J.J COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS), PUDUKKOTTAI.

B.Sc., BIOTECHNOLOGY

Course Structure Under Choice Based Credit System
(Applicable for the Candidates Admitted from Academic Year 2019-2020 Onwards)

Sem	Part	Course Code	Course Title	Ins. Hrs/ Week	Credit	Exam Hrs	Marks		Total
							Int.	Ext.	
I	I	U1R1TL1/HL1/ FL1/SL1/ABL1	Language Course – I	6	3	3	25	75	100
	II	U1R1EL1	English Language Course – I	6	3	3	25	75	100
	III	U1R1BTCC1	Cell Biology	5	5	3	25	75	100
		U1R1BTCC2P	Major Practical-I (Covering CC-1)	5	5	3	40	60	100
		U1R1BTAC1	Allied Course (First) – I Biochemistry	5	3	3	25	75	100
		#	Allied Course (First) - II Allied practical (AC I and AC III)	3	-	-	-	-	-
Total				**30**	**19**	**-**	**-**	**-**	**500**
II	I	U2R1TL2/HL2/ FL2/SL2/ABL2	Language Course – II	5	3	3	25	75	100
	II	U2R1EL2	English Language Course – II	5	3	3	25	75	100
		U2R1BTCC3	Genetics and Molecular Biology	5	5	3	25	75	100
	III	U2R1BTCC4P	Major Practical-II (Covering CC-3)	5	5	3	40	60	100
		U2R1BTAC2P	Allied Course (First) - II Allied Practical-II(Covering AC1 and AC3)	3	3	3	40	60	100
		U2R1BTAC3	Allied Course (First) – III Microbiology	5	3	3	25	75	100
	IV	U2R1ES	Environmental Studies	2	2	3	25	75	100
Total				**30**	**24**	**-**	**-**	**-**	**700**
III	I	U3R1TL3/HL3/ FL3/SL3/ABL3	Language Course – III	5	3	3	25	75	100
	II	U3R1EL3	English Language Course III	5	3	3	25	75	100
	III	U3R1BTCC5	r -DNA technology	5	5	3	25	75	100
		U3R1BTCC6P	Major Practical - III (Covering CC5)	5	5	3	40	60	100
		U3R1BTAC4	Allied Course (Second) – IV Immunology	5	3	3	25	75	100
		#	Allied Course (Second) - V Allied Practical-IV (Covering AC4)	3	-	-	-	-	-
	IV	U3R1VE	Value Education	2	2	3	25	75	100
Total				**30**	**21**	**-**	**-**	**-**	**600**

IV	I	U4R1TL4/HL4/ FL4/SL4/ABL4	Language Course – IV	5	3	3	25	75	100
	II	U4R1EL4	English Language Course – IV	5	3	3	25	75	100
	III	U4R1BTCC7	Plant Biotechnology	5	5	3	25	75	100
		U4R1BTCC8P	Major Practical - IV (Covering CC7)	5	5	3	40	60	100
		U4R1BTAC5P	Allied Course (Second) – V Allied Practical-IV (Covering AC4 & AC5)	3	3	3	40	60	100
		U4R1BTAC6	Allied Course (Second) – VI Biostatistics	5	3	3	25	75	100
		U4R1BTSBE1	Skill Based Elective Course – I Marine Biotechnology	2	2	3	25	75	100
Total				**30**	**24**	**-**	**-**	**-**	**700**
V	III	U5R1BTCC9	Bioinstrumentation	7	5	3	25	75	100
		U5R1BTCC10	Bioinformatics	7	5	3			100
		U5R1BTCC11P	Major Practical - V (Covering CC9 and CC10)	7	5	3	40	60	100
		U5R1BTMBE1	Major Based Elective Course -I Pharmaceutical Biotechnology	5	4	3	25	75	100
	IV	U5R1BTSBE2	Skill Based Elective Course - II Medical Laboratory Technology	2	2	3	25	75	100
		U5R1BTIDC1	Inter Disciplinary Course - I To be opted from the Department	2	2	3	25	75	100
Total				**30**	**23**	**-**	**-**	**-**	**600**
VI		U6R1BTCC12	Animal Biotechnology	6	5	3	25	75	100
		U6R1BTCC13	Environmental Biotechnology	6	5	3	25	75	100
		U6R1BTCC14P	Major Practical VI (Covering CC12 and CC13)	5	5	3	40	60	100
		U6R1BTMBE2	Major Based Elective Course -II Food and Industrial Biotechnology	4	4	3	25	75	100
		U6R1BTMBE3	Major Based Elective Course -III Nanobiotechnology	4	4	3	25	75	100
	IV	U6R1BTSBE3	Skill Based Elective Course – III Mushroom Cultivation and Value Addition	2	2	3	25	75	100
		U6R1BTIDC2	Inter Disciplinary Course – II To be opted from the Department	2	2	3	25	75	100
	V	U6R1GS	Gender Studies	1	1	3	25	75	100
			Extension Activities	-	1				
Total				**30**	**29**	**-**	**-**	**-**	**800**
Grand Total					**140**				**3900**

CC-Core Course / AC – Allied Course / MBE – Major Based Elective / SBE – Skill Based Elective/

IDC – Inter Disciplinary Course/ P – Practical

Total Credit – **140** / Total Marks – **3900**

Extension Activities Shall Be Outside the Instruction Hours.

LIST OF MAJOR BASED ELECTIVE COURSES

1. Pharmaceutical Biotechnology
2. Food and Industrial Biotechnology
3. Nanobiotechnology
4. Cancer Biology
5. Stem Cell technology

LIST OF SKILL BASED ELECTIVE COURSES

1. Marine Biotechnology
2. Medical laboratory technology
3. Mushroom technology and Value Addition
4. Agricultural Biotechnology
5. Endocrinology

LIST OF INTERDISCIPLINARY COURSES (Offered by the Department)

1. Organic Farming
2. Applied Biotechnology
3. Mushroom Technology

PROGRAMME SPECIFIC OBJECTIVES – U.G.

- To impart basic knowledge and skills of various aspects of biotechnology .
- To train the students for industrial need and to pursue further education.
- To inculcate entrepreneurship among the students so as to start their own ventures in the field of biotechnology.
- Our graduates will contribute to the field of biotechnology and allied industries designing, developing and providing solutions for product/processes/technology development.
- To pursue higher education and research in reputed institute at national and international level.

PROGRAM SPECIFIC OUTCOME – U.G.

- Graduates will gain and apply knowledge of Biotechnology, Science and Engineering concepts to solve problems related to field of Biotechnology
- Students will be able to understand, analyze and apply the concepts and incredibly wide diversity of applications including Pharmaceutical development, Crop and Livestock improvement, Industrial processing and Bioremediation of contaminated environment
- Graduates will be able to justify societal, health, safety and legal issues and understand his responsibilities in biotechnological engineering practices
- Students can become Junior Production Officer and Technical Assistant in biotechnology, pharmaceutical Companies, bio fertilizer industry, aquaculture industries, environmental units, crop production units, food processing industries, national bio-resource development firms, banking and KPO.

SEMESTER - I - CORE COURSE – I
CELL BIOLOGY

Course Code: U1R1BTCC1 **Max Marks: 100**
Hours/Week: 5 **Internal Marks: 25**
Credits: 5 **External Marks: 75**

COURSE OBJECTIVES

- To acquire the basic knowledge on the fundamentals of the cell biology.
- To study the principles on cell theory and cell organelles.
- To study the cell divisions, cell cycle and cellular organelles at structure and functional level
- To understand the various aspects of structure and functions of living cells
- To acquire broad knowledge on basic and recent trends of genetics

Total Instruction Hours: 60

UNIT I: Introduction to Cell **Hours: 10**

Origin of Cell - Classification of Cell types, Cell size and shape, Cell theory - Organization of plant and animal cells, Overview of the Prokaryotic and Eukaryotic cells.

UNIT II: Membrane structure and functions **Hours: 12**

Structure of Plasma Membrane, Lipid Bilayer, Membrane Protein Diffusion, Osmosis, Ion Channels, Active Transport.

UNIT III: Structural organization and function of intracellular organelles **Hours: 15**

Cell wall, Nucleus, Mitochondria, Golgi bodies, Lysosomes, Endoplasmic Reticulam, Peroxisomes, Plastids, Vacuoles, Chloroplast, Cytoskeleton.

UNIT IV: Cell cycle and Cell division **Hours: 09**

Steps in Cell Cycle and its regulation and Control of Cell Cycle. Mitosis and Meiosis and their regulations,

UNIT V: Cellular communication **Hours: 11**

Principles of Cell Communication, Cell Adhesion and its roles, Gap junctions, Integrins, Neuro transmission.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 03**

Latest development related to the course during the semester concerned

TEXT BOOKS

1. C.B Powar, Cell Biology, Himalaya Publishers (2010)
2. Gupta, P.K. A Text Book of Cell & Molecular Biology, Rastogi Publications.(2015)
3. P.S.Verma , P.K. Agarwal, Cell Biology, S.Chand (2016)

REFERENCES

1. De Robertis, E.D.P. and De Robertis, E.M.F. Cell and Molecular Biology. VIII Edition. Lippincott (2014).
2. Harvey Lodhish, Arnold Berk, Molecular Cell Biology, WI Freeman Publishers, 8th Edition 2016

NET REFERENCES

- http://www.landesbioscience.com/journals/BioArchitecture/about/
- *http://expmed.bwh.harvard.edu/main/labs.html*
- *http://www.unc.edu/depts/salmlab/mafia/mafia.html*

COURSE OUTCOME

- Students will understand the complete nature of Cell and its Organelles in detail.
- This Course provides the in depth information about the Cell division and Communication.
- Students will apply their Knowledge of Cell Biology to selected changes or loss in Cell function.
- Analyse the various factors determining the heredity from one generation to another.
- Acquire combined knowledge with special emphasis on molecular mechanism of heredity.

SEMESTER – I - MAJOR PRACTICAL - I (Covering CC-I)
CELL BIOLOGY

Course Code: U1R1BTCC2P **Max Marks: 100**
Hours/Week: 5 **Internal Marks: 40**
Credits: 5 **External Marks: 60**

EXPERIMENTS

1. Demonstration of instrumentation methods for cell biology, (Microscope, Micrometry and Microtome).
2. Equipments used in cell culture laboratory general practice and maintenances (demo only).
3. Morphological characterization of various types of cells –Prokaryotes & Eukaryotes
4. Histochemical staining techniques (students are advised to familiarize various staining techniques) - Demo
5. Chemical/enzymatic disaggregation of tissue cells.
6. Cell organelle separation by centrifugation methods.
7. Isolation of Leydig cells (testis) and Islet cells.
8. Enumeration of cell (any type of prokaryotic/eukaryotic cells).
9. Identification and characterization of different types of Blood cells.
10. Enumeration of Red Blood Cells.
11. Enumeration of White Blood Cells.
12. Identification of various stages of cell division (mitosis and meiosis).

REFERENCES

1. Sambrook et al., (1989), A manual on Molecular cloning.
2. K.V. Chaitanya, (2013), Cell and Molecular Biology: A Lab Manual.

SEMESTER - I - ALLIED COURSE – I
BIOCHEMISTRY

Course Code: U1R1BTAC1 **Max Marks: 100**
Hours/Week: 5 **Internal Marks: 25**
Credits: 3 **External Marks: 75**

COURSE OBJECTIVES

- To get a basic knowledge about the chemical bonding in biological system.
- To have a detailed knowledge about the function and properties of biomolecules
- To learn about the basic metabolic reactions of living organisms
- To have a basic knowledge about the enzymes and biological energy transducers
- To provide knowledge on metabolic pathways and their Biochemical importance

Total Instructional hours: 60

UNIT I : Chemical bonding in biological system **Hours: 10**

Structure of atoms, molecules, and chemical bonds, stabilizing interactions: Vander walls, electrostatic interactions, hydrogen bonding, hydrophobic interactions.

UNIT II : Buffers and conversions **Hours: 10**

Percentage solution, molarity, normality, molarity, properties of water- hydrogen bonding, acids bases and their concepts, buffer and electrolytes – acidity, alkalinity and pH determination - Energy and it is forms-free energy

UNIT III : Biomoloecules **Hours: 17**

Biomolecules – Introduction - classification, function and properties. Carbohydrates, Lipids, Amino acids, Proteins and Nucleic acids

UNIT IV : Vitamins and Minerals **Hours: 10**

Vitamins: Source, classification, biological role, daily requirements and deficiency. **Minerals:** requirements, essential micro and macro minerals, source and functions.

UNIT V : Enzymes **Hours: 10**

Classification and nomenclature of enzymes – physiochemical nature of enzymes – enzyme kinetics – mechanism of enzyme action – factors affecting enzyme activity, industrially important enzymes.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 03**

Latest development related to the course during the semester concerned

TEXT BOOKS

1. Biochemistry, Sathyanarayanan.U and Chakrapani.C, (2013), Books and allied (P) Ltd
2. Fundamentals of Biochemistry, Deb,A.C., (7^{th} Edition). New central agency.
3. Fundamentals of Biochemistry, Jain, J.L., (2005), (6^{th} Edition), S.Chand Publications
4. Essentials of medical physiology, Sembulingam.K and Prema Sembulingam (2003). (2^{nd} Edition). Jaypee Brothers Medical Pulishers (P) Ltd.

