CMS COLLEGE OF SCIENCE AND COMMERCE

(AUTONOMOUS)

Chinnavedampatti, Coimbatore - 641 049

An ISO 9001:2000 certified institution and accredited at the 'A' level by NAAC

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DEPARTMENT OF BIOTECHNOLOGY

I Year M.Sc., Biotechnology

CURRICULUM, SCHEME OF EXAMINATION AND SYLLABI (CBCS)

(2011)

(FOR STUDENTS ADMITTED DURING THE ACADEMIC YEAR 2011)

DEPARTMENT OF BIOTECHNOLOGY

M.Sc., Biotechnology

REGULATIONS

INTRODUCTION

BIOTECHNOLOGY

Any technology application that uses biological systems, living organisms or derivatives thereof, to make or modify product and processes for specific use

OBJECTIVES

On successful completion of the course, students will thoroughly understand what is Biotechnology, various Biotechnological processes, fundamental techniques in Biotechnology, as well as key applications of Biotechnology in various fields, such as Medical Biotechnology, Pharmaceutical Biotechnology, Animal Biotechnology, Plant Biotechnology, Immunotechnology, Genetic Engineering and Recombinant DNA Technology, Microbial Biotechnology, Bioprocess Technology, Fermentation Technology, Genomics & Proteomics, Molecular Biology, IPR, IPP and Patenting of live forms, Germplasm preservation & Cloning of animals, and Nanobiotechnology. Students will also be acquainted with recent trends, developments, and advancements in Biotechnological research

ELIGIBILITY

B.Sc. Degree with Biology / Biochemistry / Chemistry with biology ancillary biotech / Biotechnology / BFS / Polymer Chemistry / Microbiology / Zoology/ Botany/ Plant science / Plant Biotechnology/ animal science/animal biotechnology / B.Pharm / Industrial Chemistry/ Applied Microbiology/ Medical Microbiology/ Human Genetics/ Medical Genetics/ Molecular Biology/ Genetics Technology/ Environmental Science/ Environmental Biotechnology/ Genetics Engineering/ Bioinformatics/ Plant Biology and Biotechnology/ Animal Cell and Biotechnology/ Biological Techniques and Specimen Preparation/ Agriculture/ B.E./ B.Tech.

DURATION OF PG COURSE

The course shall extend over a period of two years comprising of four semesters, with two semesters per year. There shall not be less than ninety instructional days during each semester. Examination shall be conducted at the end of each semester for the respective subject

DISTRIBUTION OF THE MARKS AND CREDITS UNDER CBCS

PART	SUBJECT@	No of Papers	Marks @	Credits
I	Core Subjects and Core Practicals [$]	17	1700	68
II	Elective Subjects	4	400	16
III	Project	1	150	6
	Total		**2250**	**90**

Note: I

@ Includes 25/40 % continuous assessment marks for theory and practical subjects respectively

$ In core subjects both theory and practicals are included wherever applicable

The following parameters are considered throughout study period

- **i)** Regularity of Attendance
- **ii)** Active participation in classes/Camps/Games (College/District//University)
- **iii)** Exemplary awards/certificates/prizes
- **iv)** Other Social Components (Blood Camp, Fine Arts, etc)

Note: II

The Credit points, Lecture Hours, Marks are not linked

AnnexureNo. UEC5
BOS.DT: 05-08-2011

CMS COLLEGE OF SCIENCE AND COMMERCE
COIMBATORE – 641 049
(AUTONOMOUS)
M.Sc., BIOTECHNOLOGY DEGREE COURSE
SCHEME OF EXAMINATION - CBCS PATTERN
(FOR STUDENTS ADMITTED DURING THE ACADEMIC YEAR 2011)

