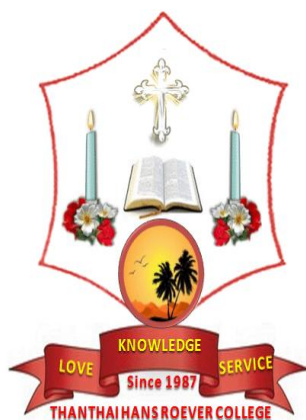


Syllabus for B.Sc., Biotechnology



PG & Research Department of Biotechnology
THANTHAI HANS ROEVER COLLEGE
Autonomous and affiliated to Bharathidasan University, Trichy
Nationally accredited by NAAC
Perambalur – 621 220

(applicable to the candidates admitted from the academic year 2018-2019 onwards)



THANTHAI HANS ROEVER COLLEGE (AUTONOMOUS), ELAMBALUR, PERAMBALUR

Bachelor of Computer Science Course Structure under CBCS

(For the candidates admitted from the academic year 2018-2019 onwards)



SEM	Subject code	PART	COURSE	COURSE TITLE	HRS/ WEEK	CREDIT	EXAM HRS	MARKS		TOTAL MARKS
								INT MARK	EXT MARK	
Semester I	18UT1	I	Language Course - I (LC) - Tamil/Other Languages	Tamil/Hindi - I	6	3	3	25	75	100
	18UE1	II	English Language Course - I	English - I	6	3	3	25	75	100
	18UBT1CC1	III	Core Course-I	General Microbiology	6	5	3	25	75	100
	18UBT1CP1		Core Practical-I	General Microbiology - Lab	4	2	3	40	60	100
	18UBC1AC1		Allied Course-I	Biochemistry	6	4	3	25	75	100
	18UVE	IV	Value Education	Value Education	2	2	3	25	75	100
Total					30	19	-	-	-	600
Semester II	18UT2	I	Language Course - II (LC) - Tamil/Other Languages	Tamil/Hindi -II	6	3	3	25	75	100
	18UE2	II	English Language Course -II	English - II	6	3	3	25	75	100
	18UBT2CC2	III	Core Course-II	Cell Biology	5	4	3	25	75	100
	18UBC2CP2		Core Practical-II	Cell Biology - Lab	3	2	3	40	60	100
	18UBC2AC2		Allied Course-II	Immunology	4	3	3	25	75	100
	18UZO2AC3		Allied Course-III	Developmental Biology	4	3	3	25	75	100
	18UES	IV	Environmental Studies	Environmental Studies	2	2	3	25	75	100
Total					30	20	-	-	-	700
Semester III	18UT3	I	Language Course - III (LC) - Tamil/Other Languages	Tamil/Hindi -III	6	3	3	25	75	100
	18UE3	II	English Language Course - III	English - III	6	3	3	25	75	100
	18UBT3CC3	III	Core Course-III	Molecular genetics	6	4	3	25	75	100
	18UBT3CP3		Core Practical-III	Molecular genetics -Lab	3	3	3	40	60	100
	18UBI3AC4		Allied Course-IV	Bioinformatics	4	4	3	25	75	100
	18UBI3AP1		Allied Course-IV Practical	Bioinformatics - Lab	3	3	3	3	60	100
	18UMB3NME1	IV	Non Major Elective -I	Human anatomy and physiology	2	2	3	25	75	100
Total					30	22	-	-	-	700
Semester IV	18UT4	I	Language Course - II (LC) - Tamil/Other Languages	Tamil/Hindi - IV	6	3	3	25	75	100
	18UE4	II	English Language Course -II	English - IV	6	3	3	25	75	100

	18UBT4CC4	III	Core Course-IV	r-DNA Technology	5	4	3	25	75	100
	18UBT4CP4		Core Course-IV Practical	r-DNA Technology -Lab	3	3	3	40	60	100
	18UMA4AC5		Allied Course-V	Bio Statistics	3	2	3	25	75	100
	18UMA4AP2		Allied Course -V Practical	Bio Statistics-Lab	3	3	3	40	60	100
	18UMB4NME2	IV	Non Major Elective -II	Microbial diseases and its control	2	2	3	25	75	100
18UBT4SBE1	Skill Based Elective-I		Mushroom Technology	2	2	3	25	75	100	
Total					30	22	-	-	-	800
Semester V	18UBT5CC5	III	Core Course-V	Animal Biotechnology	5	5	3	25	75	100
	18UBT5CC6		Core Course-VI	Plant Biotechnology	5	5	3	25	75	100
	18UBT5CC7		Core Course-VII	Nano Biotechnology	5	5	3	25	75	100
	18UBT5CP5		Core Course-V&VI Practical	Animal Biotechnology and Plant Biotechnology – Lab	4	4	3	40	60	100
	18UBT5MBE1	Major Based Elective-I	Food Bio technology	5	5	3	25	75	100	
	18UBT5SBE2	IV	Skill Based Elective-II	Vermi composting Technology	2	2	3	25	75	100
	18UBT5SBE3		Skill Based Elective-III	Medical Lab Technology	2	2	3	25	75	100
	18USSD		Soft Skills Development	Soft Skills Development	2	2	3	25	75	100
Total					30	30	-	-	-	800
Semester VI	18UBT6CC8	III	Core Course-VIII	Industrial Bio technology	6	6	3	25	75	100
	18UBT6CC9		Core Course-IX	Environmental Biotechnology	6	6	3	25	75	100
	18UBT6CP6		Core Course- VIII & IX Practical	Industrial Biotechnology and Environmental Biotechnology – Lab	5	4	3	40	60	100
	18UBT6MBE2		Major Based Elective-II	IPR, Biosafety and Bioethics	6	6	3	25	75	100
	18UBT6MBE3	Major Based Elective-III	Cancer Biology	6	6	3	25	75	100	
	18UGS	V	Extension Activities	Extension Activities	-	1	-	-	-	-
			Gender Studies	Gender Studies	1	1	3	25	75	100
Total					30	30	-	-	-	600
Grand Total					180	140	-	-	-	4200

- denotes that Non major elective 1 and 2 for those who studied Tamil under part I [(a) Basic Tamil for other language students, (b) Special Tamil for those who studied Tamil upto +2 but not opt for other languages in degree programme]

COURSE GENERAL STRUCTURE

Language Part I	-	4	Skill Based Elective	-	3
English Part II	-	4	Major Based elective	-	3
Core Paper	-	9	Environmental studies	-	1
Core Practical	-	6	Value education	-	1
Allied Paper	-	5	Soft Skill Development	-	1
Allied Practical	-	2	Gender Studies	-	1
Non Major Elective	-	2	Extension Activities	-	1

Note:

	Internal Marks	External Marks
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1. Theory	25	75
2. Practical	40	60

3. Separate passing minimum is prescribed for Internal and External marks

The passing minimum for CIA shall be 40% out of 25 marks [i.e. 10 marks]

The passing minimum for University Examinations shall be 40% out of 75 marks [i.e. 30 marks]

Examination at the end of the semester.

Extension activities shall be outside the instruction hours.

List of Elective papers

Non Major Elective Course I

1. Mushroom and Vermitechnology

Non Major Elective Course II

1. Quality Control and Hygienic Practices

Skill Based Elective Course I

1. Mushroom Technology

Skill Based Elective Course II

1. Vermi Composting Technology

Skill Based Elective Course III

1. Medical Lab Technology

Major Based Elective Course I

1. Food Biotechnology

Major Based Elective Course II

1. IPR, Biosafety and Bioethics

Major Based Elective Course III

1. Cancer Biology

Semester: I
Hours: 6

Course Code: 18UBT1CC1
Credit: 5

B. Sc. Biotechnology

COURSE-I: General Microbiology

Objectives

- The course supports to understand the microbial world in various aspects of structure, growth, classification & characterization.
- This course is aimed to contribute and understanding about the basics of microbiology assigning the types of microbes, and their industrial applications.

UNIT - I

Definition and scope of microbiology-History of microbiology, classification and nomenclature of microorganism, microscopic examination of microorganisms, Microscopy: simple, compound light microscope - Dark Field - Phase contrast and Electron Microscopy. Principles of different staining techniques like Simple, Gram staining and Capsular staining.

UNIT - II

General structure and function of microorganism - Bacteria, Fungi, Virus, Algae and Protozoa.

UNIT - III

Nutritional requirements of bacteria and different media used for bacterial culture, types of Nutrition (Phototrophs, autotrophs and Chemoautotrophs) Microbial growth curve, Factors affecting microbial growth- pH, light, temperatures, desiccations, osmotic pressure, radiation, pure culture techniques- pour plate, spread plate and streak plate.