REFERENCE BOOKS

1. Biochemistry, Zubay,G.L., 1998, Wm.C. Brown Publishers.
2. DNA structure and function, Sinden,S.R., 1994, First Edition**,** Academic Press.
3. Introduction to Protein Structure, Carl Branden and John Tooze, 1999, Second Edition, Garland Publishing.
4. Biochemistry, Garrett.R and Grisham.C, 2010, 4^{th} Edition, Saunders College Publishing.
5. Biochemistry, Hubert, styer, 1995, Freeman and Company, New York.
6. Principles of Biochemistry, Lehninger, Nelson, David.L and M.M.Cox, 2013**.** 6^{th} Edition, W.H.Freeman & Co.
7. Biochemistry, Berg, J.M *et al.*, 2012, 7^{th} Edition, W. H. Freeman & Co.
8. Fundamentals of Biochemistry: Life at the Molecular level, Voet, D. *et al.*, 2012, 4^{th} Edition, John Wiley and Sons.

COURSE OUTCOME

- The students will be able to understand elements which are generally involved in the biochemistry.
- The students will be able to differentiate the biomolecules from chemistry.
- The students will be able to know the importance of vitamins and minerals requirements in our health.
- The students will be able to know the nature of enzymes and its importance in our human life.
- The students will be able to understand on lipid metabolism and knowledge on amino acid and urea metabolism.

ALLIED PRACTICAL - II (Covering AC1 and AC3)
(BIOCHEMISTRY AND MICROBIOLOGY)

Course Code: U2R1BTAC2P **Max Marks: 100**
Hours/Week: 3 **Internal Marks: 40**
Credits: 3 **External Marks: 60**

BIOCHEMISTRY

1. Preparation of standard solutions.
2. Measurement of pH.
3. Preparation of buffers solutions.
4. Qualitative Analysis of Carbohydrates
5. Qualitative analysis of Lipids
6. Qualitative analysis of Amino acids
7. Qualitative analysis of Proteins
8. Qualitative analysis of Nucleic acids
9. Determination of iodine number of Fat

MICROBIOLOGY

1. Laboratory regulations and dos and don'ts
2. Maintenance of hygienic conditions in the laboratory and legal disposal of laboratory wastes.
3. Handling of Microscope.
4. Preparation of Culture media.
5. Disinfection: Phenol co–efficient method.
6. Isolation of Microorganisms-Pour Plate, Spread Plate and Streak Plate methods.
7. Quantitative estimation of Microorganisms (Counting chamber).
8. Measurement of microorganisms – Micrometry.
9. Identification of Microorganisms: Macroscopic, Microscopic, Motility tests, staining techniques, Biochemical tests, Serological and Molecular tests.
10. Growth curve of Bacteria: Lag phase, Log phase, Stationary phase and Decline phase.
11. Growth factors: pH, temperature, time, Carbon and Nitrogen sources.

REFERENCES

1. Microbiology Laboratory Manual, Sundaraj T, Mrs. Aswathy Sundararaj, 2002, First edition, IIT Chennai.
2. Laboratory Manual in General Microbiology, N. Kannan, 2002, Panima Publishers.
3. Practical Microbiology Dubey, R.C. and Maheshwari. K, 2018, S. Chand and Co.Ltd., Fifth edition, New Delhi.

4. Diagnostic Microbiology, Baron E J, and Finegold S M., 1995, Blackwell Scientific Systems.
5. Microbiology: A Laboratory Manual, Cappuccino J and Sherman N, 2012, 8th Edition, Pearson Education Publication, New Delhi.
6. Biochemical Methods, S. Sadasivam and A. Manickam, 1992, Second Edition, New Age International Publishers, New Delhi.
7. Laboratory Manual in Biochemistry, J. Jayaraman, 1981, New Age International publishers, New Delhi.

NET REFERENCE

1. www.cat.cc.md.us/course/bio141/lab manual/index.html

SEMESTER - II - CORE COURSE- III
GENETICS AND MOLECULAR BIOLOGY

Course Code: U2R1BTCC3 **Max. Marks :100**
Hours/Week: 5 **Internal Marks: 25**
Credits: 5 **External Marks: 75**

COURSE OBJECTIVES

- To make the student to understand the concept of genes and genetic material
- On successful completion of the subject the student should have understood: DNA, chromosome, plasmids and their replication
- To make the students to understand the genetic disorders
- An in-depth study on Structure and organization of Chromosome, Replication Process, Transcription process, Translation process and Mutagenesis.
- To expose the students on the basic understanding of various techniques used for molecular studies.

Total Instructional Hours: 60

UNIT I: **Classical Genetics** **Hours: 12**

Dominance, Segregation, Independent Assortment, Co-dominance, Linkage, Crossing Over, Sex linkage and Sex influenced character. Concept of Gene - allele, multiple alleles, pseudo allele.

UNIT II: Prokaryotic Genetics **Hours: 12**

DNA and RNA as a genetic material. Types, forms, Structure and functions of DNA and RNA. - *E.coli* chromosome, Plasmid – Structure, properties, types and significance. Transposons. Genetic code, gene structure, concept of Gene-expression, Transcription, Translation, Posttranslational and Transcriptional modification, Gene regulation - *Lac* operon, *Trp* operon.

UNIT III: Eukaryotic Genetics **Hours: 12**

Chromatin structure: Histones, Nucleosome, Repetitive DNA, Giant chromosomes: Polytene and Lampbrush chromosomes, RNA splicing and Transcription, Ribozyme, Translation, Population genetics, life cycle of *Neurospora crassa*, Breakage, Rejoining and models of recombination-The Holiday model.

UNIT IV: Replication of DNA, Mutation & DNA repair mechanism **Hours: 11**

Replication of DNA –Enzymes involved, models, Rolling circle model, Theta Model. Replication of RNA . Mutation and its Types, DNA repair mechanism, Transposable elements.

UNIT V: Human Genetics and Microbial Genetics **Hours: 10**

Pedigree analysis, Lod Score for Linkage testing, Karyotypes. Methods of Gene Transfer: Transformation, Conjugation, Transduction and Sexduction.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 03**

Latest development related to the course during the semester concerned

TEXT BOOKS

1. Freifelder D, Essential of molecular biology, 2011, 4th edition, Jones and Bartlett publishers.
2. Cecie Starr & Ralph Taggart , Cell Biology and Genetics,11th Revised edition (2014), Publisher: Brooks/Cole.

REFERENCES

1. Harvey Lodish, Arnold Berk, Molecular Cell Biology, WI Freeman Publishers, 8th Edition (2016)
2. Watson J.D, M Gil man et al.,Recombinant DNA technology scientific American books-WH free man publishers (2014)
3. A.Gardner, R.T.Howell and T.Davies, Human genetics, Vinod Vasishtha for Viva Books private limited, (2016).

NET REFERENCES

1. http://agridr.in/tnauEAgri/eagri50/GBPR111/index.html
2. http://www.genome.gov/10000013

COURSE OUTCOME

- Students will understand the complete nature of Genes in detail.
- This Course provides the in depth information about the Process of Genetics.
- Students will apply their Knowledge of Genetics for the further studies or Research.
- The students are be able to understand in detailed mechanisms of DNA Replication
- The students are be able to understand the overall concepts of Transcription

SEMESTER - II - MAJOR PRACTICAL II (Covering CC-3)
GENETICS AND MOLECULAR BIOLOGY

Course Code: U2R1BTCC4P **Max Marks: 100**
Hours/Week: 5 **Internal Marks: 40**
Credits: 5 **External Marks: 60**

EXPERIMENTS

1. Isolation of Genomic DNA
2. Estimation of DNA
3. Isolation of plasmid DNA
4. Isolation of Auxotrophic mutants.
5. Mutagenesis in Bacteria
   Physical method-UV Rays
   Chemical method- N-methyl-W-nitro-N nitrosoguanidine
6. Qualitative analysis of DNA-Agarose gel electrophoresis
7. Demonstration of Electrophoresis,Gel doc and Electrophorator

REFERENCES

1. Laboratory Manual of Genetics by A.M. Winchester, Publisher**:** Brown (William C.) Co,U.S.; 3rd Revised edition edition (1 January 1979)
2. Robertson, Dominigue, Shore, Scott and Miller, David M. Manipulation and Expression of Recombinant DNA a Laboratory Manual. London: Ap Professional, 1997. (574.873282, ROB.D)
3. Miller, Jeffrey H. Short Course in Bacterial Genetics a Laboratory Manual and Handbook for Escherichia Coli and Related Bacteria. USA: Gold Spring Harbar, 1992. (589.9015, MIL.J)
4. Cell and Molecular Biology: A Lab Manual (English) Author: Chaitanya K V Released: 2013 Publisher.

NET REFERENCES

1. Wiki.mcmaster.ca/Biology.../2013:day_1-1-introduction.pdf?...pages.
2. http://www.freebookcentre.net/biology -books - download/Molecular-Biology-Techniques - Laboratory- Manual-(PDF-189P).html

SEMESTER - II - ALLIED COURSE- III

MICROBIOLOGY

Course Code: U2R1BTAC3 **Max Marks: 100**
Hours/Week: 5 **Internal Marks: 25**
Credits: 3 **External Marks: 75**

COURSE OBJECTIVES

- To get a basic idea about Microbiology.
- To learn about the classification of Microorganisms.
- To know about the general characteristics and pathogenecity of Microorganisms.
- To enhance the students knowledge on the historical aspects and development of microbiology
- To acquire an overall knowledge on the morphology and functions of the structures with the prokaryotes and eukaryotes.

Total Instructional hours: 60

UNIT I: Introduction to Microbiology **Hours: 10**

Introduction-History and Scope of microbiology. Classification of microorganisms – Hackel's three kingdom concept, Whittaker's five kingdom concept. General Methods of classifying Bacteria: The intuitive method, numerical taxonomy and genetic relatedness. Classification of bacteria according to Bergey's manual, - Classification of Viruses, Algae, Fungi and Protozoa.

UNIT II: Structure of Bacteria **Hours: 12**

The Prokaryotic Cell: Size, shape and arrangement of bacterial cells; structure of cell wall, and structures external (glycocalyx, flagella, pili, etc.,) and internal (plasma membrane, cytoplasm, inclusion bodies, etc.,) to the cell wall. Comparison of Prokaryotic and Eukaryotic cell.

UNIT III: Nutrition and growth **Hours: 10**

Aerobic and anaerobic nutritional requirements, Micronutrients, Macronutrients, Nutritional types of Microorganisms. Types of media: simple media, differential media, enriched media. Growth factors, Growth curve, Factors influencing and affecting microbial growth. Methods for preservation and storage of Microbial cultures.

UNIT IV: Reproduction and Physiology of Microorganisms **Hours: 12**

Introduction, Habitat, Structure and Reproduction of Microorganisms: Viruses, Algae, Fungi, Actinomycetes and Protozoa. Physiology of Microorganisms: Glycolysis, Pentose phosphate pathway, ED pathway, Kreb's cycle. Mechanism of Electron transport chain, oxidative Phosphorylation.

UNIT V: Extremophiles and emerging microorganisms **Hours: 13**

Nature, special features of the thermophilic, methanogenic and halophilic Archaea; photosynthetic bacteria, cyanobacteria. Swine flu, Rota, Ebola, Dengue virus and Chicken guinea virus – Morphology, Cultural characteristics, Pathogenecity, Laboratory diagnosis, Preventive measures and treatment.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 03**

Latest development related to the course during the semester concerned

TEXT BOOKS

1. Text book of Microbiology – Dr.R.Arora, 2008, CBS Publisher 3rd Edition.
2. A text book of Microbiology – R.C.Dubey, K.Maheswari, 2012, M.Chand publishers 1st Edition.
3. Microbiology – Bernard Davis, 2011, Lippincott Publishers 4th Edition.

REFERENCES

1. Microbiology - M.J. Pelczar, Jr., E.C.S. Chang and N.R. Krieg, 2006, McGraw Hill Company, New York.
2. Microbiology - Concepts and Applications, J.Pelczar, Jr., E.C.S. Chang and N.R. Krieg, 1993, McGraw Hill Company, New York.
3. Microbiology L.M. Prescott, J.P. Hareley D.A. Klein W.M.C., 2005, Brown publishers. Dutique. Jawa. Melbourne.
4. Basic and Practical Microbiology-Ronald M. Atlas, Mac. Milleen Company, New York.
5. Text book of Microbiology – Ananthanarayanan and Paniker, University Press, 8th Edition.

