE) (Marks)
4	4	-	4+2	25	75

Learning Objectives:

This course firstly explores the diversity, function and ecological adaptations of microorganisms within the environment.

The course will enable the student to understand the importance of microbial ecology as an integral part of environmental processes. The course also provides an overview of biological significance of components of environment air, soil, water and their potential in biotechnology.

It will help the learner to understand the pertinent design concepts and operations of aerobic and anaerobic bioprocesses and proper selection of technology for remediation and pollution control.

It explores the applications of biological system in the environment, their products and processes for the benefit of human society, the environment and sustainable development.

Course Outcomes:

After completion of the course, the student will have a detailed understanding of:

CO 1:The principles of microbial ecology, the importance of microbial diversity in environmental systems, interaction of microbial population with the environment, microbial life in extreme environments and the method used to study the microbial ecology for practical applications in environmental biotechnology

CO2:The modern trends in environmental biotechnology, such as treatment and disposal of effluents, remediation technologies, and will be able to describe existing and emerging technologies that are important in the area of environmental biotechnology

CO 3: Few examples of integrated applications of biotechnology for sustainable development as ecofriendly alternatives.

Outline of Syllabus: (per session plan)

Module	Description	No of Hours
1	Ecosystems and Metagenomics	15
2	Effluent treatment systems	15
3	Remediation Technologies	15
4	Integrated Applications for sustainable development	15
	Total	60
PRACTICALS		60

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UNIT	DESCRIPTION	NO OF HOURS
Module 1	**Ecosystems and Metagenomics:** **General Ecological Concepts**	15

	Major Microbial Habitats and Diversity The Microbial Environment Terrestrial Environments Aquatic Environments **Microbial community profiling and Metagenomics** Culture-Dependent Analyses of Microbial Communities Culture-Independent Analyses of Microbial Communities **Measuring Microbial Activities in Nature**	
Module 2	**Effluent treatment systems:** **Introduction** Types of waste water Characteristics of wastewater Dissolved oxygen concentration as indicator of water quality **Processes for domestic and industrial effluent treatment** Primary treatment process Secondary treatment process Tertiary treatment process **Biosystems for industrial effluent treatment.** **Aerobic processes** **Anaerobic processes** **Disposal of effluents**	15
Module 3	**Remediation Technologies** **Bioremediation Technology** Introduction to Bioremediation Types of Bioremediaton **In-situ Bioremediation** **Ex-situ Bioremediation** **Phytoremediation** Phytoremediation Factors Influencing Phytoremediation Types of Phytoremediation	15
Module 4	**Integrated Applications for sustainable development** **Sustainable energy:** Bioenergy from Wastes Biofuels- Biodiesel, Bioalcohols MFCs **Pollution abatement and odour control** Biosorbents, Bioscrubbers, Biobeds **Eco-friendly products:**	15

	Biosurfactants Biopolymers Bioplastics	

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

PRACTICAL

1. Study of Raw and Treated sewage
2. Determination of BOD
3. Determination of COD
4. Study of soil microflora
5. Study of air microflora
6. Demonstration of soil ecosystem by Winogradsky's Column
7. Enrichment and isolation of phenol degraders
8. Study of bioremediation
9. Extraction of Biopolymer

Suggested Readings

1. Brock Biology of Microorganisms (14th edn). Michael T. Madigan, John M. Martinko. Pearson NY
2. Principles of fermentation technology P.F. Stanbury & Whitaker Pergamon Press, II Ed, Butterworth Heinemann-Elsevier, 2005.
3. Environmental Biotechnology - Theory and Application – M. H. Fulekar: CRC Press and Science Publisher, USA
4. Introduction To Environmental Biotechnology, Third Edition A.K. Chatterji, PHI Learning Private Limited, New Delhi
5. Environmental Microbiology R.M Maier, I.L. Pepper and C. P. Gerba, Academic Press. (2000)
6. Environmental Biotechnology: Basic Concepts and Applications. 2006, Indu Shekhar Thakur, I. K. International Pvt Ltd
7. Environmental Biotechnology Allan Scragg Oxford University press
8. Environmental Biotechnology S.D. Jogdand (Industrial pollution management) Himalaya Publishing House

Program: B.Sc . bIOTECHNOLOGY				**Semester:** VI	
Course: ANIMAL BIOTECHNOLOGY				**Course Code:** USMABT608	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
4	1.5		2.5	25	75

Learning Objectives:

- Identification and characterization of animal breeds,
- Understand the Developing DNA - based diagnostics and genetically engineered vaccines for animals, Studying animal genomics and its varied applications
- To give a view of embryo - transfer technology, cloning, transgenic animals
- To understand the need for conservation of wild life and assess bio - processing technologies in other import areas of animal biotechnology

Course Outcomes:

After completion of the course, learners would be able to:

CO1:Evaluate the animal tissue culture and transgenic technologies in the current world

CO2:Assess the available technologies to develop better breeds, improvise the wet markets and their demands

CO3: Appply the DNA forensics, molecular diagnostics, cloning, wildlife knowledge to conserve the wild life.