UNIT - IV

Sterilization of microorganisms; Physical and chemical methods of sterilization- physical (moist heat, dry heat, filtration, pasteurization, tyndallization, radiations) and chemical (alcohols, aldehydes, phenols, halogens and hypochlorite).

UNIT - V

Microbes application; In agriculture; Biofertilizer, Microbes as a source of protein - Single Cell Protein, Microbes in medicine; Antibiotics - Penicillin Microbes in the production of acetic acid and Amylase.

Text Books

1. Prasad B.N., "A Text Book of Biotechnology", (2003) Budha Academic Enterprises, G.P.O., Box 20195, Kathmandu, Nepal.
2. Pelczar MJ, Chan ECS and Krein NR, (1993) Microbiology, Tata McGraw Hill Edition, New Delhi, India.
3. Ananthanarayanan R & Jayaram Panicker, C.K. (2005) Textbook of Microbiology, Orient Longman.

References

1. Prescott, L.M J.P. Harley and C.A. Klein, Microbiology 2nd edition (1995). Wm, C. Brown publishers.
2. Talaron K, Talaron A, Casita, Pelczar and Reid. (1993) Foundations in Microbiology, W.C. Brown Publishers.
3. Michael T. Madigan John M. Martin & Jack Parker, (1984), Biology of Microorganisms Prentice Hall International, Inc., London.
4. Edward A. Birge, (1992), Modern Microbiology – Principles and application. Wm.C. Brown Publishers, Inc. U.S.A.
5. Gerard J. Tortora, Berdell R. Funke, Christine & L. Case, (2001), Microbiology - An Introduction. Benjamin Cummings, U.S.A.
6. Rajan S and Selvi Christy R. Essentials of Microbiology, Anjanaa Book House, Chennai, 2015.

Semester: I
Hours: 4

Course Code: 18UBT1CP1
Credit: 2

COURSE-I Practical: General Microbiology- Lab

Objectives

- This practical is designed to give an understanding about the basic techniques in Microbiology.
 - To know about isolation of microorganism from soil.
1. Good Laboratory Practice, Maintenance of hygienic conditions in the laboratory and legal disposal of laboratory wastes.
 2. Microscope and its functions, preparation of culture media and sterilization methods.
 3. Methods of Staining techniques - simple, grams, spore and capsular staining.
 4. Bacterial culture technique – streaking, pour plate and spread plate method. Fungal culture techniques.
 5. Motility of bacteria, Growth studies of bacteria.
 6. Isolation of microbes and slide preparation – quantitative methods of microbes. Characterization bio fertilizer microbes.

References

1. Bucker, J.M., Caldwell, C.A., Zachgo, E.A. 1990. A Laboratory course, Academic Press.
2. Harold J. Berson 1994. Microbial Applications. WM.C. Brown Publishers.
3. William Claus. G.W.1989. Understanding Microbes – A Laboratory textbook for Microbiology, W.H. Freeman and Co., New York.
4. Cappuccino J.G. & Sherman N. (2002). Microbiology: A laboratory manual, Addison Wesley.

Semester: I
Hours: 6

Course Code: 18UBC1AC1
Credit: 4

ALLIED COURSE-I: Biochemistry

Objectives

- To ensure the technology based strategies and gain knowledge about the biomolecules.
- To learn about structure, properties and functions of biomolecules.
- This course is planned to validate the knowledge based on their application in relation to Bioinstrumentation.

UNIT - I

Structure of atoms and biomolecules: atomic theory, valency, atomic weight, molecular weight, Molarity, molality and normality. Chemical Bonding, properties of Water, ionization constant, pH and buffers.

UNIT - II

Macromolecules-Carbohydrates-Structure, classification, properties and functions of mono, di and polysaccharides.

UNIT - III

Protein-Structure, Classification, properties and function. Classification, Properties and function of amino acids.

UNIT - IV

Lipids-Classification, Structure, Properties and function Vitamins-Classification, Properties and its functions.

UNIT - V

Instrumentation - pH meter and colorimeter, Spectrophotometer, centrifuge, Methods for detecting radioactivity - GM and Scintillation counter. Principle and applications of

Chromatography- Paper and Column Chromatography Electrophoretic techniques-AGE,SDS-PAGE.

Text Books

1. Michael Cox., David. L. Nelson, (2004). Lehninger, Principles of Biochemistry, Kalyani Publishers, New Delhi.
2. H.S. Srivastava (2006). Elements of Biochemistry, Rastogi Publications, Meerut.
3. Jain, J.L., Jain, S and Jain, N., Fundamentals of Biochemistry, S.Chand & Company. New Delhi.
4. Sathyanarayana U and Chakrapani U. Biochemistry, 4th edition, Elsevier Publishers. 2013.
5. Biophysical chemistry – Upadhyay, Himalaya Publication,edition 3, 2005.

References

1. Stryer.L. (2003) Biochemistry, V. Edition. W.H. Freeman & Co. NY.
2. Robert K. Murray Daryl K. Granner, Peter. A.Mayes. & Victor W. Rodwell (2004) Harpers Biochemistry – Prentice Hall International, ISBN-8385-3612-3.
3. Geoffrey L. Zubay, William W. Passon, Dennis L. Vance, (1988), Principles of Biochemistry, IVedition, W. M. C. Brown Publishers, Australia.
4. Murray, R.K. A. Grannor, D.K. Mayes, P.A. and Rodwell V. W. (2000) Harper's Biochemistry, McGraw Hill Pvt. Ltd., New Delhi.
5. Voet D & Voet J.G (1990) Biochemistry, John Wiley & Sons, New York.
6. Zubay G (1998). Biochemistry 2/e, McMillan Publishers New York, Collier McMillan Company, London.

Semester: II
Hours: 5

Course Code: 18UBT2CC2
Credit: 4

CORE COURSE-II: Cell Biology

Objectives

- To know the basic knowledge of Cell biology.
- In this course the students will learn different areas of cellular biology including the structure and functions of cell, its organelles, membrane structure and function; bioenergetics; cellular communication.

UNIT - I

Cell as a basic unit of life - classification of cell types - cell theory - organization of Prokaryotic and Eukaryotic cells - comparison of microbial, plant and animal cells.

UNIT - II

Ultra structure of cells - Structure and function of cell organelles – Ribosome, Nucleus, Mitochondria, Chloroplast, Golgi apparatus, Lysosomes and Micro bodies, Endoplasmic reticulum.

UNIT - III

Integrative and specialized cellular events, cell-cell signaling, cytoskeleton, microfilaments, microtubules, intermediate filaments - vacuoles, peroxisomes, lysosomes and nuclear compartment. Heterochromatin and euchromatin, polytene chromosomes.

UNIT - IV

Cell cycle and Cell division (Eukaryotic and Prokaryotic) - mitosis, meiosis. Growth and differentiation of normal and cancer cells, Tumor suppressor genes, p53, Apoptosis, Stem cells.

UNIT - V

Transport across all membrane, pinocytosis, phagocytosis, Autophagy, permeability of water and salts, salt antagonism, Membrane transport- Mechanism of Active and passive transport.

Text books

1. Cell and Molecular Biology, 8th Edition, 2001, De Robertis E.D.P. & De Robertis Jr. E.M.F., Lippincott & Williams.
2. Alberts, B., et al., (1994). Molecular Biology of the Cell, 3rd Edition, Garland Publishing Inc.
3. Gerald Karp, (1996) Cell and Molecular Biology, John Wiley & Sons Inc

References

1. Ambrose E.J., and Dorothy M.E. Cell biology- (2002) ELBS Camlet press, Great Britain
2. Harvey Lodes and David Baltimore *et al.*, (2000) W. H. Freeman. Molecular cell Biology (3rd Edition)
3. Cell and molecular biology, 3rd edition, Philip Sheeler, Donal E Bianchi, John Wiley.
4. Molecular cell biology, Lodish, Baltimore (1994), Scientific American books.
5. Molecular and cell biology, Stephen L Wolfe (1993), Wordsworth Publishing Company.
6. Bruce Alberts, Alexander Johnson. Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter. Molecular Biology of Cell. (2014), Garland Science publication.

Semester: II
Hours: 3

Course Code: 18UBT2CP2
Credit: 2

CORE COURSE-II: Cell Biology - Lab

Objectives

- The students will learn, understand & develop the skill and hands on training in fundamentals of cell biology.
 - To know about cell organelle separation.
1. Demonstration of instrumentation, methods for cell biology, (Microscope, Microtome. etc.)
 2. Equipments used in cell culture laboratory general practice and maintenance (demo only).
 3. Morphological characterization of various types of cells including tissue cells.
 4. Histochemical staining techniques.
 5. Chemical/enzymatic disaggregation of tissue cells.
 6. Cell organelle separation by centrifugation methods.
 7. Identification and characterization of different types of Blood cells.
 8. Enumeration of Red Blood Cells.
 9. Enumeration of White Blood Cells.
 10. Identification of various stages of cell division (Mitosis and Meiosis).
 11. Barr body identification in cells of buccal smear.
 12. Grading the stages of chick embryo development (demo only).
 13. Microscopic identification of chromosome in chironomous larvae.