NET REFERENCES

1. www.microbeworld.org
2. www.microbiologyonline .org.uk/links.htm
3. www.sheffcol.ac.uk/link/science/biology/microbiology

COURSE OUTCOME

- Be impressed on the milestones of Microbiology and present status
- Identify key components and their functions in both prokaryotes and eukaryotes.
- Know various Culture media and their applications and also understand various physical and chemical means of sterilization.
- Understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolism.
- Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.

SEMESTER – III - CORE COURSE - V
r - DNA TECHNOLOGY

Course Code: U3R1BTCC5 **Max Marks: 100**
Hours/Week: 5 **Internal Marks: 25**
Credits: 5 **External Marks: 75**

COURSE OBJECTIVES

- To illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences.
- To expose students to application of recombinant DNA technology in biotechnological research.
- To train students in strategizing research methodologies employing genetic engineering techniques.
- An in-depth study on Structure and organization of Chromosome, Replication Process, Transcription process, Translation process and Mutagenesis.
- To expose the students on the basic understanding of various techniques used for molecular studies.

Total Instructional Hours: 60

UNIT I: Vectors and Enzymes **Hours: 12**

Gene Cloning Vectors – Plasmids and its types, Bacteriophages, Phagemids, Cosmids. Artificial Chromosomes: PAC, BAC, YAC. Enzymes used in Gene Manipulation – DNA Polymerases, Reverse Transcriptase, Ligases, Poly Nucleotide Kinases, Alkaline Phosphatases, Nucleases, Topoisomerases, Gyrases and Methylases.

UNIT II: Cloning strategies **Hours: 12**

Construction of genomic and cDNA libraries, Shot gun cloning, DNA Primers, Linkers and Adaptors. Library Construction and Screening. Cloning in Prokaryotes, Human Genome Project, Chromosome walking.

UNIT III: Recombinant selection and DNA sequencing **Hours: 10**

Selection and Screening of Recombinants, Site directed mutagenesis, DNA Sequencing - Maxam Gilbert's and Sanger's and automated methods of DNA sequencing. PCR – Types & Applications. Gene Transfer Techniques – Physical, Chemical and Biological.

UNIT IV: Methods in Genetic Engineering **Hours: 12**

Isolation and Purification of Nucleic Acids. AGE, PAGE, Blotting Techniques – Southern, Northern, Western and South- Western blotting. Cot Curves. RFLP and RAPD.

UNIT V: Applications of Genetic Engineering **Hours: 12**

DNA Finger Printing, Recombinant Vaccines, Transgenic Plants, Transgenic Animals, Gene Therapy and its Types, Gene Therapy for SCID, FH, Cystic Fibrosis.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 02**

Latest development related to the course during the semester concerned

REFERENCE BOOKS

1. Gene cloning, T.A Brown -3rd edition . Stanley Thrones publishers
2. Recombinant DNA technology- Watson J.D, M Gilman et al., Scientific American books-WH free man publishers
3. Principles of gene manipulation by R.N old and SB Primrose , Black well scientific publication

NET REFERENCES

- www.medicinenet.com
- www.animalresearch.info
- www.nlm.nih.gov

COURSE OUTCOME

- The student will achieve a sound knowledge on methodological repertoire which allows them to innovatively apply these techniques in basic and applied fields of life science researches.
- The students are be able to understand in-depth knowledge on Molecular Biology
- The students are be able to understand in detailed mechanisms of DNA Replication
- The students are be able to understand the overall concepts of Genetic Engineering
- The students are be able to understand in detailed application of Genetic Engineering

SEMESTER – III - MAJOR PRACTICAL - III (Covering CC-5)
r- DNA TECHNOLOGY

Course Code: U3R1BTCC6P **Max Marks: 100**
Hours/Week: 5 **Internal Marks: 40**
Credits: 5 **External Marks: 60**

EXPERIMENTS

1. Isolation of genomic DNA from Plant and Animal tissues.
2. Preparation of Competent Plasmid.
3. Restriction digestion of λ-phage DNA
4. Ligation.
5. Screening of recombinants.
6. Electroporation.
7. Polymerase Chain Reaction (Demo).
8. SDS-PAGE.
9. RFLP.
10. RAPD.

REFERENCES

1. Molecular biology and Recombinant DNA technology: Practical manual series (Volume II), 1st edition, Ashok kumar, Narendr Publishing House (2011).
2. Recombinant DNA and Biotechnology (A guide for teachers), 2nd Edition,2013, Helen Kreuzer and Adnanne Massey (ASB press).
3. Molecular cloning – A Laboratory Manual, 2010 (3rd Edn) P Sambrook and Russell.D.W.

SEMESTER III - ALLIED COURSE - IV

IMMUNOLOGY

Course Code: U3R1BTAC4 **Max Marks: 100**
Hours/Week: 7 **Internal Marks: 25**
Credits: 5 **External Marks: 75**

COURSE OBJECTIVES

- This course is designed to impart the students to understand the importance of immunology and its theoretical aspects and on the principles of immunology and immunotechnology.
- It also explains the various antigen-antibody reactions involved in diseases, Concept of Monoclonal antibodies and vaccine development.
- Students will learn about the structural features of the components of the immune system as well as their functions and responsiveness.
- The student will able to learn with the basic concepts of vaccine
- The student will able to learn with the techniques of immunology

Total instructional Hours: 60

UNIT I: Fundamental concepts of Immune system **Hours: 11**

Introduction – Historical Perspectives and Scope of Immunology. Important terminologies. Types of immunity – Innate - Natural built in barriers – skin, semen, saliva, tears, enzymes and Acquired. Immune system – Primary and Secondary lymphoid Organs, Cells involved in Immunity **–** Lymphocytes - T and B cells, Macrophages-Phagocytosis, Polymorpho nuclear leucocytes.

UNIT II: Antigens, Antibodies and Complement system **Hours: 12**

Antigen-Salient features, types - Haptens, Allergens, Antibodies - Structure, Types and function. Antigen –antibody reaction. Lympocyte activation and proliferation, Complement-Salient features and functions, Classical and Alternate Pathway.

UNIT III: Immune diseases **Hours: 10**

MHC Types- HLA tissue typing, Transplantation - Graft rejection-Types of Transplantation, Hypersensitivity – Type I,II, III, IV, Tumour immunology, Immunodeficiency diseases, Auto immune diseases.

UNIT IV: Immunotechnology **Hours: 12**

Precipitation - Immunodiffusion, Immunoelectrophoresis, Agglutination, Neutralization, Complement fixation, ELISA, ELISPOT, RIA, RIST, RAST, Immunoflouresence. Hybridoma Technology - Production and Applications of Monoclonal antibodies.

.

UNIT V: Prevention and treatment **Hours: 12**

Cytokines, Interleukins, Interferons., Recombinant antibodies.Vaccines: Types-live, attenuated, killed, subunit, recombinant and adjuvants- schedule for vaccination.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 03**

Latest development related to the course during the semester concerned

TEXT BOOKS

1. Textbook of Immunology (2013) by S.K.Mohanty, K.SaiLeela. Jaypee brothers medical Publishers Pvt. Ltd.
2. Immunology (2006) by Vaman Rao C. Narosa Publishing House.

REFERENCES

1. Kuby Immunology (2013) by Judy Owen, Jenni Punt, Sharon Stanford. Macmillan Higher Education International publication
2. Immunology by I.M. Roitt, J.Brostoff and D.K Male (1993) Gower medical publishing, London
3. Richard M.Hyde 1995 Immunology III edition ELBS London.
4. Immunology introductory textbook- Nadini shetty, new age international (p) limited, publishers, (2012).

NET REFERENCES

1. www.immunopath.com.ac.uk/-immuno/part1.html,
2. Authentic Web based resources like NCBI, Pub Med, and Science direct etc.

COURSE OUTCOME

- At the end of the course the students will, get a deep foundation in the immunological processes.
- Students will gain knowledge on how the immune system works and also on the immune system network and interactions during a disease or pathogen invasion.
- Understand the antigen antibody reactions and principles of hypersensitivity.
- Understand vaccine, immunohaematology and tumor immunology.
- Compare and contrast different bacterial diseases, including the properties of different types of pathogens, and the mechanisms of pathogenesis.

ALLIED PRACTICAL - IV (Covering AC4 and AC5)
IMMUNOLOGY AND BIOSTATISTICS

Course Code: U4R1BTAC5P **Max Marks: 100**
Hours/Week: 3 **Internal Marks: 40**
Credits: 3 **External Marks: 60**

IMMUNOLOGY:

1. Agglutination: ABO blood grouping, Rh Typing,WIDAL test, CRP and ASO.
2. Precipitation -Immune diffusion: Double immuno diffusion and Radial immuno diffusion.
3. Electrophoresis: pre-counter immuno electrophoresis, single immuno electrophoresis and Rocket immuno electrophoresis.
4. Enumeration of blood cells: RBC, WBC, platelets.
5. Differential staining of Blood cells
6. Labeled assay- Demonstration of ELISA and RIA.
7. Demonstration of Lymphoid organs in rat

BIOSTATISTICS:

1. Calculation of mean, median and mode
2. Standard deviation
3. Students T-test
4. ANOVA

REFERENCES

1. Immunology methods manual – vol 1 – lefkovits, Ivan.london Ap professional, 1997
2. Text books of practicals and clinical Immunology – Talwar.G.P. New delhi :CBS , 2005
3. "Introduction to Biostatistics" – Sokaland Rohlf- Toppan Co. 2007. Japan

SEMESTER - IV - CORE COURSE - VII

PLANT BIOTECHNOLOGY

Course Code: U4R1BTCC7 **Max Marks: 100**
Hours/Week: 5 **Internal Marks: 25**
Credit: 5 **External Marks: 75**

COURSE OBJECTIVES

- To introduce the various transformation techniques employed in plant systems.
- To get knowledge about application of genetically modified plants in the various fields of science.
- To understand the basic principles and methodologies of plant tissue culture
- To understand the different standard protocol for the production of viable clones
- To learn the knowledge on various methods of TC and secondary metabolites production.

Total Instructional Hours: 60

UNIT I: Plant tissue culture **Hours: 11**

History and Scope of plant tissue culture- Media composition and types, hormones and growth regulators, explants for organogenesis, somoclonal variation, production of haploid plants. Micro propagation, somatic embryogenesis, protoplast culture and somatic hybridization. Cryopreservation, germplasm collection and conservation.

Unit II: Plant transformation techniques **Hours: 14**

Mechanism of DNA transfer–*Agro bacterium* mediated gene transfer, Ti and Ri plasmids as vectors, direct gene transfer methods-particle bombardment, electroporation and microinjection.

Unit III : Bioproducts **Hours: 12**

Production of Industrial enzymes, biodegradable plastics, therapeutic proteins, edible vaccines and antibiotics using transgenic technology. Production of useful chemicals and secondary metabolites.

Unit IV: Genetic modification in Agriculture: **Hours: 12**

Transgenic plants- Herbicide resistance, viral resistance, bacterial resistance, fungal resistance crops, Delayed fruit ripening, stress tolerance. Genetically modified food, future perspectives & ecological impact of transgenic plants.

Unit V: Bioethics **Hours: 08**

Current status of transgenic plants in India and other countries, Ethical issues associated with GM crops and GM food; labeling of GM plants and products.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 03**

Latest development related to the course during the semester concerned

TEXT BOOKS

1. Plant Cell, Tissue and organ culture - Fundamental methods, Gamborg O.L and Philips, G.C. 1995. Narosa Publishing House, New Delhi.
2. Plant Biotechnology - The genetic manipulation of plants, Slater A., Scott N.W. and Fowler, M.R. 2008. Oxford University press, USA.

REFERENCE BOOKS

1. Principles of Plant Biotechnology, Phundan Singh, 2013, Kalyani Publishers, India.
2. Applied Plant Biotechnology, V. Kumaresan, 2015, Saras Publication, India.
3. Plant Biotechnology, Singh, 2014, 2nd Revised Edition, Kalyani Publishers, India.

COURSE OUTCOME

At the end of the course,

- The students will gain an insight into the concepts and techniques of plant biotechnology and its application to crop plants.
- Understand various media, sterilization, totipotency, cell induction, organogenesis
- Able to apply the techniques to develop a standard protocol for PTC
- Have comprehensive knowledge on GM technology, biosafety relations and germplasm storage
- They can also go for further research works during M.Phil and PhD courses.

SEMESTER IV - ALLIED COURSE- VI
BIOSTATISTICS

Course Code: U4R1BTAC6 **Max Marks: 100**
Hours/Week: 5 **Internal Marks: 25**
Credits: 3 **External Marks: 75**

OBJECTIVES

- To study on Role of statistics and Limitations.
- To review the basic concepts and knowledge in collection of Data
- Develop the skills pertinent to practice Measures of central tendency.
- To understand the concepts of Measures of Dispersion.
- To educate the Skewness and Kurtosis.

Total instructional Hours: 60

UNIT I: Introduction to Biostatistics **Hours: 12**

Biostatistics: Definition- Developments - Applications- Role of Statistics - Characteristics - Limitations- Importance.