Semester	Part	Subj. Code	Subject Title	Inst. Hrs per week	Examination Details				Credits
					Duration in Hours.	CIA Marks	End Semester Examination Marks	Total Marks	
I	I		Cell Biology & Molecular Genetics	5	3	25	75	100	4
	II		Biochemistry	5	3	25	75	100	4
	III		Microbiology	5	3	25	75	100	4
	IV		Research Methodology	5	3	25	75	100	4
	EI		Elective I	5	3	25	75	100	4
	PI		Practical – I: Cellbiology, Biochemistry and Microbiology	5	6	40	60	100	4
			Total	**30**				**600**	**24**
II	V		Microbial Biotechnology	5	3	25	75	100	**4**
	VI		Genetic Engineering	5	3	25	75	100	4
	VII		Immunology & Immunotechnology	5	3	25	75	100	4
	VIII		Bioprocess Technology	5	3	25	75	100	4
	EII		Elective II	5	3	25	75	100	4
	PII		Practical- II: Microbial Biotechnology, Bioprocess Technology and Immunotechnology	5	6	40	60	100	4
			Total	**30**				**600**	**24**
III	IX		Plant Biotechnology	5	3	25	75	100	4
	X		Animal Biotechnology	5	3	25	75	100	4
	XI		Genomics & Proteomics	5	3	25	75	100	4
	XII		Bioethics, Biosafety, Quality Management & IPR	5	3	25	75	100	4
	EIII		Elective III	5	3	25	75	100	4
	PIII		Practical- III: rDNA Technology, Plant and Animal cell culture	5	6	40	60	100	4
			Total	**30**				**600**	**24**
IV	XIII		Environmental Biotechnology	5	3	25	75	100	4
	PIV		Practical – IV: Environmental Biotechnology	5	6	40	60	100	4
	EIV		Elective IV	5	3	25	75	100	4
	Project		Project *****	-	-	-	-	150 *****	6
			Total	**15**				**450**	**18**
			Grand Total					**2250**	**90**

P = Practical subject, E = Elective subject

ELECTIVES OFFERED
(Students should choose one of the electives in each group)

Elective I (Semester I)
Human Molecular Pathology
Food Biotechnology
Human Physiology

Elective II (Semester II)
Bioinformatics
Enzyme Technology
Plant & Animal Physiology

Elective III (Semester III)
Nanobiotechnology
Molecular Diagnostics
Developmental & Evolutionary Biology

Elective IV (Semester IV)
Pharmaceutical Biotechnology
Medical Biotechnology
Conservation Biology

Each paper carries an internal component
There is a pass minimum for an external component
Theory: Internal assessment: 25 marks; External component: 75 marks
Practical: Internal assessment: 40 marks; External component: 60 marks
***** Project: 3 Reviews + Dissertation: 120 marks; Final Viva voce: 30 marks

***** The project report is the bonafide work carried out by the candidate under the guidance of a faculty authenticated and countersigned by the HOD. This project work must be presented and defended by the candidate in the department attended by all faculties and reviewed by external examiner. Candidate who has presented the work as 'Not qualified as per CBCS' must resubmit the project again in the ensuing academic year.

COMPONENTS OF INTERNAL ASSESSMENT*
Theory: Two tests in each semester (one Internal Test and one Model Test). Marks from both Tests will be taken: Total 15 marks (5 marks Internal Test and 10 marks Model Test)
Either Two Assignments – 10 marks *OR* one assignment and One Seminar – 10 marks
Practical: Marks should be awarded to each practical by the course teacher and the average of the best ten practicals be taken for 40 marks.
Project: 120 marks should be awarded as internal assessment marks (90 marks for three monthly reviews conducted by the project guide and the HOD, 30 marks for Dissertation)

***** Retest for internal examination to be conducted for genuine cases as per the recommendations of class in charge, subject in charge. The final decision to be made by the HOD.

Semester I

COURSE: M.Sc., BIOTECHNOLOGY

SUBJECT TITLE: CELLBIOLOGY AND MOLECULAR GENETICS

Total teaching hours/week: 5

Subject Description
This paper provides an overview of prokaryotic & eukaryotic cells, structure and function of intracellular organelles, as well as basics of genetics.

Goals
To provide a comprehensive overview of prokaryotic and eukaryotic cells, and subcellular organelles.

Objectives
Students will derive strong foundation in the molecular mechanisms underlying cellular function and gain knowledge about genetics.