References

1. De Robertis and De Robertis. (2004) Cell and molecular biology, WB Saunders Co, Philadelphia.
2. David Freifelder (2005) Molecular biology published by N.K.Mehra. Narosa Publishing house, NewDelhi.

Semester: II
Hours: 4

Course Code: 18UBC2AC2
Credit: 3

ALLIED COURSE-II: Immunology

Objectives

- This helps the student to understand about the immune system of the body and its response to variety of external factors and changes happening in the host during infection.
- This course presents the defense system of the higher vertebrates against invading pathogen.
- To make the student to understand the defense mechanism and their principles.

UNIT - I

Introduction - Historical Development in Immunology, Immunity-Innate and Acquired Immunity. Humoral and Cell mediated response, Primary and Secondary immune response. Cells involved in immune response.

UNIT - II

Antigen-Types and classifications. Antibody-Structure, Types, properties and their biological functions, Monoclonal antibody. Primary and Secondary lymphoid organs -Thymus, Bone marrow, Lymph nodes and Spleen.

UNIT - III

Cytokines: Structure and function- Interferons and interleukins. Complement pathways Major histocompatibility complex, HLA Typing.

UNIT - IV

Autoimmune diseases, hypersensitivity reactions - Type-I, Type-II, Type-III and Type-IV, transplantation and vaccines.

UNIT - V

Antigen-Antibody reactions. Precipitation and agglutination. Immunodiffusion and Immunoelectrophoresis. Principle and Applications of RIA, ELISA, Western blot, Fluorescent Antibody techniques.

Text Books

1. Kuby, J. (2006). Immunology 4th Edition, Goldsby R.A., Kindt T.J., Osborne B.A., W.H. Freeman and Company.
2. Abul K. Abbas, Andrew H.L, Shiv Pillai, “Cellular and Molecular Immunology” Saunders Publications.

References

1. Immunology (Vth Edition) Richard A. Goldsby, Thomas. J. Kindt, A. Osborne, Janis Kuby, (2003). W.H. Freeman and company.
2. Immunology, Ivan Roitt, (2001). Harcourt publishers, Ltd.
3. Essential immunology, Ivan Roitt, (2000). Blackwell Science, 9thEdition.
4. Immunology, An Introduction, (1995). Tizard. Saunders College Publishing Ltd.
5. Microbiology and Immunology Richard M. Hyde. 2012, 3rd Edition. Springer Science & Business Media.

Semester: II
Hours: 4

Course Code: 18UZO2AC3
Credit: 3

ALLIED COURSE-III: Developmental Biology

Objectives:

- This helps to the students to understand about organization and function in animals.
- To know about processes of growth and development in animals
- To know about fertilization in mammals.

UNIT - I

Gametogenesis and Fertilization Definition, scope & historical perspective of development Biology, Gametogenesis – Spermatogenesis, Oogenesis Fertilization - Definition, mechanism, types of fertilization. Different types of eggs on the basis of yolk

UNIT - II

Early embryonic development cleavage - Definition, types, patterns & mechanism Blastulation: Process, types & mechanism Gastrulation: Morphogenetic movements– epiboly, emboly, extension, invagination, convergence, de-lamination. Formation & differentiation of primary germ layers Fate Maps in early embryos

UNIT - III

Embryonic Differentiation - Cell commitment and determination- the epigenetic landscape: a model of determination and differentiation, control of differentiation at the level of genome, transcription and post-translation level Concept of embryonic induction Primary, secondary & tertiary embryonic induction Neural induction and induction of vertebrate.

UNIT - IV

Organogenesis, Neurulation, notogenesis, development of vertebrate eye. Fate of different primary germ layers Development of behaviour: constancy & plasticity, Extra embryonic membranes, placenta in Mammals.

UNIT - V

Organization of shoot and root apical meristem, and development. Leaf development and Phyllotaxy. Development of Microsporangium and Mega sporangium, Pollination, Embryo - Embryo sac development and double fertilization in plants, seed formation and germination. Out line of experimental embryology

Text Books

1. Gilbert, Scott's. 10th edition (2014). Developmental biology. Sinauer Association, Inc., Publishers.
2. Chattopadhyay.S. 2016. An Introduction to Developmental Biology, Books and Allied (P) Ltd, Kolkata. First Edition.

References

1. Bruce M Carlson, Patten's Foundation of Embryology, Tata McGraw Hill Co.
2. Balinsky, B.I., 1981. 5 edition. An Introduction to Embryology, W. B. Saunders Co., Philadelphia
3. Verma , P.S., Agarwal, V.K., and Tyagi., 1995. Chordate embryology, S. Chand & Co., New Delhi

Semester: III
Hours: 6

Course Code: 18UBT3CC3
Credit: 4

CORE COURSE-III: Molecular Genetics

Objectives

- This course is designed to give an understanding about the basics of molecular biology - classical genetics & molecular aspects.
- To know about the nucleic acids.

UNIT - I

Mendelian Genetics-laws and principles. Dominance, segregation, independent assortment. Allele, multiple allele, monohybrid and dihybrid inheritance. Linkage, Crossing over and pedigree analysis.

UNIT - II

Chromosome structure and organization in prokaryotes and eukaryotes. Sex chromosomes and sex linked inherited disorders- X linked recessive, dominant inheritance, Identification of the DNA as the genetic material. Genetic recombination in bacteria. Transformation, transduction and Conjugation.

UNIT - III

Principles of variation and selection process of speciation genetic drift, Mutagens and Mutation, DNA damage – mechanism of repair – excision repair, recombination repair; Human genome project.

UNIT - IV

Genetic mapping in bacteria – genetic system of Neurospora, Regulation of Gene Expression in Prokaryotes and Eukaryotes: Operon concept: lac, trp, sigma factors - Promotor, operator, terminator and attenuator. DNA methylation- Molecular genetics in relation to human diseases.

UNIT - V

Concept of gene - cistron, muton and recon – exons and introns. Discovery of types and structure of plasmids - natural and artificial plasmid transfer and their applications. Transposable elements –Transposons in Bacteria and Maize.

Text Books

1. Gardner EJ, Simmons MJ, Snustad DP (1991) Principles of Genetics, 8th edition, John Wiley & Sons.
2. Gupta PK. (1996) Genetics. Rastogi Publications, Meerut, India.

References

1. Maloy, S.R., J.Egroman and D.Friefelder. (1994). Microbial Genetics. Jones and Bartlett Publishers, Sudbury, MA, USA.
2. Coriffiths.1996 Introductions to Genetic Analysis. Freeman and Co.,U.K.
3. Lewis, R,(2001). Human genetics- concepts and application. 4th edition. McGraw Hill.
4. Griffiths, Miller, J.H., (1993). An introduction to genetic analysis W.H.Freeman. New York.
5. Winter, P.C., Hickey, G.J. and Fletcher, H.L (2000). Instant notes in genetics. Viva books, Ltd.
6. Gardener E.J. Simmons M.J.Slustad DP. (1991). Principles of Genetics. 8th edition, John Wiley & Sons, New York.
7. George M. Malacinski. 2013. Freifelder's Essentials of Molecular Biology. Norosa Publishing House.

Semester: III
Hours: 3

Course Code: 18UBT3CP3
Credit: 3

CORE COURSE-III Practical: Molecular Genetics - Lab

Objectives

- In this course the students will get hands on experience in Molecular Biology Techniques.
 - To know about DNA isolation technique.
1. Isolation of DNA from plant and animal cell
 2. Isolation of RNA
 3. Estimation of RNA
 4. Estimation of DNA
 5. Isolation of Plasmid DNA from bacteria.
 6. Mutagenesis in Bacteria: The Ames test.
 7. Transformation in *E. coli*.
 8. Biochemical characterization of selected bacteria.

References

1. Griffiths, Miller, Suzuki, Lewontin & Gilbert (1993) An introduction to Genetic Analysis, 5th Edition. W.H. Freeman & Company.
2. Birnboim, H.C. (1983) A rapid alkaline extraction method for the isolation of plasmid DNA. *Methods Enzymol.* 100, 243.
3. Sambrook, J., Fritsch, E.F., and Maniatis, T. (2012) *Molecular Cloning: A Laboratory Manual*. 4th ed. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory.

Semester: III
Hours: 4

Course Code: 18UBI3AC4
Credit: 4

ALLIED COURSE-IV: Bioinformatics

Objectives

- The course provides the details of dry lab conditions and analysis of macromolecules and genetic material and
- To help the students to have a brief knowledge about analysis of sequences of the same.