UNIT II: Collection and presentation of data **Hours: 12**

Collection of data: Data collection - Primary data - secondary data and Classification. **Classification and Tabulation:** Types of classification - Tabulation of data - Parts of a table - types of tabulation. **Diagrammatic representation**: Rules, limitations - Bar diagram (Simple, multiple, component / staked, proportional / percentage) - pie diagram. **Graphical representation**: rules, limitations - difference between diagram and graphs - histogram - frequency polygon - frequency curve - Ogive curve

UNIT III: Measures of Central Tendency **Hours: 12**

Introduction - characteristics - Arithmetic mean - Median - Mode - Geometric mean, Harmonic Mean (definition, merits and demerits, problems based on raw, discrete and continuous data) (Direct method only)

UNIT IV: Measures of Dispersion **Hours: 12**

Definition - Characteristics - Range - Mean derivation - Standard deviation and Standard errors - Coefficient of variation (definition, merits & demerits, problems based on raw data only). ANOVA- Student T-test.

UNIT V: Skewness and Kurtosis **Hours: 10**

Skewness: Definition, Types, Karl Pearson coefficient of Skewness, Bowley's coefficient Skewness - Related problems, Kurtosis & moments (concept only)

Unit –VI: Latest learnings (For CIA Purpose only) **Hours: 12**

Latest development related to the course during the semester concerned

TEXT BOOKS

1. "Biostatistics" - P.N. Arora, P.K.Malhan, Himalaya Publishing House (2014).
2. "Fundamentals of Biostatistics" - Veer Bala Rastogi, Ane Books Pvt. Ltd. (2008).

REFERENCE BOOKS

1. "Introduction to Biostatistics" – SokalandRohlf – Toppan Co. Japan
2. "Primer of Biostatistics" – Stanton A. Clantz – The McGraw Hill Inc. Newyork.

COURSE OUTCOME

The Learners would have the ability to

- Understand the basic concept of statistics, and also apply statistical measures which are used to analyze the data.
- Acquire knowledge on measures of central tendency and Measures of dispersion.
- Prepare reports to conclude the findings in data analysis.
- Review and Extend knowledge of Measures of Dispersion.
- Understand the concept of Skewness & kurtosis.

SEMESTER – IV - MAJOR PRACTICAL - IV (Covering CC-7)
PLANT BIOTECHNOLOGY

Course Code: U4R1BTCC8P **Max Marks: 100**
Hours/Week: 5 **Internal Marks: 40**
Credits: 5 **External Marks: 60**

EXPERIMENTS:

1. Preparation of plant tissue culture media and Organ culture (Shoot tip, nodal and leaf culture)
2. Callus culture: Initiation and regeneration.
3. Anther culture for the production of haploids.
4. Isolation, culture and fusion of protoplasts.
5. Isolation of plant genomic DNA from plant by CTAB method
6. Synthetic seeds (Entrapment method).
7. Establishment and maintenance of suspension culture.
8. Separation and estimation of secondary metabolites β-carotene from Carrot and anthocyanin from Beetroot
9. Extraction & Separation of Chlorophyll A & B using Column Chromatography.

REFERENCES

1. Plant Tissue culture theory & practical, Bhojwani and Razdan, M.K, 2004.
2. Tissue culture, methods and application,Hurse P.I. and Patterson, M.K.
3. Plant cell culture – A Practical Approach, Dixon, L.A. and R.A. Gonzales. Revan Press, New York.
4. Plant Tissue Culture Methods and Applications in Agriculture, Quak, F, Academic Press, New York, 1981.

SEMESTER - IV – SBE - I
MARINE BIOTECHNOLOGY

Course Code: U4R1BTSBE1 **Max Marks: 100**
Hours/Week: 2 **Internal Marks: 25**
Credits: 2 **External Marks: 75**

COURSE OBJECTIVES

- To understand the economically important marine animals and their potency as toxins and drugs.
- To learn the knowledge on the degradation process for discharged wastes.
- To know the diseases of aquaculture animals and its management.
- To know the importance of Marine toxin.
- To make the students to know about various techniques involved in water quality management.

Total Instructional Hours: 24

UNIT I: Economical importance of marine resources **Hours: 04**

Wealth of the sea-Economically important marine organisms– finfishes, shrimp, crab, edible oysters, pearl oysters and marine algae.

UNIT II: Toxins and their action **Hours: 04**

Marine toxins from animals–sources and pharmacological potentials of tetrodotoxins, conotoxins and ciguatera toxins.

UNIT III: Potential bioactive compounds **Hours: 04**

Bioactive compounds of the sea source, Collagen, Gelatin, Heparin, Chitosan. Antioxidants-omega 3 fatty acids and carotinoids.

UNIT IV: Disposal of waste in marine environment **Hours: 05**

Oil spill management, Biodegradation of pesticides, Heavy metals discharged in coastal waters, Management of solid wastes disposed into coastal waters

UNIT V: Disease and water quality management **Hours: 05**

Diseases associated with cultured shrimps and fishes-disease management-antibiotics, Immunostimulants, diagnostic kits.Water quality management in hatcheries and grow out ponds.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 02**

Latest development related to the course during the semester concerned

TEXT BOOKS

1. Milton Fingerman and Rachakonda Nagabhushanam, "Recent Advances in
2. Marine Biotechnology (Series) Biomaterials and Bioprocessing", Science Publishers, 2009.
3. Proksch and Werner E.G.Muller, Frontiers in Marine Biotechnology, Horizon Science, 2006.

REFERENCES

1. "Marine Biotechnology: Volume I, Pharmaceuticals and Bioactive Natural Products"Attaway D.H. and Zaborsky O.R., (eds)., New York: Plenum. 1993.
2. Powers D.A., "New frontiers in marine biotechnology: Opportunities for the 21st century", In: Marine Biotechnology in the Asian Pacific Region (eds). C.
3. The World Bank and SIDA G. Lundin and R. A. Zilinskas.. Stockholm. 1995.

COURSE OUTCOMES

- The students would be aware of the commercially important Marine Products
- The students would be aware of Toxin Degradation.
- The students would be aware of Diseases and Quality Management
- To know the value, production, application and marine products.
- Students will be able to know the knowledge about water quality management.

SEMESTER -V - CORECOURSE-IX
BIOINSTRUMENTATION

Course Code: U5R1BTCC9 **Max Marks: 100**
Hours/Week: 7 **Internal Marks: 25**
Credits: 5 **External Marks: 75**

COURSE OBJECTIVES

- To understand the principles of analytical techniques and equipment used in Biological science.
- To have a fundamental knowledge regarding the Microscopy, Spectroscopy, Centrifugation.
- To acquire knowledge on the Chromatographic method for the separation of biological products.
- To understand the construction and applications of the instruments used in the studies related to various disciplines of biological sciences.
- To expose the students on the basic understanding of electrophoresis.

Total Instructional Hours: 84

UNIT I: Basic Instruments **Hours: 15**

Physical balance, pH meter, Autoclave, Hot air oven, isoelectric point. Principles and application of light microscopy, phase Contrast, Bright and Dark field Microscopy fluorescence Microscopy.

UNIT II: Centrifuges and Chromatography **Hours: 15**

Basic principle of centrifugation and its types - Ultra Centrifugation, Density gradient Centrifugation, Differential centrifugation, Standard Sedimentation coefficient. Chromatography – Principle, Types and application: Paper chromatography, Thin layer chromatography, Column Chromatography and HPLC and Gas chromatography.

UNIT III: Spectroscopy **Hours: 16**

Principle and applications of Colorimeter, Bomb calorimeter, Fluorescence spectroscopy, UV/VIS Spectroscopy, IR Spectroscopy, Raman Spectroscopy

UNIT IV: Tracer Techniques **Hours: 17**

Radioactive isotope – Half life, GM counter, Liquid scintillation counter, Autoradiography, Semi auto analyzer, ELISA Reader and Thermal cycler.

UNIT V: Electrophoretic Techniques **Hours: 17**

Electrophoresis- Agarose Gel Electrophoresis, SDS-PAGE, Native Gel, 2D gel and gradient Gel Electrophoresis, Pulsed field Gel Electrophoresis (PFGE).

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 04**

Latest development related to the course during the semester concerned

TEXT BOOKS

2. Analytical biochemistry and separation techniques-A laboratory manual, P. Palanivelu, 2001, 2nd edition, Tulsi books centre**.**
3. Biophysical chemistry – Principles and techniques, Upadhyay and Nath, 3rd edition, 2002, Himalaya publishing home.
4. Laboratory manual in biochemistry, J. Jayaram 1981, Wiley publisher.
5. Bioinstrumentation, L. Veerakumari, 2011, MJP publishers**.**

REFERENCE BOOKS

1. Analytical biochemistry and separation techniques-A laboratory manual, P. Palanivelu, 2001, 2nd edition, Tulsi books centre**.**
2. Principles and techniques of practical biochemistry, Keith Wilson and John walker, 2000, 5th edition, Cambridge University press.
3. Physical biochemistry- application to biochemistry and molecular biology, Freifelder, 1982, 2nd edition
4. W. H. Freeman and company, San Fransisco.

NET REFERENCES

1. www.explainthe stuff.com.
2. www.chemguide.co.uk.

COURSE OUTCOME

- Understand the general laboratory procedures and maintenance of research equipments viz. Microscopy, pH meter, Spectroscopy, Electrophoresis.
- Understand how to separate amino acids and sugars using paper & thin layer chromatography.
- Understand the principle of flame photometer and bomb calorimeter.
- Realize the principle and applications of gas liquid chromatography and HPLC.
- Understand the principles and applications of electrophoresis

SEMESTER --V - CORECOURSE- X

BIOINFORMATICS

Course Code: U5R1BTCC10 **Max Marks: 100**
Hours/Week: 7 **Internal Marks: 25**
Credits: 5 **External Marks: 75**

COURSE OBJECTIVES

- To enable the students to understand the scope of Bioinformatics
- Students will be able to make informed decisions based on data
- Understanding the popular bioinformatics database
- Learn Fundamentals of Databases and Sequence alignment
- Approaches to drug discovery using bioinformatics techniques

Total Instructional Hours: 84

UNIT I: History, scope and importance **Hours: 15**

Important contributions - aims and tasks of Bioinformatics - applications of Bioinformatics - challenges and opportunities - internet basics- HTML - introduction to NCBI data model- Various file formats for biological sequences

UNIT II: Databases - tools and their uses **Hours: 15**

Importance of databases - Biological databases-primary sequence databases- Composite sequence databases- Secondary databases- nucleic acid sequence databases - Protein sequence data bases, structure databases - bibliographic databases - specialized genomic resources-analysis packages

UNIT III: Sequence alignment methods **Hours: 16**

Sequence analysis of biological data-Significance of sequence alignment- pairwise sequence alignment methods- Use of scoring matrices and gap penalties in sequence alignments- multiple sequence alignment methods - Tools and applications of multiple sequence alignment.

UNIT IV: Sequence analysis **Hours: 17**

Gene predictions strategies - protein prediction strategies - molecular visualization tools-phylogenetic analysis: multiple alignments and concept of trees- phylogenetic trees.

UNIT V: Drug discovery process **Hours: 17**

Discovering a drug - target identification and validation - identifying the lead compound - optimization of lead compound - chemical libraries.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 04**

Latest development related to the course during the semester concerned

TEXT BOOKS

1. Bioinformatics- Concepts, Skills, and Applications., S.C. Rastogi., 2003.CBS Publishing
2. Introduction to Bioinformatics.,T K Attwood, D J parry-Smith 2005. Pearson Education, 1st Edition, 11th Reprint.

REFERENCES

1. Bioinformatics., C S V Murthy, 2003.Himalaya Publishing House, 1st Edition.
2. Bioinformatics sequence and genome analysis, David W. Mount., 2004, Cold spring harbor laboratory press.
3. Basic Bioinformatics.,S. Ignacimuthu, S.J., , Narosa, 1995. Publishing House, 1995.

COURSE OUTCOME

- The students can able to do the sequence analysis and phylogenetic prediction with their own knowledge.
- Also capable to search the protein sequence
- Capable to analyses the genetic sequence
- The students will be able to structural information in the databases.
- Helps to ensure the sequence analysis work successfully without any error.