CO4: Correlate the need of the current trends medical technology and transgenics

Outline of Syllabus: (per session plan)

Module	**Description**	**No of Hours**
1	Introduction to ATC	15
2	Introduction to transgenic technologies: GMA	15
3	Applications of animal biotechnology	15
4	Animal Conservation Biotechnology -taxonomic studies	15
	Total	60
PRACTICALS		30

Unit	Topic	No. of Hours/Credits
Module 1	Introduction to animal Tissue culture, Biology of Cultures Cells, Laboratory design and Layout, Equipment, Aseptic Technique, Safety, Bioethics, and Validation methods, Culture Vessels and Substrates, Media and Supplements, Preparation , and sterilization, Culturing techniques	15
Module 2	Transgenesis: Introduction, livestock sperms and ovum, artificial insemination, super ovulation, embryo-splitting, embryo sexing, embryo transfer, Gene transfer methods and Labeling techniques – radioisotope, digoxigenin, In situ hybridization, Gene Delivery methods Identification techniques : Post transfection / transduction of Gene transfer: CRISPR and PCR; markers techniques, genome editing., Expression of Green Fluorescent Protein	15
Module 3	Transgenic animals: Mice, Cow, Pig, Sheep, Bird, Insect, fish Animal propagation Germ line transformation technology. Breeds of livestock; genetic characterization, marker assisted breeding, Testing for genetic abnormalities, gene knock out technology and animal models for human genetic disorders. Introduction to Stem Cell Technology and its applications. Application of biotechnology in disease diagnosis; Foot-and mouth disease, Coccidiosis, Trypanosomiasis, Theileriosis. Genetic modification in Medicine - gene therapy, Hybridoma technology. Transgenic animal production and application in expression of therapeutic proteins. Immunological and nucleic acid based methods for identification of animal species, detection of meat food/feed adulteration with animal protein	15
Module 4	Conservation Biology – Embryo transfer techniques. cloning for conservation for conservation endangered species, ethical, social and moral issues related to cloning, in situ and ex situ preservation of germplasm, modes of molecular evolution, Neutral theory of Molecular evolution, genetic markers for taxonomic purposes, comparing total genome Cladistics, DNA barcodes, chromosome painting, establishing molecular homology identification of wild animal species Regenerative medicine	15

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

PRACTICAL I

1. Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization
2. Sources of contamination and decontamination measures.
3. Preparation of Hanks Balanced salt solution
4. Preparation of Minimal Essential Growth medium
5. DNA isolation from animal tissue
6. Quantification of isolated DNA.
7. Resolving DNA on Agarose Gel.
8. Developmental biology in tissue regeneration
9. Isolation of nucleic acid from reminiscent samples like skin, meat, milk, hair and cooked and putrefied tissues

Suggested Readings

1. Gene Transfer to Animal Cells Author(s) R.M. Twyman Publisher: Garland Science/BIOS Scientific Publishers, 2005 ISBN 0-203-48923-3 2-
2. Animal Transgenesis and Cloning. Author(s) Louis-Marie Houdebine Publisher: John Wiley & Sons, 2003 ISBN: 0-470-84827-8 3-
3. Animal Transgenesis and Cloning. Author(s) Louis-Marie Houdebine Publisher: John Wiley & Sons, 2003 ISBN: 0-470-84827-8 3
4. Animal Biotechnology 2nd edition. Author(s)/Editor(s): M. M. Ranga Publisher: Agrobios India

Program: B.Sc. Biotechnology (2020-21)				Semester: VI	
Course: PLANT BIOTECHNOLOGY				Course Code: USMABT 604	
Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
04	03		2.5+1.5	25 Marks	75 Marks

Learning Objectives:

- To develop an understanding of wide idea of plant tissue cultures and production of secondary metabolites
- To understand the concept of transgenic plants,
- To know the applications of biotechnology in the fields like agriculture for the production of biofertilizers, biopesticides and biosensors, biofuels.
- To know the significance Plant biotechnology and its techniques to introduce different breeds

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Understand the relevance of plant tissue culture techniques in large scale cultivation of plants and production of secondary metabolites

CO2: Know the methods of development of transgenic plants and their applications, understanding and application in future research.