UNIT - I

Biological Databases: Sequence databases – Nucleic Acid sequence Databases: Genbank
Protein Sequence Databases: Swiss Prot; Searching Sequence Databases – Non-redundant
Databases – Low Annotation Databases – Specialized sequence Databases – Structural
Databases – Motif Databases – Genome Databases – Proteome Databases.

UNIT - II

Tools for Bioinformatics: Pairwise alignment – Dotplots – scoring matrices – Blosum
Matrices – PAM Matrix – Gap Penalty – Alignment Algorithms: Needleman – Wunsch Global
Alignment Algorithm ; Smith – Waterman Local Alignment Algorithm.

UNIT - III

Pairwise Sequence Analysis Tools: BLAST - Steps involved in using BLAST -
Interpreting BLAST results; FASTA - Alignment Scores -Multiple Alignment - Clustal W -
Phylogenetic Tree - Sequence Analysis using EMBOSS.

UNIT - IV

Protein Structure Prediction: Secondary structure Prediction - PDB-FSSP-SCOP-CATH-
Chou-Fasman - Jpred - Q3 - Trans membrane protein prediction - Tertiary structure prediction -
Comparative Modeling - Fold recognition - Ab initio prediction - modeler - RASMOL.

UNIT - V

Emerging areas of Bioinformatics: DNA microarrays - Structural genomics -Functional Genomics - Proteomics Comparative Genomics, Docking - Protein - Protein Interaction. Protein-ligand interaction, Next generation sequence.

Text Books

1. Harshawardhan, P. (2005) Bioinformatics principles and application. Tata McGraw Hill Publishers. New Delhi.
2. Manikand Vijayaraj, 2002. Bioinformatics for beginners, Kalaikathir Achchagam, Coimbatore.
3. Mount, D.W. 2005. Bioinformatics Sequence and genome analysis (IInd edition) CBS Publishers. New Delhi.

References

1. Hagen. J. B. (2000). The origin of bioinformatics. *Nat. Rev. Genetics* 1:231–6.
2. Tyers, M., and Mann, M. 2003. From genomics to proteomics. *Nature* 422:193–7.
3. Sundarajan. S. and R. Balaji. (2005), Introduction of Bioinformatics, Himalaya Publishing house, Mumbai.
4. Westhead, D.R, H.J. Parish and R.M. Twyman. (2003) Bioinformatics Viva books Private Ltd. New Delhi.
5. J. M.Keith. Bioinformatics. Vol. 1: 2008 Data, sequence analysis & evolution. Humana Press.

Semester: III
Hours: 3

Course Code: 18UBI3AP1
Credit: 3

ALLIED COURSE-IV Practical: Bioinformatics Lab

Objectives

- To Study the basic of Nucleic acid and protein sequence databanks.
 - To describe the widely used relational database model and biological sequence.
1. Study of Nucleic acid sequence databanks – GenBank, EMBL nucleotide sequence databank, sDDBJ, UniGene.
 2. Study of protein data banks - PIR, Swiss-PROT, UniPROT.
 3. Study of Protein Structure and Classification databases – PDB, SCOP, CATH, FSSP, PDBSUM.
 4. Study of Domain / Motif databases – BLOCKS, PRINTS, SBASE and PFAM.
 5. Gene structure and function prediction (using GenScan, GeneMark).
 6. Sequence similarity searching (NCBI BLAST)
 7. Protein sequence analysis (ExpASy proteomics tools).
 8. Multiple alignments – CLUSTALW.
 9. Building structure for a given sequence using Homology modeling.
 10. Evaluation of protein structure by Swiss PDB viewer and by other molecular visualization tools.

References

1. Droit, A., Poirier, G. G., and Hunter, J. M. 2005. Experimental and bioinformatic approaches for interrogating protein-protein interactions to determine protein function. *J. Mol. Endocrinol.* 34:263–80.
2. Stanton, L. W. 2001. Methods to profile gene expression. *Trends Cardiovasc. Med.* 11:49–54.

Semester: IV

Course Code: 18UBT4CC4

Hours: 5

Credit: 4

CORE COURSE-IV: r-DNA Technology

Objectives

- This paper provides the student a thorough knowledge in principles and methods in genetic engineering, vectors in gene cloning, transformation in higher organisms.
- To enable the students to grasp of the latest advances in genetic engineering techniques and the applications in various fields of biotechnology.

UNIT - I

Enzymes in genetic engineering - restriction endonucleases - ligases - alkaline phosphatase - polynucleotide kinase-terminal deoxynucleotidyl transferase -S1 nuclease - DNA polymerase I, holoEnzyme - DNA polymerase III, Klenow fragment - Taq DNA polymerase - RNases - ribonuclease - reverse transcriptase – poly (A) polymerase –Deoxy ribonuclease.

UNIT - II

Vectors - plasmids -- types - isolation of plasmid DNA - cloning vectors based on bacterial plasmids - plasmid pBR322, Col E1 plasmid, bacteriophage vector, cosmid vectors, shuttle vectors and expression vectors.

UNIT - III

Cloning strategies - core techniques is gene manipulating; cutting and joining DNA - Introduction of DNA into cells - Cloning strategies - construction of genomic libraries and cDNA libraries - probe construction and labeling.

UNIT - IV

Methods of selection and screening of recombinant DNA - gene transfer techniques - Molecular mechanism and application of anti sense technology. Splicing, Inhibition of splicing - poly adenylation and translation, capping.

UNIT - V

DNA finger printing and its applications, Variable Number of Tandem Repeats (VNTRs)/ Microsatellite sequences, RFLP, Polymerase Chain Reaction (PCR) and its types, RAPD, Site Directed Mutagenesis, methods of nucleic acid sequencing.

Text Books

1. Keya Chaudhuri. 2012. Recombinant DNA Technology. The Energy and Resources. Institute, TERI.
2. Biotechnology : Fundamentals and Applications" by S.S. Purohit , Agrobios(Ind).Jodhpur, 2002.

References

1. Old RW, Primrose SB, "Principles of Gene Manipulation, An Introduction To Genetic Engineering ", Blackwell Science Publications, 1993.
2. Sambrook *et al*, Vol. 1-3, "Molecular Cloning"
3. From Genes to Clones by Ernat-.L.Winnacker, Panima Publishing Corporation,India, 2003.
4. Biotechnology: Fundamentals and Applications" by S.S. Purohit , Agrobios(Ind),Jodhpur, 2002.
5. Gene Cloning - An Introduction" by T.A.Brown,VNR (U.K) Co.Ltd, England,1988.

Semester: IV
Hours: 3

Course Code: 18UBT4CP4
Credit: 3

CORE COURSE-IV Practical: r-DNA Technology - Lab

Objectives

- The course helps the students to understand about the recombinants from the basics to advanced techniques, giving in detail about each factor during construction of recombinants.

1. Isolation of genomic DNA from plant, animal, human & from bacteria
2. Isolation of plasmid DNA from bacteria
3. Size analysis of plasmids by agarose gel electrophoresis
4. Restriction digestion - single & double digestion.
5. Ligation.
6. Preparation of competent E.coli cells
7. Transformation of E.coli with recombinant DNA.
8. Selection & screening of rDNA products – Antibiotic resistance, Blue white colony.
9. PCR amplification
10. Southern blot and northern blot.
11. RAPD
12. RFLP

References

1. J. Sambrook and D.W. Russel. 2011. Molecular Cloning: A Laboratory Manual, Vol 1-3. CSHL.
2. T.A. Springer. 1985. Hybridoma Technology in the Biosciences and Medicine. Plenum Press New York.
3. Judith W. Zyskind and Sanford I. Bernstein.1989. Recombinant DNA Laboratory Manual.Academic press.

Semester: IV
Hours: 3

Course Code: 18UMA4AC5
Credit: 2

ALLIED COURSE-V: Biostatistics

Objectives

- This part of the curriculum helps the students to understand the statistical approach of biology.
- To know about statistical applications in the biological field.

UNIT - I

Biostatistics: Concepts of statistics-types of data, methods of collection of data. Sampling design – essentials of sampling – census methods - sampling methods – statistical laws – statistical error – test of reliability of sample.

UNIT - II

Experimental designs. Classification and tabulation of data. Diagrammatic and graphical representation of data.

UNIT - III

Measures of central tendency – mean, median and mode. Measures of dispersion: Mean deviations, standard deviation.

UNIT - IV

Correlation analysis (Karl Pearson's and Spearman's Rank) Regression analysis – simple linear.

UNIT - V

Tests of significance -'t'-test, Chi-square and goodness of fit, 'F' test Analysis of variance (ANOVA): One-way and Two-way.