SEMESTER- V

MAJOR PRACTICAL –V (Covering CC-9 and CC-10)

BIOINSTRUMENTATION AND BIOINFORMATICS

Course Code: U5R1BTCC11P **Max Marks: 100**
Hours/Week: 7 **Internal Marks: 40**
Credits: 5 **External Marks: 60**

BIOINSTRUMENTATION EXPERIMENTS:

1. Preparation of buffers and determination of pH using pH meter
2. Estimation of Protein by Lowry/ Burette method
3. Estimation of Amino acid by Ninhydrin method.
4. Differential and density gradient centrifugation.
5. Differential and density gradient centrifugation.
6. Separation of pigments by Paper Chromatography and Column Chromatography.
7. Separation of amino acid by Thin layer Chromatography.
8. Demonstration of Agarose gel Electrophoresis.
9. Poly Acrylamide Gel Electrophoresis.
10. Biochemical Estimation of DNA/ RNA using Spectrophotometer.
11. Isolation and separation of plasmids and nucleic acids using agarose gel electrophoresis.
12. Demonstration of PCR

BIOINFORMATICS EXPERIMENTS:

1. Protein Sequence Database
   i. SWISSPROT ii. PROSITE iii. PIR
2. Nucleotide Sequence Database
   i. DDBJ ii. EMBL iii. GENBANK
3. Structural Database
   i. PDB ii. MMDB
4. Bioinformatics Tools.
   i. PDB analysis of protein structure by RASMOL
   ii. BLAST and FASTA search
   iii. Alignments – pair wise and multiple sequence alignment – Clustal W and X

REFERENCE BOOKS:

1. Analytical biochemistry and separation techniques-A laboratory manual, P. Palanivelu, 2nd edition 2001, Tulsi books centre.
2. Laboratory manual in biochemistry, J.Jayaram 1981, Wiley publisher.
3. Principles and techniques of practical biochemistry, Keith Wilson and John walker, 5th edition 2000, Cambridge University Press.
4. Bioinformatics., CSV Murthy, 2003. Himaliaya Publishing, 1st Edition.

SEMESTER – V- MBE - I
PHARMACEUTICAL BIOTECHNOLOGY

Course code: U5R1BTMBE1 **Max Marks: 100**
Hours/ Week: 5 **Internal Marks: 25**
Credits: 4 **External Marks: 75**

COURSE OBJECTIVES

- To know the Systemic pharmaceutical Biotechnology
- To critically analyze the day to day development in new drugs
- To understand the principles of Pharmacodynamics
- To learn the preparative methodologies of various drug formulations to control disease and symptoms
- To update newer developments in pharmaceutical Biotechnology/emerging trends/ novel mechanisms of drug action etc.

Total Instructional Hours: 60

UNIT I: Introduction **Hours: 08**

Introduction to Pharmaceutical Biotechnology, history, nature and source of drugs. Drug targets. Structure and functions; Physiochemical properties of drugs. Pharmacodynamics, pharmacokinetics and drug metabolism. Screening and isolation of bioactive compounds.

UNIT II: Drugs **Hours: 12**

Adverse response to drugs, Drug tolerance, Drug intolerance, drug allergy, drug induced side effects. Tachyphylaxis, biological effects of drug abuse and drug dependence, vaccination against infection, factor that modifies the effect of drug. Assay of drug potency- bioassay and immunoassay.

UNIT III: Pharmacodynamics and toxicity **Hours: 08**

Protein mode of action and pharmacodynamics- Overview of the mode of action of a biopharmaceutical Pre-clinical studies- -Toxicity (Reproductive toxicity and Teratogenicity, Mutagenicity, Carcinogenicity and Other tests); Clinical trials - Clinical trial design, Trial size design and study population.

UNIT IV: Pharmaceutical products **Hours: 14**

Biopharmaceutical and biological drug development, Manufacturing of biopharmaceutical, therapeutic proteins and peptides. Recombinant growth hormones, growth factors, therapeutic monoclonal antibodies, therapeutic enzymes and their application in health care.

UNIT V: Pharmaceutical regulations **Hours: 15**

Role and remit of regulatory authorities-The Food and Drug Administration (FDA), Investigational new drug application, New drug application; European regulations, National regulatory authorities, European medicines agency and the new EU drug approval system, Centralized procedure, Mutual recognition, Indian drug regulations and pharmacopeia.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 03**

Latest development related to the course during the semester concerned

TEXT BOOKS

1. Pharmaceutical Biotechnology-Concepts and Applications, Gary Walsh, 2007. John Wiley & Sons Ltd.,
2. Textbook of Pharmacology, Barar FSK, 2013, 1st Edition, S. Chand Publishing.

REFERENCE BOOKS

1. The Pharmacological Basis of Therapeutics, Laurence Brunton, Bruce A Chabner, Bjorn Knollman, 2013, Goodman & Gillman's, 12th Edition, McGraw-Hill Education.
2. The Theory and Practice of Industrial Pharmacy, Lachman/Liebermans: Roop K Khar, Vyas. SP, Farhan J Ahmad, Gaurav K Jain, 2013, 4th Edition, CBS Publishers and Distributors.
3. Textbook of Pharmacology, Barar FSK, 2013, 1st Edition, S. Chand Publishing.

COURSE OUTCOME

- Elucidate scientific principles for Biotechnology in pharmaceutical product development
- Explain the components of, and challenges in development of biologicals and drugs in the pharmaceutical and Biotechnology industry
- Appreciate the economic values of pharmaceutical products
- The students will be able to know the pharmaceutical regulations
- Understand the connecting link between pharmacodynamics and toxicity

SEMESTER-V - SBE - II
MEDICAL LABORATORY TECHNOLOGY

Course Code: U5R1BTSBE2 **Max Marks: 100**
Hours/Week: 2 **Internal Marks: 25**
Credits: 2 **External Marks: 75**

COURSE OBJECTIVES

- To understand the basic principles and procedure followed in medical laboratory
- To develop a skill in that field for initiating the laboratory
- To understand the principles of hematology
- To get knowledge about clinical microbiology
- To know the detail knowledge about clinical diagnosis

Total Instructional Hours: 24

UNIT I: Basic needs for Medical Laboratory **Hours: 04**

Introduction-Organization of Clinical laboratory-basic needs, functional components - Basic laboratory safety, Carcinogens, Chemicals and radioactive substances, Corrosive chemicals, , Explosive chemicals, Firefighting equipment, First aid in laboratory accidents, Flammable chemicals-First Aid in laboratory accidents.

UNIT II: Human body and Human system **Hours: 05**

Introduction to Body organs and system, Physiology of Organs and system-Cardiovascular system, Respiratory system, excretory system. Units of measurement: The Metric system-Preparation of reagent Solutions (Molar, Percentage)-Laboratory calculations.

UNIT III: Hematology **Hours: 04**

Introduction- Components of Blood and their functions-Human Blood group systems-Rh Blood group-Collection of Blood-transportation of Blood-storage of Blood-Haematopoietic system of the body-Determination of Haemoglobin concentration. Clinical haematology, Anticoagulants, Blood cell counts, Blood film examination.

UNIT IV: Clinical Microbiology **Hours: 05**

Microbiology: Laboratory Identification of infectious bacterial agents-Mycotic infections-Human parasites. Media used for culturing of Pathogens-Pathological features of *Salomonella typhi, Vibrio cholerae* and *Mycobacterium tuberculosis.* Emerging viruses and diseases.

UNIT V: Clinical Diagnosis **Hours: 04**

Urine analysis-Abnormal porphyrin metabolism, Blood in urine, Calcium in urine, Casts in urine, Chemical examination of urine, Semen analysis-Semen examination, Evaluation of infertility, Expensive examination of the female, Pregnancy test- Advantages of serum testing, Dipstick ICT pregnancy test, ELISA pregnancy test, ICT techniques for urine, Interpretation of test results, Material provided with the kit, Performance characteristics, Slide test for pregnancy.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 02**

Latest development related to the course during the semester concerned

REFERENCES

1. Kanai L.Mukherjee Medical laboratory technology vol I,II,and III
2. Basic and Practical Microbiology-Ronald M. Atlas, Mac.Milleen Company, New york.
3. Harper's illustrated biochemistry, David A. Bender et al., Mc Graw Hill, 27th edition 2006, New Delhi.

LEARNING OUTCOME

- Assist physicians in the diagnosis and treatment of diseases
- The student will be get knowledge about prevention and diagnosis of diseases
- Understand the principle to work in hospitals or doctors office
- The student will be able to get diagnosis the disease
- Understand the principles of clinical sample collection

SEMESTER – VI - CORE COURSE- XII
ANIMAL BIOTECHNOLOGY

Course Code: U6R1BTCC12 **Max Marks: 100**
Hours/Week: 6 **Internal Marks: 25**
Credit: 5 **External Marks: 75**

COURSE OBJECTIVES

- It gives introduction to the various transformation techniques employed in animal systems.
- It also describes the application of genetically modified animals in the various fields of science.
- The techniques of animal cell culture and its industrial and medical applications are described.
- To understand the principles and applications of embryology.
- To know the knowledge about gene therapy.

Total Instructional Hours: 72

Unit I: Embryology **Hours: 15**

Gametogenesis and fertilization in animals, Molecular events during fertilization, genetic regulations in embryonic development – Artificial Fertilization methods (IVF, IUF, ICSI) and embryo transfer, Superovulation, Polycystic ovarian syndrome (PVS), Collection and preservation of embryo, culture of embryos, culture of embryonic stem cells and its applications.

Unit II: Animal cell culture **Hours: 15**

Fundamentals, Facilities and Applications. Media preparation for Animal cells culture. Types of cell culture: Primary and secondary cell culture, cell transformation, cell lines, Insect cell lines, stem cell cultures, Tests: cell viability and Cytotoxicity. Biology of cultured cells, measurement of growth, cell synchronization, senescence and apoptosis. Organ culture and transplantation, Cryopreservation.

Unit III: Genetic engineering in animals **Hours: 12**

GMO (Genetically modified organism), methods of DNA transfer into animal cells - calcium phosphate co precipitation, micro-injection, electroporation, Liposome encapsulation, Biological vectors - Bacteria, Virus. Hybridoma technology, DOLLY, Vaccine production.

Unit IV: Gene therapy **Hours: 15**

Mapping of human genome, Human Genome Project (HGP). RFLP, RAPD and its applications. Gene silencing, DNA finger printing and Forensic Science. Molecular diagnosis of Genetic disorders.

Unit V: Transgenics **Hours: 11**

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

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 04**

Latest development related to the course during the semester concerned

TEXT BOOKS

1. Textbook of Animal biotechnology, B Singh, SK Gautam and MS Chauhan. 2013. The Energy and Research Institute.
2. Biotechnology: V: (Including Animal Cell Biotechnology, Immunology and Plant Biotechnology).M.K. Sateesh. 2010. 2nd Edition. New Age International.

COURSE OUTCOME

At the end of the course,

- The students will gain an insight into the concepts and techniques of animal biotechnology and its wide industrial and medicinal applications.
- The students are be able to gain knowledge on GMO and production of useful compounds
- The students are be able to know the production of vaccine
- The students are be able to understand the concepts and methods in Genetic engineering
- They can also go for further research works during M.Phil and PhD courses

SEMESTER- VI - CORE COURSE-XIII
ENVIRONMENTAL BIOTECHNOLOGY

Course Code: U6R1BTCC13 **Max Marks: 100**
Hours/Week: 6 **Internal Marks: 25**
Credits: 5 **External Marks: 75**

COURSE OBJECTIVES

- The course explains the application of biotechnology in environment.
- To understand the energy sources, environmental pollution and remediation using biotechnology and its control.
- Students will get an idea about the hazards to our environment, solutions to protect and for sustainable development.
- To know the importance in the era of industrialization leading to environmental hazards and it will help students to take up a career in tackling industrial pollution
- To get knowledge about biogeotechnology

Total instructional Hours: 72

UNIT I: Basic concepts of ecology **Hours: 15**

Interaction between environment and biota; Concept of habitat and ecological niches; Limiting factor; Energy flow, food chain, food web and tropic levels; Ecological pyramids and recycling, biotic community-concept, structure, dominance, fluctuation and succession; N.P.C and S cycles in nature. Population ecology.

UNIT II: **Environmental pollution** **Hours: 15**

Issues and scopes of environmental biotechnology, Types of pollution-methods for the measurement of pollution, air pollution and its control, Air pollution – Source of air pollution, Classification of air pollutants and its control – Electrostatic precipitator. Global environmental problems: Ozone depletion, Green house effect and Acid rain, Land and noise pollution, Water pollution -Waste Water treatment: Primary, Secondary and Tertiary treatment, Eutrophication.

UNIT III: Industrial waste water **Hours: 15**

Environmental problems and treatment of industrial waste waters: Distillery, tannery, paper pulp etc..Toxicity testing in waste water treatment plants. Solid waste management- Anaerobic digestion, Composting

UNIT IV: Biodegradation of xenobiotics **Hours: 14**

Mechanisms and factors affecting biodegradation. Pollution problems and biodegradation of simple aliphatic, aromatic, polycyclic aromatic hydrocarbons, halogenated hydrocarbons, azo dyes, lignin and pesticides. Bioremediation: Biostimulation and bioaugmentation , In situ and ex situ bioremediation technologies for various pollutants and sites. Bioremediation of oil spills and heavy metal pollution. Use of GMO in bioremediation. Biofilteration of polluted air.