UNIT I
Structure of Prokaryotic and Eukaryotic cells. Structure and functions of plasma membrane and intracellular organelles - mitochondria, chloroplast, endoplasmic reticulum, Golgi apparatus, lysosomes, ribosomes, peroxysomes and microbodies.

UNIT II
Structure and functions of nucleus, nucleolus, chromosomes and types - giant chromosomes (polytene and lampbrush). Microtubules, microfilaments and intermediate filaments, cell recognition, cell-to-cell signaling, Cell division-mitosis and meiosis.

UNIT III
Mendel's monohybrid and dihybrid cross, Mendel'laws, Mechanism of linkage (Maize and Drosophila), crossing over and its importance. Lethal genes, multiple alleles, transposable elements in maize and drosophila. Determination of sex and its differentiation, Sex-linked inheritance.

UNIT IV
DNA as genetic material -Transformation, conjugation, transduction. Mechanism & types of DNA replication, Mechanism of RNA transcription and processing, Post-transcription. Translation, Regulation of gene expression in prokaryotes & eukaryotes, Operon concept (*lac*, *trp*), DNA repair-photo reactivation, excision repair, mismatch repair and SOS repair.

UNIT V
Types of mutations, origin of spontaneous and induced mutation, different types of chromosomal and gene mutation, syndromes (Klinefelter's, Turner's and Down's). Cancer-characteristics & causative agents, oncogenes and tumour suppressor genes. Hardy Weinberg principle, natural & artificial selection, genetic drift, variation and its importance in evolution.

REFERENCES:

TEXT BOOKS

1. **Molecular Biology of the Cell**. Alberts. B *et al* (1994), Garland Publishing Inc New York.
2. **Molecular Cell Biology**. Lodish, *et al*, (2000) 5th Edition, W.H Freeman and Company, New York.
3. **Genes VIII**. Benjamin Lewin (2004), Pearson Education Corporation, New Jersey.
4. **Essentials of Molecular biology**. Freifelder, George M. Malacinski, (2008) 4th Edition, Narosa Publishing House, New Delhi.

REFERENCE BOOKS

1. **Molecular & Cellular Biology**. Stephen. I Wolfe. (1993). Wadsworth publishing company.
2. **Principles of Genetics**. Gardner (2001), John Wiley & Sons Inc, New York
3. **Principles of Genetics**. Robert Tamarin, (1996) 5th Edition. WMC Brown publication, Boston.

Semester I

COURSE: M.Sc., BIOTECHNOLOGY

SUBJECT TITLE: BIOCHEMISTRY

Total teaching hours/week: 5

Subject description
This paper presents the study of biomolecules, including their metabolism.

Goals
To provide the student with a firm foundation in the biochemical aspects of cellular functions.

Objectives
Students will get an overall understanding of chemical bonds, energetics, enzyme kinetics, biomolecules and their metabolic reactions in a living system.

CONTENTS:

UNIT I
Introduction to Biochemical concepts:
An overview of Structure of atoms and molecules: chemical bonds – covalent, non- covalent interactions. Structure and catalysis of water: Weak interactions, ionization of water, weak acids and weak bases, buffers in biological systems.
Bioenergetics and Thermodynamics:
Concept of free energy and standard free energy, Phosphoryl group transfer and ATP synthesis, Biological Oxidation and Reduction reactions, Electron transport chain and oxidative phosphorylation.

UNIT II:
An overview of Biochemistry of Biomolecules:

i. Carbohydrates:

Classification and reactions. Structural features of homoglycans, heteroglycans and complex carbohydrates.

ii. Proteins:

Amino acids and peptides - Classification, chemical reactions and physical properties. Peptide bond, Primary structure of proteins, structural comparison at secondary and tertiary levels (Ramachandran plot), conformation of proteins and polypeptides (secondary, tertiary, quaternary and domain structure), protein folding - biophysical and cellular aspects. collagen triple helix and hemoglobin.

iii. Lipids:

Classification, structure and functions. Triglycerides; Phospholipids; Steroids and terpenes. Glyco and lipoproteins - structure and function. Role of lipids in biomembranes.

iv. Nucleic acids:

Structure of double stranded DNA (B, A, C, D, T and Z DNA). The biological significance of double strandedness. Types of RNAs and their biological significance. Conformational properties of polynucleotides, Secondary and tertiary structural features.