Text Books

1. Norman T. J. Bailey, 2009. Statistical methods in Biology. University press, Cambridge

2.Rastogi, V.B. 2009. Fundamentals of Biostatistics, Anne Books, India.

References

1. Sokal, R.R. and F.J. Rohlf. 1981. Biometry. W.K. Freeman. San Francisco.
2. Zar, J.H. 2003. Biostatistical Analysis. Pearson Education (Singapore) Pvt. Ltd. Indian Branch, New Delhi.
3. Pranab Kumar Banerjee. 2014. Introduction to Bio statistics. 4th edition, S. Chand and company Ltd.
4. Bernard Rosner. 2010. Fundamentals of Biostatistics, 7th edition, Cengage Learning.

Semester: IV
Hours: 3

Course Code: 18UMA4AP2
Credit: 3

ALLIED COURSE-II PRACTICAL: Biostatistics Lab

Objectives

- To know about statistical applications in the biological field.
1. Collection of data, sampling designs, tabulation and graphic representation using biological materials.
 2. To find mean, mode, median, coefficient of variance using biological materials.
 3. Tests of significance 't' test and 'chi' square,
 4. Tests of significance standard error and standard deviation.
 5. Tests of significance standard deviation

References

- 1 .Maicello Pagano, Kimberlee Gauvreau. Principles of Biostatistics, 2nd edition, Duxbury Press. 2000.
2. Roland Ennos. Statistical and Data Handling Skills in Biology, 3rd edition. Pearson. 2011.

Semester: V
Hours: 5

Course Code: 18UBT5CC5
Credit: 5

CORE COURSE-V: Animal Biotechnology

Objectives

- The course helps the students to know about the animal cell culture techniques and applications from basics to advanced level.
- To know about *in vitro* fertilization and transgenic animal applications.

UNIT - I

Embryology-Gametogenesis and fertilization in animals, Molecular events during fertilization, genetic regulations in embryonic development – *In vitro* fertilizations and embryo transfer, Collection and preservation of embryo, culture of embryos, culture of embryonic stem cells and its applications.

UNIT - II

Animal cell culture-Fundamentals. Facilities and Applications. Media for Animal cells. Types of cell culture: Primary cell culture, secondary culture, cell transformation, cell lines, Insect cell lines, Stem cell cultures, cell viability and cytotoxicity. Biology of cultured cells, measurement of growth, cell synchronization, senescence and apoptosis. Organ culture. Cryopreservation.

UNIT - III

Genetic engineering in animals-methods of DNA transfer into animal cells-calcium phosphate co precipitation, micro-injection, electroporation, Liposome encapsulation, Biological vectors. Hybridoma technology, Vaccine production.

UNIT - IV

Gene therapy, mapping of human genome. RFLP and applications. DNA finger printing and Forensic Science. Molecular diagnosis of Genetic disorders.

UNIT - V

Transgenics-Transgenic animals. Production and recovery of products from animal tissue cultures:cytokines, Plasminogen activators, Blood clotting factors, Growth hormones. Transgenic animals - Merits and demerits - Ethical issues in animal biotechnology.

Text Books

1. Dubey RC. A textbook of Biotechnology. S. Chand and Company Ltd. 2013.
2. R.Sasidhara. 2006. Animal Biotechnology. MJP publishers 8. Duhcy R.C. 2007.

References

1. Freshney, E. D. 2000. Animal Cell Culture. A practical approach. John Wiley Pub. New York.
2. M.M. Ranga, 2000, Animal Biotechnology, Agrobios, India.
3. Satyanarayana, U., 2006,Biotechnology, Satyanarayana, Books and Allied (P) Ltd.
4. B Singh, SK Gautam and MS Chauhan. 2015. Textbook of Animal biotechnology. Teri Publication.
5. B Singh, SK Gautam and MS Chauhan. 2013. Textbook of Animal Biotechnology. The Energy and Research Institute.
6. M.K. Sateesh. 2010. Biotechnology: V: (Including Animal Cell Biotechnology, Immunology and Plant Biotechnology). 2nd Edition. New Age International Pvt. Ltd. Publishers.

Semester: V
Hours: 5

Course Code: 18UBT5CC6
Credit: 5

CORE COURSE-VI: Plant Biotechnology

Objectives

- The course helps the students to know about the plant cell culture techniques and applications from basics to advanced level.
- To know about gene transfer methods and transgenic plants application.

UNIT - I

Conventional methods of crop improvement- Selection, mutation, polyploidy and clonal selection; Plant tissue culture-Callus culture, organogenesis, meristem culture, anther, pollen, embryo culture and their applications. Somatic hybridization, Somatic embryogenesis.

UNIT - II

Plant genome organization. Organization of chloroplast genome and mitochondrial genome, cytoplasmic male sterility. Protoplasmic isolation and fusion.

UNIT - III

Genetic engineering in plants, Genetic engineering of plants for pest resistance, Herbicide resistance. Resistance to fungi and bacteria, Delay of fruit ripening. Regulation of gene expression in plant development. Plant hormones and phytohormone. Seed storage proteins.

UNIT - IV

Molecular Biology of plant – pathogen interactions (an overview) - Importance of RFLP in plant Breeding- Ti plasmid vectors for plant transformation,. Classification of plant viruses- management aspects of plant genetic engineering - tagging and cloning of plant genes.

UNIT - V

Biochemistry and molecular biology of Nitrogen fixation in legumes by Rhizobium. Molecular biology of plant stress response (abiotic). Agrobacterium and crown gall tumour. Synthetic seed production.

Text Books

1. H.S. Chawla, 2002. Introduction to Plant Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
2. Phundan Singh, 2013. Principles of Plant Biotechnology. Kalyani Publishers, India.
3. Kumaresan, V 2015. Applied Plant Biotechnology. Saras Publication, India.
4. Singh, 2014. Plant Biotechnology, 2nd Revised Edition, Kalyani Publishers, India

References

1. Grierson, D and S.N. Covey. 1988. Plant Molecular Biology. Blackie & Sons. Ltd. Glasgow.
2. Lycett, G.W. and D. Grierson (Eds). 1990. Genetic Engineering of Crop Plants. Heinemann, London.
3. Chrispeeds, M.J. and D.F. Sadava .1994. Plants, Genes and Agriculture.. Jones and Bartlett, Boston.
4. Mantel. S. H, Mathews. J. A, Mickee. R.A. 1985. An Introduction to Genetic Engineering in Plants. Blackwell Scientific Publishers, London.
5. Marks. J.L. (Ed.). 1989. A Revolution on Biotechnology. Cambridge Univ. Press, Cambridge.
6. Bernard R Glick and J.J. Pasternak. 2002. Molecular biotechnology, Principle and Applications of Recombinant DNA. ASM Press, Washington, D.C.

Semester: V
Hours: 4

Course Code: 18UBT5CP5
Credit: 4

CORE COURSE- Practical –V&V1: Animal and Plant Biotechnology-Lab

Objectives

- The course helps the students to know about the plant cell culture techniques and animal cell culture techniques.

Animal Biotechnology-Lab

1. Preparation of tissue culture medium
2. Preparation of single cell suspension from spleen and thymus.
3. Cell counting and viability
4. Cryopreservation and thawing
5. Preparation of metaphase chromosome from cultured cell.

Plant Biotechnology-Lab

1. Surface sterilization
2. Preparation of media for plant tissue culture (MS and B5).
3. Establishment of callus cultures from carrot cambial tissue
4. Micropropagation – Direct and Indirect Organogenesis
5. Protoplast Isolation
6. Cytological examination of regenerated plants
7. Embryo culture of maize
8. Polyethylene glycol (PEG) mediated fusion of protoplasts.

Semester: V
Hours: 5

Course Code: 18UBT5CC7
Credit: 5

CORE COURSE-VII: Nano Biotechnology

Objectives

- This helps the students to understand the various nanomaterial, their construction and biological approach of the same in medical field.
- To know about Environmental Nano Technology

UNIT - I

Introduction - Scope and Overview, Length scales, Importance of Nanoscale and technology. History of Nanotechnology, Future of Nanotechnology: Nanotechnology Revolution, Silicon based Technology.

UNIT - II

Nanoparticles - Introduction, Types of Nanoparticles, Pure Metal, Gold, Silicon, Silver, Cobalt, Metal Oxides, Silica, Zinc oxide, Iron oxide, Alumina, Titania, Techniques to Synthesize Nanoparticles, Characterization of Nanoparticles.

UNIT - III

Applications of nanotechnology: Nanosensors - types and its applications. Nanocarriers for Drug Delivery - Polymeric Nanoparticles as Drug Carriers. Micelles for Drug Delivery. Nanomedicine- Nanotechnology for Cancer Research and Therapy.