UNIT V: Biogeotechnology **Hours: 10**

Bioleaching of metals, biobeneficiation, microbially enhanced oil recovery, biodesulfurization of coal. Microbes in the environment- Biofilms and its relevance in microbial survival, its effect in the environment. Microbial Insecticides: Biopesticides. Bacterial, fungal and viral insecticide

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 03**

Latest development related to the course during the semester concerned

TEXT BOOKS

1. Environmental Biotechnology- Dilip Kumar MarKandey and Neelimn Rajvaidya (APH publishing corporation, New Delhi)
2. Applied Biotechnology – LP Rema (MJP publishers, Chennai).
3. Biotechnology – Fundamentals and application -SS Purohit SK Mathur

REFERENCES

1. Environmental Biotechnology by Alan Scragg. Pearson Education Limited, England.
2. Environmental Biotechnology by S.N. Jogdand. Himalaya Publishing House.Bombay.
Online resources Authentic Web based resources like NCBI, PubMed, Science direct etc.

COURSE OUTCOME

At the end of the course:

- The students will, obtain knowledge on basic principles and technologies of decontamination of persistent organic pollutants (dangerous contaminants of the environment) mainly by means of the biological approaches i.e. using bioremediation etc.
- The students will know about the principles and techniques underpinning the application of biosciences to the environment
- Realize the waste management and sewage treatment systems
- Acquire knowledge on bioremediation and microbial leaching
- Know the Biosafety and environmental monitoring regulations

SEMESTER - VI

MAJOR PRACTICAL- VI (Covering CC--12 and CC-13)
ANIMAL BIOTECHNOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY

Course Code: U6R1BTCC14P **Max Marks: 100**
Hours/Week: 5 **Internal Marks: 40**
Credits: 5 **External Marks: 60**

ANIMAL BIOTECHNOLOGY:

1. Preparation of Media for cell culture.
2. Trypsinization.
3. Cell viability test.
4. Cell counting.
5. Cytotoxicity testing
6. Animal Handling & Care (Demo)

ENVIRONMENTAL BIOTECHNOLOGY:

1. Determination of total dissolved solids, BOD and COD of water sample
2. Estimation of Chromium in Industrial effluent by colorimetry
3. Estimation of Calcium & Chloride in water sample by titration method
4. Isolation of bacteriophages from sewage
5. Sludge analysis (a) Organic matter, (b) Nitrogen (c) Phosphorous (d) Potassium
6. Biodegradation of industrial aromatic compounds
7. Determination of Phosphate and nitrate from sewage samples
8. Microbial analysis of water-MPN

REFERENCE

1. Animal Cell Culture: A practical approach, Freshney, E.D., 2000, John Wiley Pub., New York.
2. Handbook of cell and Organ culture, Marchan, D, J. (2^{nd} Ed). Burgess Pub. Co., Minneapolis, USA. (1964).

SEMESTER -IV - MBE - II
FOOD AND INDUSTRIAL BIOTECHNOLOGY

Course Code: U6R1BTMBE2 **Max Marks: 100**
Hours/Week: 4 **Internal Marks: 25**
Credits: 4 **External Marks: 75**

COURSE OBJECTIVES

- This paper adds information about the role of microorganisms in many food industries both in production and spoilage processes.
- To create awareness among the students about the food quality analysis and the role of government organizations involved in food quality control.
- To encode the importance processing, preservation and packaging of many food products
- To study the principles and methodologies of Industrial Biotechnology.
- Motivate the students to form the Industries and R and D Labs.

Total Instructional Hours: 48

UNIT I: Introduction to Food Technology **Hours: 08**

Definition and Scope of Food Technology - Components of food industry; Quality factors in food- Functional groups and properties. Nutritive factors of food constituents – protein, carbohydrates, fats in nutrition, Dietary fiber (fibre), Vitamins.

UNIT II: Food Preservation and Packaging **Hours: 08**

Food preservation: Principles of food preservation – methods of preservation: Physical (irradiation, drying, heat processing, smoking, chilling and freezing. Chemical (Sodium benzoate Class I & II); Biological: Probiotics and bacteriocins. Brief description of packaging of frozen products, dried products, types of packaging.

UNIT III: Introduction to Industrial Biotechnology **Hours: 10**

Introduction - history - isolation and screening of industrially important microorganisms, enrichment liquid culture and enrichment cultures using solid media. Preservation and storage of microbial cultures- lyophilization, liquid nitrogen, Strains improvement.

UNIT IV: Sterilization and Growth Kinetics **Hours: 10**

Microbial growth kinetics – Batch culture, fed-batch culture and continuous culture, up-stream processing - media formulation for industrial fermentation. Sterilization: Batch and continuous sterilization systems - filter sterilization. Downstream processing – removal of microbial cells and solid media, foam separation, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane process, drying and crystallization.

UNIT V: Fermented Products **Hours: 10**

Industrial production using microorganisms: Enzymes - Amylase, Acid - Citric acid, Alcohol - Ethanol, Beverages - wine, Bakery products -Bread, antibiotics -penicillin, vaccine - polio, SCP - *Spirulina*, Vitamins - Vitamin B_{12}.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 02**

Latest development related to the course during the semester concerned

TEXT BOOKS

1. Food Biotechnology, Varun Mehta, 2007. Neha Publishers & Distributors
2. Food Microbiology- Frazier, 2011, Tata McGraw-Hill Education.
3. Biotechnology: A text book of Industrial microbiology – Wulfcrueger and Anne liesecrueger, 2000. Panima publishing corporation, New Delhi/Bangalore

REFERENCES

1. Food Biotechnology, SecondEditionKalidasShetty October 11, 2005 by CRC Press
2. Biotechnology, 1983, VI-VIII, Rehm, H.J. and Reed,G, VerlagChemie,Wainheim.
3. Genetic Engineering Applications for Industry, 1981, Paul,J.K.,Noyer Corporation, New Jersey.
4. Principles of fermentation technology - P.F. Stanbury, A. Whitaker and S.J. Hall Elsevier publication, second edition, 2005.

NET REFERENCES

1. http://as.wiley.com/WileyCDA/WileyTitle/productCd-1118384911.html
2. http://www.ftb.com.hr/

COURSE OUTCOME

- Construct the framework to establish a Bioreactor set up.
- Integrate downstream processing after upscale execution.
- Explain the essentials for Bioprocess Technology in microbiologists perspective
- Discuss the theory and mathematics behind microbial growth
- Be able to understand in depth the techniques/process used in microbial products using fermentation technology

SEMESTER -VI - MBE - III
NANOBIOTECHNOLOGY

Course Code: U6R1BTMBE3 **Max Marks: 100**
Hours/Week: 4 **Internal Marks: 25**
Credit: 4 **External Marks: 75**

COURSE OBJECTIVES

- The aim of this course is to provide basic knowledge in the interface between chemistry, physics and biology on the nano structural level with a focus on biotechnological usage.
- To get knowledge about characterization of the Bioproducts
- To aware the basic principles about protein nanostructures
- To get basic principles about spectroscopy
- The students get knowledge about applications of nanotechnology

Total Instructional Hours: 48

UNIT I: Nano Biology **Hours: 09**

Concepts, definitions, prospects; nanoparticles – size, shape, properties. Bio nanoparticles – nanostarch, nano composites – dendrimers. Hot–Dot nanoparticles. Types of biomaterials. Biodegradable polymers.

UNIT II: Tools in Nano Biotechnology **Hours: 10**

Analysis of bimolecular nanostructures by Atomic Force Microscopy, Scanning Probe Electron Microscopy. Nanofabrication - lithography. Drug nanoparticles - structure and preparation, Liposomes, Cubosomes and hexosomes. Lipid based nanoparticles-liquid nano dispersion, solid liquid nanoparticles

UNIT III: Protein and DNA Based Nanostructures **Hours: 08**

S-Layer proteins, Biotemplating -Engineered Nanopores, protein based nanostructure formation, Nanoparticle-biomaterial hybrid systems -De Novo Designed Structures, Biomolecular Motors – DNA-Protein nanostructures, Biomimetic fabrication of DNA-based metallic nanowires, conjugates and networks.

Unit IV: Spectroscopy **Hours: 09**

Relationship between electromagnetic radiation range and spectroscopy. Fundamentals and working principle of UV-Visible spectroscopy, difference between absorbance and surface plasmon resonance (SPR), principle of Fourier-Transformation, fundamentals and working principle of FT-IR, application in functional group determination of organic compounds (-OH, -COOH, -NH2, -NH-, -O-).

UNIT V: Application of Nanotechnology **Hours: 09**

Nanotubes, Nanorods, Nanofibers and Fullerenes for nanoscale drug. Bionanoelectronics. Applications of nanobiotechnology in medicine, drug designing and cancer treatment. Medical, social and ethical considerations of nanobiotechnology.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 03**

Latest development related to the course during the semester concerned

REFERENCES

1. Nanobiotechnology and Nanobiosciences, Claudio Nicolini, Pan Stanford Publishing Pte. Ltd, 2009.
2. Nanobiotechnology, Concepts, Applications and perspectives, C.M. Niemeyer and C.A. Mirkin, WILEY-VCH, Verlag Gmb H & Co, 2004.
3. Bionanotechnology, Lessons from Nature, S. David Goodsell, Wiley-Liss, Inc., 2004.
4. Nanotechnology in Drug Delivery, Melgardt M.deVilliers, Pornanong Aramwit, Glen S. Kwon, Springer-American Association of Pharmaceutical Scientists Press 2009.
5. Nanomedicine, Robert A. Freitas Jr. Volume I: Basic Capabilities, Landes Bioscience, 1999.

COURSE OUTCOME

- Understanding about the fundamentals of nanotechnology in biomedical and biological research.
- This course will also guides on how to use and make nanomaterials.
- The students will be able to understand the principles of spectroscopy
- Understand the nanotechnology mechanism and related events of microbes
- Acquire knowledge on physiological response of nanoproducts

SEMESTER- VI - SBE- III
MUSHROOM CULTIVATION AND VALUE ADDITION

Course Code: U6R1BTSBE3 **Max Marks: 100**
Hours/Week: 2 **Internal Marks: 25**
Credits: 2 **External Marks: 75**

COURSE OBJECTIVES

- To study the general characteristics and structure of Mushrooms.
- To know about the importance and need have Mushrooms.
- To acquire knowledge regarding the cultivation and contamination possibilities of Mushrooms.
- Motivate the students to form a Mushroom cultivation unit.
- To understand the effective methodology to cultivate Oyster, button and milky mushrooms.

Total Instructional Hours: 24

UNIT I: Introduction to Mushrooms **Hours: 05**

Introduction, History of mushroom cultivation, edible and non-edible mushrooms, Classification and distribution of mushrooms, most commonly cultivated mushrooms in the world, life cycle of mushrooms. Research centers: International level, National level and Regional level.

UNIT II: Spawn preparation and production **Hours: 05**

Spawn preparation: Isolation of pure culture, Nutrient media for pure culture, layout of spawn preparation room , raw material of spawn ; sterilization , preparation of mother spawn and multiplication. Production methodology – layout of mushroom shed - small scale and large scale production unit. Types of raw material – preparation and sterilization; Mushroom bed preparation – maintenance of mushroom shed – harvesting method storage and preservation of mushrooms.

UNIT III: Cultivation and economic importance **Hours: 05**

Cultivation of following types of mushroom – milky Mushroom, oyster Mushroom, button Mushroom and any one medically valuable Mushroom - Preparation of compost and cultivation of *Agaricus bisporus* and *Pleurotus flabelltus*. Economics of mushroom cultivation : Fixed assets, recurring expenditure, labour, economics of cultivation throughout the year and seasonal growing. Cost benefit ratio : Marketing in India and abroad – Export value.

UNIT IV: Nutritional values of Mushrooms **Hours: 02**

Nutrient values of Mushrooms – protein, carbohydrate, fat, fibre, vitamins and amino acid contents and pharmacological values. – short and long term storage of Mushrooms. Medicinal value of Mushrooms.

UNIT V: Mushroom recipes and research **Hours: 05**

Soup, cutlet, omlette, samosa, pickles, curry, chutney and Briyani. Research centers: International level, National level and Regional level. Formulation of project report for getting finance from funding agencies.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 02**

Latest development related to the course during the semester concerned

TEXT BOOKS

1. Oyster Mushrooms, Marimuthu et al., 1991, Dept. of Plant pathology, TNAU, Coimbatore.
2. Mushroom cultivation, Tewan and Pankaj Kapoor S.C. 1993, Mittal Publication. Delhi.

REFERENCES

1. Book of Mushrooms, Nita Bahl, 1988, Hand II ed., Vol I & II.ct and environmental impact. 2nd ed., CRC press.
2. Mushroom cultivation: A practical guide to growing mushrooms at home, Paul Stamets, J.S. and Chilton, J.S. 2004, Agarikon Press
3. Mushrooms: Cultivation, nutritional value, medicinal effe ct, Shu Fing Chang, Philip G. Miles and Chang, S.T. 2004.

NET REFERENCES

1. www.tnau.ac.in/micro/ug/html
2. www.scienceandsociety-dst.org/highlights.html

COURSE OUTCOME

- Understand the prospects of mushrooms and its cultivation.
- Gain the knowledge of cultivation of different types of edible mushrooms.
- Understand, appreciate and develop the self-confidence for embarking on self employment.
- Understand the mushroom characteristics and their importance
- Discuss on the principles and methods involved in different stages of mushrooms
- Apply their knowledge in cultivating various tropical and subtropical mushrooms and their role in human welfare.