UNIT III:

Enzymology: Classification and nomenclature of enzymes, Enzyme action: Active site, apoenzyme, holoenzyme, activators, inhibitors, isoenzymes, allosteric enzymes, ribozyme, abzymes and coenzymes. Enzyme specificity, Lock and Key Mechanism and Induced fit hypothesis.

Enzyme kinetics: Negative and positive co-operativity, Michaelis-Menten kinetics, Enzyme inhibition: Reversible - competitive, noncompetitive, uncompetitive, irreversible inhibition. Significance of K_i and V_{max}, Mechanism of enzyme catalysis: Serine proteases family – Cholinesterase enzyme.

UNIT IV

Metabolism:

Introduction to metabolism-anabolism, catabolism and amphibolism.

i. Carbohydrate metabolism:

Glycolysis and TCA cycle; Glycogen breakdown and synthesis; Gluconeogenesis; interconversion of hexoses and pentoses: Co-ordinated control of metabolism.

ii. Nucleic acid metabolism:

Biosynthesis of purines and pyrimidines.

iii. Fatty acid metabolism:

Oxidation of lipids; Biosynthesis of fatty acids; Triglycerides; Phospholipids; Sterols.

iv. Amino acid metabolism:

An overview of aminoacid metabolism.

UNIT V

Biochemistry of hormones and signal transduction:

Introduction to hormones, Types of hormones - Group I: Steroid hormones, Group II: Peptide and catecholamine hormones, signal generation in Group I and Group II hormones: Hormone response elements, G Protein–Coupled Receptors (GPCR), cAMP, Camodulin and Phosphotidyl inositol.

Biochemistry of drugs:

An overview of Phase I and Phase II xenobiotic metabolism.

REFERENCES

TEXT BOOKS

1. **Principles of Biochemistry**. Lehninger, 4th Edition, (2004) Published by W.H Freeman and Company, New York
2. **Biochemistry** – U. Satyanarayana (2004) Books and Allied Pvt Ltd., Kolkata.

REFERENCE BOOKS

1. **Principles of Biochemistry**. Smith, *et al*.,(1983) 8th Edition, McGraw Hill International book company
2. **Biochemistry.** Jeremy M.Berg, John L.Tynoczko, Lubert Stryer (2002) 5th Edition, W.H. Freeman and company, New York.
3. **Biochemistry** - Christopher K. Mathews, Kensal E. van Holde, Kevin G. Ahern (1999) 3rd Edition, Pearson Education.
4. **Harpers Illustrated Biochemistry**. Robert K. Murray, Drayl. K. Granner, Peter. A. Victor. W. Rodwell,(2010), 28 th Edition, Published by The McGraw-Hill companies, International Edition
5. **Fundamentals of Biochemistry** – Voet *et al.*, (1999) John Wiley and Sons, Inc.

Semester I

COURSE: M.Sc., BIOTECHNOLOGY

SUBJECT TITLE: MICROBIOLOGY

Total teaching hours/week: 5

Subject Description
This subject provides an overview of the microbial world, classification of microorganisms, morphology and microscopic examination, methods to grow microorganisms, sterilization and preservation.

Goals
To cover fundamental aspects of microbiology.

Objectives
Students would be aware of different types of microorganisms, their basic metabolism, and would acquire an overview of viruses.

CONTENTS:

UNIT I
History of Microbiology. Pure culture techniques, two dimensional culture. Microbial nutrition – Requirements of carbon, nitrogen, sulphur, growth factors. Culture media - pH, chelating agents, oxygen, CO_2, Light. Types of culture media - Solid & Liquid. An overview of selective, enriched and differential media. Sterilization- heat, chemical and filtration.