UNIT - IV

Environmental Nano Remediation Technology - Thermal, Physico-Chemical, and Biological methods. Nano Filtration for the Treatment of Wastes, Removal of Organics, Inorganics and Pathogens. Nanotechnology for Water Purification.

UNIT - V

Ethical issues in nanotechnology: Introduction, Socio-economic Challenges, with special Reference to Nanomedicine, Social and Ethical Issues, Economic Impacts.

Text Books

1. Christef M. Niemeyer, C. A. Mirkin. 2004. Nanobiotechnology: Concepts, Application and Properties. Wiley – VCH Publishers, New York.
2. Tuan Vo-Dinh.2007. Nanotechnology in Biology and Medicine: Methods, Devices and Applications.

References

1. Ratner M, Ratner D, “Nanotechnology: A Gentle Introduction to the next Big idea” Prentice Hall, 2005.
2. H.S. Nalwa,“Encyclopedia of Nanoscience & Nanotechnology”, McGraw Hill, 2004.
3. CNR Rao, “The chemistry of Nanomaterials: Synthesis, Properties & Application”, Springer 2006.
4. Viola Vogel, “Nanomedicine & Nanotechnology”, John Willey & Sons Ltd, 2008.
5. Goodshell, “ Nanobiotechnology”, John Willey & Sons Ltd,3rd edition, 2004.
6. Ralph S. Greco, “Nanoscale Technology in Biological systems”, CRC Press, 2005.

Semester: V
Hours: 5

Course Code: 18UBT5MBE1
Credit: 5

MAJOR BASED ELECTIVE-I: Food Biotechnology

Objectives:

- This is helps to the students to understand about food preparation
- To know about Food borne diseases.
- To help the students to understand about the industrial food process.

UNIT - I

Microorganisms associated with food - bacteria, fungi and yeast. Enzymes in food preparation. Food contaminations. Food preservation. Food carcinogens & mutagen (N-nitrosamines, Acrylamide & their mode of action)

UNIT - II

Food borne diseases. Food Allergens. Antioxidants. Food colors (natural & artificial food colourants). Food flavoring agents. Properties & function of Emulsifiers & Stabilizers in food. Food Sweeteners – Saccharine, Acesulfane, Aspartame & Sucrolose).

UNIT - III

General principle, plant design, construction, functionality of building, Plant layout. Pest proofing / fumigation methods. Water supply to food processing unit.

UNIT - IV

Food engineering operations: Characteristics of food raw materials, preparative operations in food industry, cleaning of food raw materials, sorting of foods, grading of foods. Sensory evaluation of food quality, quality factors for consumer safety. FSSA, HACCP FDA.

UNIT - V

Cleaning and sanitation of process plants. Classification & Characterization of waste from food industry. Treatment methods for solid & liquid waste. Genetically Modified Food – Bovine somatotropin, alpha lactalbumin & lactoferrin in milk, Edible vaccine (Cholera vaccine – potatoes & Hepatitis B vaccine - maize).

Text Books

1. B.Siva 2011.Food Processing & Preservation –PHI Learning Pvt Ltd.

References

1. D.G. Rao, 2010. Fundamentals of Food Engineering –PHI Learning Pvt Ltd.
2. Narang, Food Microbiology
3. Michael P. Doyle, Larry. R. Food Microbiology – Fundamentals & Frontiers
4. Frazier, Food Microbiology
5. Yiu Hui & G. Khachatourians, Food Biotechnology
6. Ipek, Laramie & Bhunia, Fundamentals of Food Microbiology, CRC Press.

Semester: VI
Hours: 6

Course Code: 18UBT6CC8
Credit: 6

CORE COURSE-VIII: Industrial Biotechnology

Objectives

- The course curriculums help in the understanding of the bioreactors behind the bioprocess technology
- To help the students to understand about the industrial processes.

UNIT - I

Introduction, scope and achievement of industrial biotechnology. A historical overview of industrial fermentation process - traditional and modern biotechnology. Rate of microbial growth and death. Basic requirements, design and parts of fermentor.

UNIT - II

Isolation and preservation of industrially important microorganisms - strain development. Media formulation- characteristics of an ideal production medium. Media for industrial fermentation - Sterilization of media (batch and continuous). air sterilization.

UNIT - III

Fermentation types - Batch, continuous and fed batch fermentation - principle types of fermentor: tower fermentor, cylindro conical fermentor, airlift fermentor, deep jet fermentor, photo bioreactor and enzyme reactor.

UNIT - IV

A brief outline of processes for the production of some commercially important products
Organic acids: citric acid and acetic acid; Amino acids: glutamic acid and lysine, Alcohol: ethanol. Antibiotics-Penicillin and streptomycin, Vitamins: B2 and B12.

UNIT - V

Enzyme immobilization, Production and application of Industrial Enzymes: proteases, amylases. Production of Biopesticides and Biofertilizers, Production of Cheese and Yohurt, Biopolymers: PHB, Production and application of Single cell protein.

Text Books

1. Wulf Cruger and Anneliese Crueger, (2003) Biotechnology: A Textbook of Industrial Microbiology, Panima Publishing Corporation.
2. Stanbury, A.H., A. Whittaker and Hall S.J. 1995. Principles of fermentation technology 2nd edition, Pergamon Press.

References

1. Casida Jr, L.E., (2000) Industrial Microbiology, New Age International (P) Ltd.
2. Prescott, Dunn, Industrial Microbiology, Agrobios (India).
3. Patel. A.H. 2005. Industrial Microbiology, Mac Millan India Ltd.
4. Springer Verlag. 2008. Current Developments in Solid-state Fermentation.
5. Peppler HJ and Pearlman D. Microbial Technology – Fermentation Technology. Vol.1 and 2, 2nd edition, Academic Press, London. 2004.

Semester: VI
Hours: 6

Course Code: 18UBT6CC9
Credit: 6

CORE COURSE-IX: Environmental Biotechnology

Objectives

- To gain knowledge on the importance of environmental education and ecosystem.
- To acquire knowledge about environmental pollution- sources, effects and control measures of environmental pollution.
- To understand the treatment of wastewater and solid waste management.
- To acquire knowledge with respect to biodiversity, its threats and its conservation and appreciate the concept of interdependence.
- To be aware of the national and international concern for protecting the environment.

UNIT - I

Basic Concepts - Interactions between environment and biota; Concept of habitat and ecological niches; Limiting factor; Ecosystem dynamics and management: Stability and complexity of ecosystems; Energy flow, food chain, food web and trophic levels; Ecological pyramids, Population ecology.

UNIT - II

Environmental Pollution - Water Pollution: Sources of pollution. Industrial effluents, Domestic wastes, Agrochemical, Heavy metals Water pollution analysis and monitoring, prevention and control of water pollution. Soil pollution - sources, effects and its control. Air pollution- sources, air pollutants, effects and control measures. Ozone depletion and global warming. Air pollution analysis and monitoring. Noise pollution, Radioactive pollution, Thermal pollution and their Sources, effects, prevention and control measures.

UNIT - III

Bioremediation and Bio-leaching - Microbial bioremediation of oil spills and toxic metal ions. Phytoremediation. Microbial leaching of ores – direct and indirect mechanisms. Genetic Engineering in Environmental Biotechnology: Role of Genetically engineered microorganisms in environment.

UNIT - IV

Biomass energy - Biomass waste as renewable source of energy; Conversion of Solid Waste to Methane (Biogas production). solid waste management and Industrial waste water management- Management of Sludge and Solid waste treatment-Land filling, Composting and VermiComposting.

UNIT - V

Biodiversity-Definition, Types, Diversity of Genes (genetic diversity) species (species diversity) and ecosystems (ecosystem diversity). Conservation of biodiversity- Current practices in conservation. *In situ* (Afforestation, Social forestry, Agro forestry, Zoos, Biosphere reserves, National parks, Sanctuaries), and *ex situ* (Cryopreservation, Gene banks, Sperm banks, DNA banks, Tissue culture and Biotechnological strategies). Eco restoration, environmental and biodiversity laws, environmental education.

Text Books

1. Jogdand SN. Environmental Biotechnology. 2010. Himalaya Publishing House. New Delhi.
2. Gaston, K. J. 1996. Biodiversity: Biology of numbers and Difference. Blackwell
3. Prescott, Harley, Klein. 2003. Microbiology. 5th Edition. McGraw Hill Publication.