MBE- IV - CANCER BIOLOGY

Hours/Week: 4 **Max Marks: 100**
Credit: 4 **Internal Marks: 25**
External Marks: 75

COURSE OBJECTIVES

- This paper has been designed to educate students on various genetic and molecular changes behind the transformation of normal cells into malignant cancer cells.
- These modifications include unregulated cell proliferation, evasion of cell death, and metastasis.
- This paper will describe factors that contribute to cancer development and discuss cancer diagnosis and currently available therapeutic treatments.
- To understand the principles of molecular genetics of cancer cells
- To get knowledge about tumor immunology

Total Instructional Hours: 48

UNIT I: Introduction to cancer **Hours: 08**

Cancer: Definition, Cancer incidence and mortality; Origin of neoplastic cells; Cancer as cellular disease; Types of Cancer: Benign Tumors vs. Malignant Tumors, Common Symptoms and Causes of Cancer

UNIT II: Cell cycle regulation and cell signaling in cancer **Hours: 10**

Growth Characteristics of Malignant Cells; Cell Cycle Regulation; Evasion of Apoptosis (Programmed Cell Death); Growth Factors; Signal Transduction Mechanisms - G protein-linked receptors, Tumor necrosis factor receptor signaling, Tumor growth factor-β signal transduction.

UNIT III: Molecular genetics of cancer **Hours: 08**

Molecular Basis of Cancer: DNA Methylation and Cancer; Loss of Heterozygosity; Telomeres and Telomerase; Molecular Genetic Alterations in Cancer Cells - Translocations and Inversions, Chromosomal Deletions, Gene Amplification, Point Mutations, Aneuploidy, Disomy, Trinucleotide Expansion, Microsatellite Instability, Mismatch DNA Repair Defects, Gene Derepression in Cancer Cells, Oncogenes, Tumor Suppressor Genes.

UNIT IV: Tumor Immunology **Hours: 10**

Mechanisms of the Immune Response to Cancer: Antigen Presenting Cells; Antigen Processing; T Lymphocytes and T Cell Activation; The Immunological Synapse; B Lymphocytes and B Cell Activation; Natural Killer Cells; Cell-Mediated Cytotoxicity; Role of Gene Rearrangement in the Tumor Response; Heat Shock Proteins as Regulators of the Immune Response; Inflammation and Cancer; Immunotherapy.

UNIT V: Cancer diagnosis and treatment **Hours: 10**

Tumor Markers; Gene Expression Microarrays; Proteomic Methods; Circulating Epithelial Cells; Circulating Endothelial Cells and Endothelial Progenitor Cells; Molecular Imaging; Haplotype Mapping. Molecular Mechanisms of Aging and cancer: Somatic Mutation; Telomere Loss; Mitochondrial Damage; Formation of Oxygen-Free Radicals; Cell Senescence; DNA Repair and Genome Stability; Caloric Restriction. Diet and Cancer Prevention; Chemoprevention; Antiproliferative Agents; Antioxidants; Protease Inhibitors; Histone Deacetylase Inhibitors; Statins; Multiagent chemoprevention.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 02**

Latest development related to the course during the semester concerned

REFERENCES

1. Cancer Biology, Raymond W. Ruddon, 2007, 4th edition, Oxford University Press,
2. Molecular Biology of Cancer by F. Macdonald, C.H.J. Ford, and A.G. Casson; Garland Science / Bios Scientific Publishers
3. The Biology of Cancer, Weinberg. Robert A, 2007, New York: Garland Science.
4. Molecular Biology of Human Cancers by Wolfgang Arthur Schulz Springer.
5. Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics 2nd Edition by Lauren Pecorino. Oxford University Press.

COURSE OUTCOME

End of the course,

- The students will be able to show core knowledge of the molecular and genetic basis of cancer.
- Identify significant and original problems that will impact human health
- Critically evaluate a defined body of knowledge relevant to their field
- Design and conduct independent, innovative research in accordance with the scientific research method
- Collect and store data in accordance with good lab practices

MBE-V - STEM CELL TECHNOLOGY

Hours/Week: 4 **Max Marks: 100**
Credit: 4 **Internal Marks: 25**
External Marks: 75

COURSE OBJECTIVES

- To learn the unique properties of all stem cells.
- To understand the embryonic and adult stem cells.
- To know the potential uses of human stem cells**.**
- To know the principle of surface antigen markers
- To understand the principles of stem cell therapy

Total Instructional Hours: 48

UNIT I: Introduction to stem cells **Hours: 09**

Definition, Classification and sources, primary embryonic stem cells, Umbilical cord stem cells, human embryonic stem cells. Properties of Stem cells-Pluripotent- Totipotent.

UNIT II: Embryonic stem cells **Hours: 10**

Blastocyst and inner cell mass cells, organogenesis, stem cell differentiation,trophoblastic stem cells, identification and lineage specificity, isolation and maintenance of neural precursors**.**Laboratory test to identify ES cells.

UNIT III: Adult stem cells **Hours: 08**

Somatic stem cells,Different type of adult stem cells,Test for identification of adult stem cells, Adult stem cell differentiation, Skin, mammary gland, dental and neural stem cells.Endodermal stem cells-Liver stem cells – GI tract and liver, pancreatic stem cells**.**

UNIT IV: Receptor and its identification **Hours: 09**

Surface antigen markers and its identification, microarray

UNIT V: Application of stem cells **Hours: 09**

Stem cell therapy for Neuro degeneration disease, Parkinson's, Alzheimer, spinal cord injury and other brain syndrome, tissue system failures, diabetes, cardiomyopathy, kidney failure, liver failure.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 03**

Latest development related to the course during the semester concerned

REFERENCE BOOKS

1. Stem cell technologies, basics and applications, Kaushik D.Deb, 2010 1st edition, Mc Graw Hill education.
2. Stem cells, Eapen cherian, 2011, 1st edition, Jay Pee brothers medical publishers**.**
3. Human Embryonic stem cells, Kiessling AA, 2nd Edition, 2006, Jones and Barlett Publishers.
4. Essentials of Stem cell Biology, Lanza .R, 2005,Academic Press.

NET REFERENCES

1. Stem cells.nih.gov/info/basics.
2. www.medicalnewstoday.com/info/stem_cell/

COURSE OUTCOME

This paper gives,

- Knowledge on stem cells and their applications.
- Details on adult and embryonic stem cells.
- Information about stem cell bank.
- Stem cell therapy
- Microarray techniques

SBE- IV- AGRICULTURAL BIOTECHNOLOGY

Max Marks: 100

Hours/Week: 2 **Internal Marks: 25**

Credits: 2 **External Marks: 75**

COURSE OBJECTIVES

- To learn about the significance of soil microbes in agriculture
- To understand the various aspects of crop improvement.
- To learn about the horticulture
- To understand the principles of organic inoculants
- To get knowledge about horticulture

Total Instructional Hours: 24

UNIT I: Soil Microbiology **Hours: 04**

Soil – properties of soil- structure, texture and formation, soil tillage, land Preparation. Role of microbes in soil fertility – Influence of soil and environment factors on Microflora. Ecology of soil microorganisms.

UNIT II: Plant microbial interactions **Hours: 05**

Interactions among soil microorganisms: Beneficial - mutualism, commensalism, proto – cooperation: Harmful – amensalism, antagonism, competition, parasitisim, predation. Bigeochemical cycles : Carbon cycle – Nitrogen cycle – Sulphur cycle – Phosphorus cycle – Iron cycle. Fossil plants, Fossils and Fossilization.

UNIT III: **Biotechnology for crop improvement** **Hours: 04**

Tissue culture in crop improvement, Micropropagation for virus-free plants, Somaclonal variation, Somatic hybridization, Haploids in plant breeding. Genetic engineering for biotic stress tolerance (Insects and fungi). Genetic engineering for abiotic stress (Salt and temperature), quality improvement of nutrients and secondary metabolites in medicine and agriculture. The concept of gene synteny.

UNIT IV: Organic Inoculants **Hours: 04**

Microbial interaction between microbes, interaction of microbes with plants - Biological nitrogen fixation- Diazotrophs – Symbiotic and Non –Symbiotic bacteria and cyanobacteria – Rhizopane, rhizosphere, Mycorrhizae - Phosphate solubilizing Bacteria – Biopesticide and bioinsecticides by GMO. Genetic engineering of microbes to enhance Nitrogen fixation, Nutrient uptake efficiency. Vermicompost:Preparation and use of Vermicompost. Earthworm species used in vermicompost production- endemic species, exotic species. Vermicomposting as a tool for soil waste management.

UNIT V: Horticulture **Hours: 05**

Horticulture Cultivation of commercial flower crops and vegetables; Propagation methods: cutting, layering, grafting and budding; Outdoor gardening: Hedges, fences, trees, rockeries and terrace garden; Indoor gardening: Bonsai and hanging basket.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 02**

Latest development related to the course during the semester concerned

TEXT BOOKS

1. Henry R. J., Plant Genotyping: The DNA fingerprinting of plants. CABI, New Delhi, 2005
2. A Textbook of Microbiology, R.C.Dubey and D.K. Maheswari, 2010, S.Chand Publications.
3. Kannaiyan S, 2003. Biotechnology of Biofertilizers, CHIPS, Texas
4. The Complete Technology Book on Vermiculture and Vermicompost (2004) by NPCS, Board of Consultants and Engineers. Asia Pacific Business Press Inc.
5. Kumar, N. 2010. Introduction to Horticulture. VII Edition, Oxford and IBH publishing Co. Pvt. Ltd. New Delhi.

REFERENCES

1. Anolles, G. C. and Gresshoff, P.M., DNA markers – protocols, applications and overviews. Wiley – Liss, New York, 1997
2. Soil Microbiology, N.S. Subba Rao, 2012, 4th Edition, Oxford & lbh Publishing Co Pvt Ltd.
3. Biotechnology – Fundamentals and Applications, Purohit, S. S., 2007, 8th Edition, Agrobios, India,.
4. Biofertilizers And Biopesticides, H.C. Lakshman, Channabasava A, 2014, Neha Publishers & Distributors (I-II).
5. Microbial Inoculants and Biofertilizer Technology, H. A. Modi, 2012, Neha Publishers & Distributors (Unit- I-V)
6. Ervin, L.D. 1979. Principles of horticulture. MacMillen Publishing Co. Inc. New Yor**k.**

COURSE OUTCOME

- Acquire knowledge on soil and soil microorganisms in the field of Agriculture.
- Understand the organic inoculants to improve the production of crops
- Acquire combined knowledge with special emphasis over pure line and clonal selections
- Acquire knowledge on various aspects of Indoor and Outdoor gardening
- The student will be get clear knowledge about terrace garden

SBE – V- ENDOCRINOLOGY

Max Marks: 100

Hours/Week: 2 **Internal Marks: 25**

Credits: 2 **External Marks: 75**

COURSE OBJECTIVES

- To study the basic properties of hormones.
- To learn the role of the hormones in maintaining body function
- To gain the knowledge about the major endocrine disorders.
- To know about the mechanism of synthesis of hormones.
- To understand the principles of CNS

Total Instructional Hours: 24

UNIT I: Hormones - Hypothalamus and Pituitary Hormones **Hours: 05**

History of endocrinology definition, classification, Overview of circulation biosynthesis and degradation. Hormone receptors - general features, structure and regulation. Mechanism of hormone action, class I and II hormone receptors, steroids. Feedback control of hormone secretions. Mechanism of action of Hypothalamus and Pituitary hormones, Hypothalamic releasing factors, Anterior Pituitary hormones, Vasopressin, Oxytocin. Regulation of synthesis. Lactogenic hormones. Glycoprotein hormones of the POMC family, endorphins, MSH, Hypo and hyper activity of Pituitary hormones - gigantism, acromegaly, dwarfism, syndrome of inappropriate ADH secretion.

UNIT II: Thyroid Hormones **Hours: 05**

Biosynthesis, secretion, transport, regulation and biological actions. Hypo and hyper thyroidism, antithyroid agents. Parathyroid Hormone – Biological actions, regulation of calcium and phosphorous homeostasis, role of Calcitrol, calcitonin - Hypo and hyperparathyroidism.

UNIT III: Pancreatic & Gastrointestinal Hormones **Hours: 04**

Pancreatic hormones - Islets of langerhans, cell types. Insulin and glucacon: biosynthesis, mechanism of action and biological effects. Hormonal action of Glucagon, somatostatin and pancreatic polypeptide, insulin like growth factors. Diabetes Mellitus. Gastrointestinal hormones - location of .peptide producing cells, synthesis, structure, functions and mechanism of action of secretin, GIP, VIP, gastrin, CCK and other peptides.