UNIT II
Microbial taxonomy: Modern trends of classification. Classification and salient features of Bacteria according to Bergey's manual of Systematic Bacteriology. Brief note on Archaebacteria; Methanogens, Halophiles and Thermoacidophiles.
Phycology: An introduction to Algae. General features of Algae: Vegetative structures, Life cycle, Nutrition. Classification of algae. Occurrence, thallus organization. Role of Algae in nature. Economic importance of algae.

UNIT III
Mycology: An introduction to fungi, Classification of fungi. Symbiotic associations of fungi; The Mycorrhizae and Lichens. Homothallism. Heterothallism, The Parasexual cycle. Hormones in fungi. Fungal diseases of Plants. Economic importance of fungi.

UNIT IV
Bacteriology: Overview of Morphology & Ultrastructure of Bacteria, Morphological types; rickettsia and chlamydia. Cell wall, capsule, cell membrane. Structure and functions of flagella, cilia, pili, chromosome. Sporulation, Reserve food materials, Microbial metabolism – aerobic and anaerobic respiration, ATP synthesis, Photosynthesis in blue green algae, Purple, non-S and green-S bacteria.

UNIT V
Virology: Viruses - discovery, structure; General classification; classification of Plant & Animal Viruses. Detection and enumeration of viruses; lysogenic and lytic cycles; viriods,

prions. Microorganisms as geochemical agents, P, O, C, N and S cycles through geological times.

REFERENCES:

TEXT BOOKS

1. **General Microbiology**. Roger Y Stanier, John I Ingraham, Mark I Wheelis and Page R Painter. (1986) 5th Edition. Macmillan Press Ltd. Hampshire.
2. **Microbiology**. Prescott, Harley, Klein (1999) 4th Edition; Mc Graw Hill Inc.

REFERENCE BOOKS:

1. **Microbiology**. An introduction. Gerald J Tortora, Berdell R Funke, Christine L Case (1995), 5th Edition; The Benjamin Cummings Publishing Co.Inc. USA.
2. **Microbiology**. Principles and Explorations. Jacquelyn G.Black (2008) 7th Edition; John Wiley & Sons Pte. Ltd.Asia.

Semester I

COURSE: M.Sc., BIOTECHNOLOGY

SUB JECT TITLE: RESEARCH METHODOLOGY

Total teaching hours/week: 5

Subject Description
This paper presents the basics of research methodology, principles and applications of different instruments, use of statistics in research

Goals
This paper is introduced to impart advanced training to the students with post graduate qualification in biotechnology, to gain knowledge in research methodology and handling of basic instruments

Objectives
On successful completion of the course the students should have:
1. Understood the basics of research methodology
2. Learnt the concepts of different instrumental techniques
3. Learnt basic statistics

CONTENTS:

UNIT I
Introduction to research methodology: defining the research problem, significance of research, experimental / research design, literature collection, literature citation, research report, format of thesis, manuscript / research article. Interpretation and report writing, bibliography.

UNIT II
Methods in Microscopy: light, fluorescence, phase contrast, and electron microscopy. Colorimetry, UV-Visible, IR, NMR, and atomic absorption spectroscopy. Chromatography: Paper, Thin layer, Gas, and HPLC.

UNIT III
Centrifugation: Types of centrifugation. Electrophoretic techniques: Agarose, PAGE, Denaturing gradient gel electrophoresis, isoelectric focusing and 2D gel electrophoresis, RIAs, Southern, Northern and Western blotting techniques.

UNIT IV
Definition & scope of Biostatistics, Classification and tabulation of data, Graphical and diagrammatic representation (scale diagrams, Histograms, Frequency curves). Measures of Central tendency: arithmetic mean, median and mode. Calculation of mean, median, mode in series of individual observations, discrete series.

UNIT V
Measures of Dispersion: standard deviation and standard curves. Chi – square test, Students t test, regression, correlation, one way and two way ANOVA.