References

1. Alan Scragg. 1999. Environmental Biotechnology. Pearson Education Limited, England.

2. Jogdand, S.N. 1995. Environmental Biotechnology. Himalaya Publishing House, Bombay.
3. Chatterji AK. Introduction to Environmental Biotechnology. Prentice-Hall of India Private Limited. 2005.
4. Primack, R. B. 1993. Essentials of Conservation Biology, Sinauer Associates, USA
5. Groom bridge, B. 1992. Global Biodiversity. Status of the Earth's Living Resources. Chapman and Hall, London.
6. Reaka - Kudla, M. L., D. E. Wilson and E.O. Wilson 1997. Biodiversity II: Understanding and Protecting our Biological Resources. Joseph Henry Press, Washington, DC.

Semester: VI
Hours: 5

Course Code: 18UBT6CP6
Credit: 4

CORE COURSE-VIII & IX Practical
Industrial and Environmental Biotechnology-Lab

Objectives

- Industrial Biotechnology helps the students to understand about the industrial processes.
- To acquire knowledge about environmental pollution- sources, effects and control measures of environmental pollution.

Industrial Biotechnology – Lab

1. Isolation of industrially important microorganisms for microbial processes
2. Determination of thermal death point and thermal death time
3. Microbial production of citric acid using *Aspergillus*
4. Microbial production of Penicillin.
5. Immobilization of algal cells and enzymes.
6. Production of red wine from grapes.

Environmental Biotechnology- Lab

1. Detection of coli forms for determination of purity of fresh water.
2. Determination of total dissolved solids of sewage.
3. Determination of COD and BOD of sewage samples.
4. Estimation of nitrates in drinking water.
5. Study of biogenic methane production in different habitats.
6. Estimation of chloride in soil.

References

1. Life Sciences laboratory manual by Dr.Rajan. 2015.
2. Industrial Microbiology laboratory manual by D.Chellapandi

Semester: VI
Hours: 6

Course Code: 18UBT6MBE2
Credit: 6

MAJOR BASED ELECTIVE-II: IPR, Biosafety and Bioethics

Objectives

- This part of the syllabus helps the students to understand the ethical, social, legal aspects in biology and bio containment.
- This course is designed to give knowledge on IPR & Bioethics

UNIT - I

Biosafety: Introduction; biosafety issues in biotechnology-historical background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals.

UNIT - II

Biosafety Guidelines: Biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulations of Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

UNIT - III

Introduction to Intellectual Property: Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications- importance of IPR – patentable and non patentables – patenting life – legal protection of biotechnological inventions – world intellectual property rights organization (WIPO). Protection of GMOs IP as a factor in R&D; IPs of relevance to Biotechnology-few Case Studies.

UNIT - IV

Patent Filing Procedures: National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting-disclosure/non-disclosure; Financial assistance for patenting -Introduction to existing schemes Patent licensing and agreement Patent infringement- meaning, scope, litigation, case studies. Agreements and Treaties: History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments.

UNIT - V

Bioethics: Introduction to ethics/bioethics – framework for ethical decision making; biotechnology and ethics-benefits and risks of genetic engineering - ethical aspects of genetic testing - ethical aspects relating to use of genetic information - genetic engineering and bio warfare; Ethical implications of cloning: Reproductive cloning , therapeutic cloning ; Ethical, legal and socioeconomic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research-GM crops and GMO's - biotechnology and biopiracy - Ethical implications of human genome project.

Text Books

1. Senthil Kumar Sadhasivam and Mohammed, Jaabir. 2008. IPR, Biosafety and Biotechnology Management. Jasen Publications, Tiruchirapalli, India.

References

1. Ethics in engineering, Martin. M.W and Schinzinger.R. 3rd Edition, Tata McGraw-Hill, New Delhi. 2003.
2. Bareact, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007.
3. Kankanala, K.C.2007. Genetic Patent Law&Strategy, 1st Edition. Manupatra Information Solution Pvt. Ltd. Noida, India.
4. Jose B. Cibelli, Robert P. Lanza, Keith H. S. Campbell, Michael D.West.2002. Principles of Cloning, Academic Press, San Diego, Gurdon.
5. Hoosetti, B.B.2002. Glimpses of Biodiversity. Daya, New delhi.

6. Ellen Frankel Paul, Fred D. Miller, Jeffrey Paul, *Bioethics*, 2002. Fred Dycus Miller
Cambridge University Press, 2002.
7. <http://www.cbd.int/biosafety/background.shtml>.
8. <http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section.html>.

Semester: VI
Hours: 6

Course Code: 18UBT6MBE3
Credit: 6

MAJOR BASED ELECTIVE-III: Cancer Biology

Objectives

- The course helps the students to know the mechanism of cancer development and progression.
- To know the knowledge of molecular and genetic basis of cancer.
- To know about differentiation between normal and cancer cells.

UNIT - I

Introduction - Growth characteristics of cancers cells; Morphological and ultrastructural properties of cancer cells. Types of growth-hyperplasia, dysplasia, anaplasia and neoplasia. Nomenclature of neoplasms. Differences between benign and malignant tumors. Epidemiology of cancer.

UNIT - II

Cancer biology and biochemistry -Aberrant metabolism during cancer development; Paraneoplastic syndromes; Tumor markers; cellular protooncogenes- oncogene activation. Growth factors-EGF, TNF- α and TGF- β and growth factor receptors–Signal transduction in cancer - Role of transcription factors.

UNIT - III

Carcinogenesis-radiation and chemical carcinogenesis-stages in chemical carcinogenesis-Initiation, promotion and progression. Free radicals, antioxidants in cancer; Viral carcinogenesis -DNA and RNA Viruses and human cancer; Cancer endocrinology.

UNIT - IV

Cell Cycle Regulation-Tumor suppressor genes p53, p21, Rb, BRACA1 and BRACA2. Telomeres, Telomerase, and Immortality; cell-cell interactions, cell adhesion-invasion and metastasis-VEGF signaling, angiogenesis; Epigenetics-Role of DNA methylation in gene silencing- epigenetic silencing of tumor-suppressor genes; Apoptosis in cancer-Cell death by apoptosis-role of caspases; Death signaling pathways-mitochondrial and death receptor pathways.

UNIT - V

Strategies of anticancer drug therapy-chemotherapy-gene therapy. Immunotherapy and Radiotherapy; Stem Cells and Cancer.

Text Books

1. The Biological Basis of Cancer: R. G. McKinnell, R. E. Parchment, A. O. Perantoni, G. Barry Pierce, I. Damjanov. 2nd Edition, Cambridge University Press, 2006.
2. The Biology of Cancer: R. A. Weinberg. Garland Science. 2006.

References

1. The Molecular Biology of Cancer: S. Pelengaris, M. Khan. Blackwell Publication. 2002
2. The Cancer Hand Book: Malcolm R. Alison. Nature Publishing Group.

Semester: IV
Hours: 2

Course Code: 18UBT4SBE1
Credit: 2

SKILL BASED ELECTIVE-I: Mushroom Technology

Objectives

- To facilitate self-employment
- To know the nutrient value of mushroom
- This helps to the students to understand about the mycoprotein from fungi and its nutritional values.

UNIT - I

Introduction – history – scope of edible mushroom cultivation – Types of edible mushroom available in India - *Calocybe indica*, *Volvarela Volvacea*, *Pleurotus sp.*, *Agaricus bisporus*.

UNIT - II

Pure culture-preparation of media (PDA and Oatmeal agar media) sterilization – Preparation of test tube slants to store mother culture – culturing of *Pleurotus* mycelium on petriplates – Preparation of mother spawn in saline bottle and polypropylene bags and their multiplication.

UNIT - III

Cultivation Technology-Infra structure, Substrates (locally available) polythene bag, vessels, Inoculation hood – inoculation loop – low cost stove – sieves – Cultural rack mushroom unit (Thatched house) – Mushroom bed preparation – Paddy straw, sugarcane trash, maize straw, banana leaves.

UNIT - IV

Storage and nutrition: Short term storage - Long term storage (scanning, Pickles, papads, drying, storage in salt solutions) - Nutrition: Proteins, amino acids, mineral elements. Nutrition: Carbohydrates - Crude fiber content, Vitamins.

UNIT - V

Food preparation, Types of foods prepared from mushroom - soup, cutlet, omelette, samosa, pickles, curry. Research Centres - National level and Regional Level Cost benefit ratio – Marketing in India and abroad - Export value.