UNIT IV: Adrenal, Gonadal Hormones and others **Hours: 04**

Biosynthesis, secretion, transport, mechanism of action and excretion of glucocorticoids mineralocorticoids, adrenal medullary hormones – epinephrine and nor epinephrine. Abnormal secretion of Adrenal hormones- Addison's disease, phaeochromocytoma. Gonadal hormones - Androgens, estrogens: secretions, biological actions and disorders. Ovarian cycle. Pregnancy, Biochemical changes in pregnancy. Others: Local hormones in tissues – Prostaglandins and Thromboxanes, Local hormones in blood – Kinins.

UNIT V - Central Nervous System **Hours: 04**

Structure and function of the brain, central nervous system, peripheral and autonomic nervous system . Cells of nervous system: neurons, glail cells, oligoendocytes and Schwann cells. Neurotransmitters-synthesis, storage, release, uptake, degradation and action of neurotransmitters Acetyl choline, GABA serotonin, dopamine, glutamate, aspartate, nitrous oxide, mechanisms of actions of anesthetics, analgesis, hallugcigens ,depressants , stimulants and toxins on the nervous system, addiction and drug abuse.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 02**

Latest development related to the course during the semester concerned

TEXT BOOKS

1. William's Text book of Endocrinoloqv- Larsen et al
2. Mechanisms of hormone action - Autin and Short.
3. Harper's Biochemistry- Murray et al
4. Principles of Biochemistry- White, Handler & Smith
5. Endocrinology - Mac.E.Hadley
6. Edward staunton wert, Wilbert R.todd, Howard S. maron,johnT.van bruggen, 1996. Textbook of biochemistry ,4th edition ,oxford and IBH publishing co.pvt.Ltd

REFERENCES

1. Donald voet, Judith G. Voet,CharlottW. Pralt. Fundamendals of Biochemistry, upgrade edition.John Willey and sons . INC,
2. Essentials of Medical Physiology by K. Sembulingam and Prema Sembulingam, 2012, 6th Edition, Jaypee brothers medical publishers (P) Ltd.
3. Fundamentals of Biochemistry, J.L. Jain, 2004, S. Chand publications.
4. Textbook of Biochemistry, Edward Staunton West, Wilbert R. Todd, Howard S. Mason, John T. VanBruggen, 1996, 4th edition, Oxford & IBH publising Co. Pvt. Ltd.

COURSE OUTCOME

- The students will be able to identify the malfunctioning of glands by a set of symptoms.
- The students will be able to explain the immense affect of endocrine system in all over the entire body
- The students will be able to list endocrine organs, their hormones and functions.
- Understanding the mechanisms of endocrine secretion
- Students will be understanding the structure and functions of CNS

IDC - ORGANIC FARMING
(Offered by the Department)

Hours/Week: 2 **Max Marks: 100**
Credits: 2 **Internal Marks: 25**
External Marks: 75

COURSE OBJECTIVES

- To study the principles and practices of organic farming for sustainable crop production.
- To develop an understanding of the historical, biological and ecological basis for Organic farming including crops and live stocks management.
- To learn the basic principles of organic matter management by utilizing cover crops and compost.
- To develop critical and creative thinking with a system of approach for multiple and diverse farming systems, including vegetables, fruit, field crops and livestock and use the skills for development of a group farming systems plan.
- To understand and realize the social, economic, political and environmental context for current and future organic agricultural production and sales.

Total Instructional Hours: 24

UNIT I: Introduction to organic farming **Hours: 05**

Introduction to organic farming – Principles, types, need and development of organic farming Conventional farming v/s Organic farming, Biodynamic farming – Scope of organic farming in Tamil Nadu, National, International status – Agencies and institutions related to organic agriculture.

UNIT II: Organic farming systems **Hours: 05**

Organic farming systems: Land preparation – Soil tillage – Choice of propagation (Seed and Planting materials) Seed treatments – crop rotations, multiple and relay cropping systems – Water management. Manure: Green manure – Composting and factors – Composting methods.

UNIT III: Biofertilizers **Hours: 04**

Biofertilizers: types – methods of applicaton – advantages and disadvantages. Weed management, diseases and insect pest management, bio-pesticides – Vermicomposting – organic manures – Concentrated organic manures – Organic amendments and sludges.

UNIT IV: Production of organic crops **Hours: 04**

Organic crop production: methods – Rice – Coconut – Cashew – Okra – Pulses – Amaranthus – Solanaceous – Cucurbits – Mango – Banana – Pepper – Ginger – Turmeric – Ornamental crops – Live stock components in organic farming.

UNIT V: Economy of organic farming **Hours: 04**

Basic concepts of economics – Demand, supply – Economic viability of a farm – Marketing, Imports and exports – Farm inspection and certification. Entrepreneurship Development: Entrepreneurship – Concept – characteristics – approaches – need for entrepreneurship - Agri Enterprises – Stages of establishing enterprise – Project Identification.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 02**

Latest development related to the course during the semester concerned

REFERENCES

1. Organic Framing – Theory and Practice, Palaniappan SP & Anandurai K, 1999, Scientific Publ (Unit I – V)
2. Ananthakrishnan TN. (Ed.). 1992. Emerging trends in Biological control of Phytophagous Insects. Oxford & IBH.
3. Small Farmer Focused Integrated Rural Development: Socioeconomic Environment and Legal Perspective, Rao BV Venkata, 1995, Publ.3, Parisaraprajna Parishtana, Bangalore.
4. Reddy MV. (Ed.). 1995. Soil Organisms and Litter Decomposition in the Tropics. Oxford & IBH
5. Sharma A. 2002. Hand Book of Organic Farming. Agrobios (Unit I – V).
6. Veeresh GK, Shivashankar K and Sugilachar MA. 1997. Organic Farming and Striable Agriculture. Association for Promotion of Organic Farming, Bangalore (Unit I – V).

NET REFERENCES

Free- E-book: http://agridr.in/tnauEAgri/eagri50/GBPR111/Index.html

COURSE OUTCOME

- Understand the role of microbes in agriculture.
- Understand the biological nitrogen fixation on both symbiotic and non symbiotic.
- Knowing the value, production, application and crop response of biofertilizers.
- Student will be understand the production biofertilizers and biopesticides and become Entrepreneur.
- Understanding the knowledge about organic crops.

IDC - APPLIED BIOTECHNOLOGY
(Offered by the Department)

Max Marks: 100
Hours/Week: 2 **Internal Marks: 25**
Credits: 2 **External Marks: 75**

COURSE OBJECTIVES

- To impart knowledge on various biotechnological commercial processes and its usefulness
- To provide hands on exposure to various biotechnological commercial processes such as biogas production, ornamental fish cultures.
- To provide hands on exposure to composting methods
- To get knowledge on exposure to mushroom production
- To under the principles of *Spirulina* cultivation

Total Instructional Hours: 24

UNIT I: Biogas technology **Hours: 04**

Introduction and history – anaerobic digestion – microbes involved – factors influencing methane production – Stages of methane generation – Wastes used in methanogenesis – various bioreactors used for methane generation – Advantages and disadvantages.Visit to biogas production units with field demonstration.

UNIT II: Composting technology **Hours: 04**

Historical background – waste availability – factors influencing – methods- biomaturity-enrichment of Compost and crop productivity.Vermiculture Technologies: History – species – life cycles – methods – different types of waste suitable for vermicomposting. Utilization of vermicompost for crop production. Visit to vermicompost industries with field demonstration.

UNIT III: Mushroom technology **Hours: 04**

Bioconversion of organic wastes into protein - Oyster mushroom technology, paddy mushroom technology, milky mushroom and button mushroom technology, post harvest technology. Mushroom farming and prospects. Visit to mushroom farms with field demonstration.

UNIT IV: *Spirulina* Cultivation technology **Hours: 05**

Biology of *Spirulina* - cultivation methods, post harvest technology and single cell protein formulation.

UNIT V: Ornamental fish culture **Hour: 05**

Present status and importance – popular varieties – artificial and live feeds – breeding techniques of egg layers – gold fish, angel fish, fighter and barbs – live bearers – guppy, molly, platy and sword tail – economics. Visit to ornamental fish farms with field demonstration.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 02**

Latest development related to the course during the semester concerned

TEXT BOOKS

1. Introduction to mushroom science, Kaul, T.N., 1999, Oxford & IBH Co., Pvt. Ltd., New Delhi.
2. Mushroom biology, Philip G. Miles, Shu-Ting Chang, 1997, World Scientific, Singapore.
3. Handbook on mushrooms, Bahl, N., 1988, Oxford & IBH Publishing Co., Pvt. Ltd., New Delhi.
4. Advances in Biogas Technology, Chawla O.P. 1986, ICAR, New Delhi.
5. Introduction to Soil Microbiology, Martin Alexander 1976, Wiley eastern Ltd.,New Delhi.
6. Aquarium management, Anita Saxena, 2003, Daya Pub, House, New Delhi.
7. Aquarium fish keeping, Srivastava, C.B.L, 2002, Kitab Mahal, Allhabad.

REFERENCES

1. A Textbook on Biotechnology, Kumar, H.D., 1991, II Edition, East-west Press Pvt. Ltd., New Delhi.
2. Textbook of Biotechnology, Chatwal, G.R., 1995, Anmol Publications Pvt. Ltd., New Delhi.
3. Environmental Biochemistry, Jasra, O.P., 2002. I Ed., Sarup & Sons, New Delhi, India.

COURSE OUTCOME

- The student are be able to understand in-depth understanding on_biogas technology and its uses
- The student are be able to understand composting technology and its applications
- The student are be able to know the cultivation and uses of mushrooms
- The student are be able to know the cultivation and uses *Spirulina*
- The student are be able to understand the value of Ornamental Fish culture

IDC - MUSHROOM CULTIVATION

Hours/Week: 2 **Max Marks: 100**
Credits: 2 **Internal Marks: 25**
External Marks: 75

COURSE OBJECTIVES

- To study the general characteristics and structure of Mushrooms.
- To know about the importance and need have Mushrooms.
- To acquire knowledge regarding the cultivation and contamination possibilities of Mushrooms.
- Motivate the students to form a Mushroom cultivation unit.
- To understand the effective methodology to cultivate Oyster, button and milky mushrooms.

Total Instructional Hours: 24

UNIT I: Introduction to Mushrooms **Hours: 02**

Introduction, History of Mushroom cultivation, edible and non-edible Mushrooms, Classification and distribution of Mushrooms, most commonly cultivated Mushrooms in the world, life cycle of Mushrooms. Research centers: International level, National level and Regional level.

UNIT II: **Spawn preparation** **Hours: 02**

Spawn preparation: Isolation of pure culture, Nutrient media for pure culture, layout of spawn preparation room, raw material of spawn; sterilization, preparation of mother spawn and multiplication.

UNIT III: Cultivation of Mushrooms **Hours: 02**

Cultivation of Mushrooms: Layout of Mushroom shed, small scale and large scale production unit. Types of raw materials, preparation and sterilization, Mushroom bed preparation, maintenance of Mushroom shed, harvesting method, storage and preservation of Mushrooms.

UNIT IV: Harvesting and economic importance **Hours: 02**

Harvesting of following types of Mushrooms: Milky Mushrooms; oyster mushrooms, button mushrooms and any one medically valuable Mushroom. Economics of Mushroom cultivation: Fixed assets, recurring expenditure, labor, economics of cultivation throughout the year, Cost benefit ratio: Marketing in India and abroad – Export value.

UNIT V: **Nutritional values and recipies of Mushrooms** **Hours: 02**

Nutritional values of Mushroom – protein, carbohydrate, fat, fibre, vitamins and amino acid contents and pharmacological values. Mushroom dishes: Soup, cutlet, omlette, samosa, pickles, curry, chutney.

UNIT VI: Latest learnings (For CIA Purpose only) **Hours: 02**

Latest development related to the course during the semester concerned

TEXT BOOKS

1. Oyster Mushrooms, Marimuthu et al., 1991, Dept. of Plant pathology, TNAU, Coimbatore.
2. Mushroom cultivation, Tewan and Pankaj Kapoor S.C. 1993, Mittal Publication. Delhi.

REFERENCES

1. Book of Mushrooms, Nita Bahl, 1988, Hand II ed., Vol I & II.ct and environmental impact. 2nd ed., CRC press.
2. Mushroom cultivation: A practical guide to growing mushrooms at home, Paul Stamets, J.S. and Chilton, J.S. 2004, Agarikon Press
3. Mushrooms: Cultivation, nutritional value, medicinal effe ct, Shu Fing Chang, Philip G. Miles and Chang, S.T. 2004.

NET REFERENCES

1. www.tnau.ac.in/micro/ug/html
2. www.scienceandsociety-dst.org/highlights.html

COURSE OUTCOME

- Understand the prospects of mushrooms and its cultivation.
- Gain the knowledge of cultivation of different types of edible mushrooms.
- Understand, appreciate and develop the self-confidence for embarking on self employment.
- Understand the mushroom characteristics and their importance
- Discuss on the principles and methods involved in different stages of mushrooms
- Apply their knowledge in cultivating various tropical and subtropical mushrooms and their role in human welfare.