TEXT BOOKS

1. **Research Methodology**, Methods and techniques. C. R. Kothari, New Age publication
2. **An introduction to Practical Biochemistry**. David T. Plummer, 3 rd edition, University Press.
3. **Analytical Biochemistry**. P. Ashokan, Chinna publications.
4. **Principles & Techniques of Practical Biochemistry**. Keith Wilson, Kenneth H. Goulding, Cambridge University Press.
5. **Introductory Biostatistics**. T.Lee, Wiley – Interscience publication.

REFERENCES

1. **Instrumental methods of chemical analysis**. B. K. Sharma, 11th edition, Blackwell publications.
2. **Statistical Methods**. Stephen W. Looney (Humana publications).
3. **Biostatistics: A Methodology for the Health Sciences**. Gerald Van belle, 2nd Edition, Wiley – Interscience publication

Semester I

COURSE: M.Sc. BIOTECHNOLOGY

SUBJECT TITLE: Elective Paper I: HUMAN MOLECULAR PATHOLOGY

Total teaching hours/week: 5

Subject Description: This Paper presents the basics of medical science and molecular pathology concepts as applied to human.

Goals: This paper is introduced to impart advanced training in human molecular pathology to the students with post graduate qualifications in Biotechnology to develop novel tools and diagnostic methodologies for the betterment of mankind.

Objectives
On successful completion of the course the students should have:

- Understood the basics of medical science
- Learnt the concepts of pathogenesis, role of diagnostic tests and kit development
- Learnt the modern trends in Human molecular pathology

CONTENTS:

UNIT I:
An overview of human molecular pathology:
Infections of Bacteria and Parasites: The History of Infectious diseases, host pathogen interactions. Toxins of Bacteria: serotoxins and Endo toxins. Parasites of biomedical importance: *Plasmodium vivax*, *Wuchereria bancrofti*, *Trypanosome gambiense* and *Entmoeba histo*lyt*ica*.
Pathogenic Viruses and fungi: General characters of viruses, diagnosis of viral infections. Interferons: Introduction, biomedical importance and properties of Interferon. Common superficial and deep seated fungal infections.

UNIT II:
Disorders of Kidney: Acute renal failure, chronic renal failure, proteinuria and nephritic syndrome and urinary calculi.
Disorders of Liver: Acute hepatitis, chronic hepatitis, acute liver failure, cirrhosis, alcohol and liver. Inherited abnormalities of bilirubin metabolism: Gilber's, Crigler – Najjar, Dubin-johnson, and jaundice.
Disorders of hypothalamus and pituitary: Disorders of anterior pituitary hormones: Hypopituitarism, Growth hormone deficiency, Growth hormone excess: acromegaly and gigantism.
Disorders of poster pituitary hormones: Vasopressin and Diabetes insipidus.

UNIT III:
Disorders of Adrenal glands: Disorders of Adrenal cortex: Adrenal hypofunction (Addison's disease). Adrenal hyperfunction: Cushing's syndrome, conn's syndrome, congenital adrenal hyperplasiam (CAH). Disorders of adrenal medulla: catacholamines.
Disorders of Thyroid gland: Hyperthyroidism, hypothyroidism, goitre and cancer of thyroid.

Disorder of Gonads: Disorders of male gonadal function, Delayed puberty and hypogonadism in females, Amenirrhoea, oligomernorrhoea and infertility.

UNIT IV:

Disorders of Plasma proteins and enzymes: Hypoalbuminaemia, hypoganmaglobulinaemia and hypergammaglobulinaemia.

Disorders of haemoproteins, porphyrins and Irons: Hameoproteins-Hameoglobinopathies, Thalassaemias. Porphyrins: acute and chronic porphyrias, Iron: Iron deficiency and Herediatary (primary) haemochromatosis.

UNIT V:

Disorders of carbohydrate metabolism: Diabetes mellitus – IDDM, NIDDM, Glycosuria and hypoglycaemia.

Disorders of Lipids, lipo proteins and cardiovascular diasease: Lipids-Primary and secondary hyperlipidaemias, Types of. Lipoprotein – abetalipproteinaemia, Hypobetalipoproteinaemia. Diseases of Heart: Myocardial infarction, Heart failure and Hypertension.