References

1. Marimuthu *et al.*, (1991) Oyster Mushrooms, Dept. of Plant pathology, TNAU, Coimbatore.
2. Nita Bahl (1988) Hand book of Mushrooms, II edition, Vol.I & II.
3. Paul Stamets, J.S. and Chilton, J.S. (2004). Mushroom Cultivator: A practical guide to growing mushrooms at home, Agarikon Press.
4. Shu-Ting Chang, Philip G. Miles, Chang, S.T. (2004). Mushrooms: Cultivation, nutritional value, medicinal effect and environmental impact, 2nd ed, CRC press.
5. Swaminathan M. (1990) Food and Nutrition, Bappco. The Bangalore Printing and Publishing Co. Ltd., Bangalore.
6. Tewari and Pankaj Kapoor S.C. (1988) Mushroom cultivation, Mittal Publications, Delhi.
7. Chang. T. W.A. Haynes 1978. "Biology and cultivation of Mushrooms" Acad Press.N.Y.
8. Zadrazil. F & K. Grabbe 1983 "Edible Mushroom, Biotechnology" Vol. 3, Weinheim: Verlag Chemie, Berlin.
9. Kannaiyan. 2001. Handbook of Edible Mushrooms" TNAU Publication.

Semester: V
Hours: 2

Course Code: 18UBT5SBE2
Credit: 2

SKILL BASED ELECTIVE-II: Vermi Composting Technology

Objectives

- To facilitate self-employment
- To know about the vermicomposting and its agricultural value
- This helps to the students to understand about the earthworm and its applications.
- To know about organic fertilizer.

UNIT - I

Earthworms: Taxonomic position and diversity - Types: morphological and ecological grouping - Ecological roles and economic importance of earthworms - need for earthworm culture.

UNIT - II

Vermiculture: definition, scope and importance - common species for culture - Environmental requirements - culture methods - wormery breeding techniques - indoor and outdoor cultures - monoculture and polyculture - relative merits and demerits.

UNIT - III

Applications of vermiculture - Vermiculture Bio-technology: vermi-composting, use of vermicastings in organic farming / horticulture - earthworms for management of biomedical solid wastes - feed / bait for capture / culture fisheries - forest regeneration.

UNIT - IV

Marketing the products of vermiculture - quality control, market research, marketing techniques - creating the demand by awareness, demonstration, and advertisements - packaging and transport - direct marketing.

UNIT - V

Future perspectives - Predator / pathogen control in wormeries - Cost-benefit analysis of vermi-composting - Potentials and constraints for vermiculture in India.

References

1. Edwards, C.A and Bohlen, P.J. 1996, Biology and Ecology of earthworms-3rd Edition, Chapman and hall.
2. Ismail, S.A., 1970, Vermicology. The biology of earthworms. Orient Longman, London.
3. Lee, K.E., 1985. Earthworms - Their ecology and relationship with soil and land use, Academic Press, Sydney.
4. Brady, C.N, 1974 "The Nature and Properties of soils" Macmillan publishing Co. New York, London.

Semester: V
Hours: 2

Course Code: 18UBT5SBE3
Credit: 2

SKILL BASED ELECTIVE-III: Medical Lab Technology

Objectives

- To facilitate self-employment
- The course provides the students about the medicinal approach of Biotechnology
- To helps in understanding the various techniques and advancements of Biotechnology in medical field.

UNIT - I

Medical lab management: Laboratory management and planning- reception and recording of specimen, knowledge of maintenance and use of the following: microscope, hot plates, refrigerators, cryostat, blood bank refrigerators, walking coolers, refrigerated centrifuge, incubator, oven, autoclave.

UNIT - II

Histopathology- Tissue processing-details of paraffin embedding, vacuum embedding, decalcification, section cutting and different types of microtomes, frozen section- uses and techniques- Staining procedures in Histopathology- Museum methods- mounting of specimens, preparation of mounting medium.

UNIT - III

Hematology- Blood-Collection of haematological specimens, Different methods of estimation of hemoglobin- Staining procedures in haematology, Peripheral blood smears, Salient features and investigations for iron deficiency anemia, megaloblastic anaemia and haemolytic anaemia, Leukaemias, Haemorrhagic disorders.

UNIT - IV

Body fluids and excretory products: Examination of stool, Urine-its formation, normal and abnormal constituents, Examination of sputum, Examination of body fluids-pleural, pericardial, ascetic, cerebrospinal fluid and semen examination.

UNIT - V

Blood bank management: Blood bank management and planning the receiving and recording of blood samples, indexing, Inheritance and nomenclature of ABO and Rh blood group systems, other blood group systems, Transfusion reactions-recognition and investigations. Criteria used while selecting a blood donor.

Text Books

1. Rajan S. Medical Microbiology. MJP Publishers, Chennai. 2007.
2. Rajan S. Parasitology. SRS Publications, Chennai. 2007.

References

1. K.L. Mukherjee, "Medical Laboratory Technology" Vol. I, II & III, Tata McGraw Hill Publishing company, New Delhi, 2008.
2. C.R. Maity, "Medical Laboratory Technology", New Central Book Agency Pvt Ltd. Kolkata, 2005
3. Alan H Gowenlock, "Varley's Practical Clinical Biochemistry", CBS Publications & Distributors, New Delhi, 2009.
4. Monica Cheesbrough, "District Laboratory Practice" in Tropical Countries Part – 1 & 2 Cambridge Low- Price Edn. 2000.

Semester: III
Hours: 2

Course Code: 18UMB3NME1
Credit: 2

NON MAJOR ELECTIVE – I: Human Anatomy and Physiology

Objectives:

- This helps to the students to understand about the human body
- To know about organ of the body and its functions.

UNIT - I

Basic Embryology, Osteology and Histopathology. Circulatory and Respiratory Systems. Structure of heart, structure of lungs, Trachea and its branchings, Regulation of breathing, Carrier of oxygen and Carbon dioxide, Blood cell types and functions.

UNIT - II

Structure and function of nervous tissues, Physiology of emotion, Regulation of temperature, Cerebro spinal fluid, sensory end organs, Tongue, Mechanism of sight, hearing and smelling.

UNIT - III

Structure of alimentary canal and related digestive glands, Mechanism of alimentary canal. Secretion of digestive fluids. Function of liver.

UNIT- IV

Structure of Kidney, Bladder and Colon, Physiology of urine formation, Physiology of menstruation, Physiology of defecations.

UNIT - V

Pituitary gland, Thyroid, Parathyroid glands and pancreas, Ovary and Testis.

Text Books

1. T. S. Ranganathan (2002) A Text book of Human Anatomy; 6/e Rev. S. Chand Company Ltd, Ram nagar, New Delhi.

2. Hadley, M.E. (2000). Endocrinology, 5th ed. Prentice Hall, Upper Saddle River, NJ.
Martin, C.R. Endocrine Physiology, Oxford University Press.

References

1. Charles A. Jacob, "Textbook of Anatomy and Physiology in Radiological Technology"
The C.V.Mosby Company, Sam Louis, 1968.
2. Warrick C.K, "Anatomy and Physiology for Radiographers", Oxford University press,
Henglong, 1977.

Semester: IV
Hours: 2

Course Code: 18UMB4NME2
Credit: 2

NON MAJOR ELECTIVE-II: Microbial Diseases and its Control

Objectives

- To highlight the roles and characteristics of microorganisms.
- To know about infectious micro organism
- To study the clinical manifestation - prevention and control measures of microbes in public health.

UNIT - I

Microorganisms-microbial interactions - pathogens. General epidemiology - pathogenesis - pathology - diagnostic procedure - clinical manifestation - prevention and control measures.

UNIT - II

Virus: (a) HIV, (b) Pox virus, and (c) Picorna virus - Epidemiology - pathogenesis - pathology - diagnostics procedure - clinical manifestation - prevention and control measures.

UNIT - III

Bacteria: (a) Streptococcus (b) Staphylococcus and (c) Salmonella -Epidemiology - pathogenesis - pathology - diagnostic procedure - clinical manifestation - prevention and control measures.

UNIT - IV

Fungi: (a) Aspergillus, (b) Candida and (c) Microspora-Epidemiology - pathogenesis - pathology - diagnostic procedure - clinical manifestation - prevention and control measures.

UNIT - V

Protozoa: (a) Entamoeba histolytica, (b) Plasmodium species and (c) Trypanosoma gambiense - Epidemiology - pathogenesis - pathology - diagnostic procedure - clinical manifestation - prevention and control measures - vectors.

Text Books

1. Rajan S. Medical Microbiology. MJP Publishers, Chennai. 2007.
2. Rajan S. Parasitology. SRS Publications, Chennai. 2007.

References

1. Panjarathinam R. Textbook of Medical Parasitology. 2nd edition, Orient Longman.2007.
2. Ananthanarayanan R and Jeyaram Paniker CK. Textbook of Microbiology. 9th Ed. University Press. 2013.
3. Prescott, Harley, Klein. 2003. Microbiology. 5th Edition. McGraw Hill Publ.
4. Medical Microbiology David Green Wood Richard slack & John Peuthrer. Medical Microbiology. Churchill Livingston Company.
5. K.P.Chatterjee Text book of Medical Parasitology. Jawelz, Melnick, Geo R.Brokes Me Graw-Hill Company.