CO3: Know the applications of Biotechnology in agriculture and development of biofertilizers, iopesticides, biosensors as well as biofuels

Outline of Syllabus: (per session plan)

Module	Description	No of Hours
1	**Plant Tissue Culture**	**15**
2	**Transgenic Plants**	**15**
3	**Biofertilizers, Biopesticides and Biosensors**	**15**
4	**IPR & Bioethics**	**15**
Total		**60**
PRACTICALS		

Unit	Topic	No. of Hours
Module 1	**Plant Tissue Culture** **Plant tissue cell and organ Culture**-Medium for tissue culture, micropropagation, regeneration of plants, Organogenesis, callus culture, meristem tip culture, virus	**15**

	elimination, Plant suspension cultures, Biosynthesis- batch, continuous cultures, **Plant cell culture as a system for production of fine chemicals -** why culture plant cells, Introduction to primary and secondary metabolism Production of alkaloids and other secondary metabolites, Metabolic engineering for production of secondary metabolites, elicitation, immobilized plant cells, biotransformation and hairy root cultures.	
Module 2	**Transgenic Plants** **Artificial (Direct DNA uptake** by protoplast, electroporation, liposome mediated, and particle gun transformation) **Natural method of gene transfer** (*Agrobacterium* and virus). **Applications of Transgenic Plants -** Development of Insect, pathogen and herbicide resistant plants. Transgenic plants for improving nutrient content, Modification of plant taste and appearance, plants as bioreactors, Edible vaccine, Golden rice	**15**
Module 3	**Biofertilizers, Biopesticides and Biosensors** Types of biofertilizers, Production, application. advantages and limitations: Introduction, advantages over chemical fertilizers, Production of *Rhizobium, Azotobacter* based biofertilizers Study of biopesticides based on *Bacillus thuringenesis*, Biofuels Biosensors-Types of biosensors, Principle, working and applications	**15**
Module 4	**IPR & Bioethics** Intellectual property rights - Introduction, Types of IP-Trade secret, Patents, Copyright, plant variety protection, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, International framework for the protection of IP. IP as a factor in R&D; IPs of relevance to Biotechnology. Patenting genes and DNA sequences, Gene patents and genetic resources, patenting related to genetically modified organisms, Management of IPR Patenting biotech inventions Introduction to History of GATT, WTO, WIPO and TRIPS Bioethics: Concepts; Ethical Terms, Relevance to Biotechnology, Ethical and moral issues related to GMOs	**15**

PRACTICAL I
(If applicable)

1. Seed and explants sterilization
2. Preparation of MS medium
3. Study of callus culture, micropropagation
4. Study of suspension culture,

5. Isolation of *Rhizobium* from root nodules
6. Isolation of *Azotobacter* from soil
7. Production of Biopolymer from *Azotobacter*
8. Study of Mycorrhiza
9. Case study for IPR

Suggested Readings

1. Plant tissue Culture – Kalyan Kumar Dey
2. Advanced Biotechnology – R.C. Dubey
3. Comprehensive Biotechnology – Ramavat & Mathur
4. Molecular Biotechnology - Glick & Pasternak 4th Edition;
5. Biotechnology – Fundamentals and Applications - S.S.Purohit, 3rd edition
6. Recombinant DNA Biotechnology: expanding horizons – BD Singh Kalyani Publishers
7. Biotechnology – B. D. Singh. Kalyani Publishers

Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
4	4		2+2	25	75

Learning Objectives:

The course is a comprehensive course covering various applications of biotechnology in the field of nanotechnology, reproductive biotechnology, molecular biotechnology and Bio-analytical techniques. The course also introduces the learner to the fundamentals and various applications of diagnostic tools, gene therapy and radioactive isotopes in biological sciences.

Course Outcomes:

CO1. The emerging field of nano-biotechnology, their applications in biological sciences.
CO2. The aspects of molecular biotechnology fields in diagnostics and therapeutics.
CO3. The basic principle and applications of reproductive biotechnology and bio analytical techniques

Outline of Syllabus: (per session plan)

Module	Description	No of Hours
1	Nano-biotechnology	**15**
2	Healthcare biotechnology	**15**
3	Molecular biotechnology	**15**
4	Bio analytical techniques	**15**
	Total	**60**
PRACTICALS		

Unit		No. of Hours/Credits
Module 1	**Nano-biotechnology** Introduction to nanoparticles Applications of nanomaterials in Agriculture Environment Food Cosmetics	**15**
Module 2	**Healthcare biotechnology** Nature and importance of vaccines Classification of vaccines Traditional and modern methods of vaccine production Preparation, standardization and storage of vaccines	**15**

Module 3	**Molecular biotechnology** Molecular diagnostics Protein therapeutics Nucleic acid as therapeutics	**15**
Module 4	**Bio analytical techniques** Principles of chromatography Types of chromatography Gel permeation chromatography Affinity chromatography Ion Exchange chromatography	**15**
TOTAL		60

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

PRACTICAL I
(If applicable)

1. Chromatographic separation of molecules by molecular size exclusion.
2. Separation of biomolecules by affinity chromatography.
3. Preparation of vaccine.
4. Determination of TDP and TDT of heat killed vaccine
5. Sterility testing of the given vaccine.

Suggested Readings:

1. B. Vishwananthan. Nanotechnology
2. M H Fulekar. Nanotechnology
3. Upadhyay Upadhyay and Nath. Biophysical chemistry. Himalaya Publishing House
4. Glick and Pasternak. Molecular biotechnology. principles and applications of recombinant DNA .4th edition. Washington Dc
5. Advances in gene biotechnology- S.N Jogdand

Reference Books:

1. Sambamurthy K and Aushotosh Kar, 2006. Pharmaceutical biotechnology