Inherited metabolic diseases: Glucose 6 phosphatase deficiency, Galactisaemia, cystic fibrosis and sickle cell anemia.

REFERENCES:

TEXT BOOKS

1. **Clinical Chemistry** by William J. Marashall (Fifth edition, Mosby Publications).
2. **An Illustrated color text of clinical Biochemistry** by Allen Gaw Robert A.Cowan, (1999, second edition, Churchill Living stone press).
3. **Harper's Illustrated Biochemistry** (27 th Edition) by Robert K.Murray, Dary K.Granner, Victor W. Rodwell.
4. **Lippincott's Illustrated reviews: Biochemistry** (Lipppincott press, third Edition) by Richard Harvery and Pemela C.Champe.
5. **Medical Microbiology** by Paniker.
6. **Medical Microbiology** by Roitt.
7. **Medical Parasitology** by Panicker.

REFERENCE BOOKS:

1. **Color Atals of Biochemistry** (second edition, Thieme Publications, revised and enlarged) by jan Koolman and Klaus – Heinrich Roehm.
2. **Marks' Basic Medical Biochemistry**: A Clinical Approach (2 nd Edition), by Colleen M.
3. **Medical Microbiology** by Jawetz.

Semester I

COURSE: M.Sc. BIOTECHNOLOGY

SUBJECT TITLE: Elective Paper I: FOOD BIOTECHNOLOGY

Total teaching hours/week: 5

Subject Description: This paper presents the basic insight in to the food aspects with respect to the contamination, production and preservation.

Goals: This paper is introduced to impart the knowledge of sanitary aspects of food handling and production.

Objectives
On successful completion of the course the students should have:

1. Understood the scope of food biotechnology.
2. Factors affecting food quality control.
3. Food production using microorganisms.

CONTENTS:

UNIT I
Scope of food technology, constituents of food (carbohydrates, lipids, proteins, vitamins, minerals, energy value of food). Production of additives, colours and flavours by biotechnological approaches, applications of different enzymes in food technology.

UNIT II
Habitat of microbes in atmosphere, soil, water, plants and animals. Intrinsic & extrinsic factors affecting microbial growth. Food spoilage by microbes: degradation of carbohydrates, protein, lipid, vegetables, fruits, meat, poultry, and dairy products.

UNIT III
Bacterial agents of food-borne illnesses *Aeromonas: Bacillus, Clostridium botulinum, E. coli, salmonella, shigella, vibrios.* Non-bacterial agents of food-borne illnesses: toxins of algae, and mycotoxins. Food-borne viruses: Polio, Hepatitis A & E, gastroenteritis viruses.

UNIT IV
Food preservation: different types of heat processing, irradiation, pasteurization, low temperature preservation (chilling, freezing). Different types of chemical preservatives, canning process. Importance of lactic acid bacteria and yeasts in food technology.

UNIT V
Fermented and microbial food production and uses: milk products (yogurt, cheeses), fermented meat, fish, fermented vegetables. Production of Baker's yeast. Different types of microbial SCP production, production of volvarella, pleurotus mushrooms and their applications.

REFERENCES:

TEXT BOOKS

1. **Basic Food Microbiology**. George J. Banwart, 2nd edition, CBS publication.
2. **Food Microbiology**. M. R. Adams, M. O. Moss, 1st edition, New Age International Publication.

REFERENCES

1. **Food -The chemistry of its components**. Coultate TP, 2nd edition, Royal Society, London
2. **Food processing and preservation**. Sivasanker. B, 1st edition, Prentice Hall of India Pvt Ltd.
3. **Food Microbiology**. Frazier WC, Westhoff. D. C, 4th edition, McGraw-Hill publication, New York.
4. **Microbial technology** - edited by H. J. Peppler, D. Perlman.

Semester I

COURSE: M.Sc., BIOTECHNOLOGY

SUBJECT TITLE: Elective Paper I: HUMAN PHYSIOLOGY

Total teaching hours/week: 5

Subject Description: This course deals with the study of various systems such as digestive, respiratory, circulatory, nervous, excretory and endocrine systems present in humans, along with their structure and function. It also gives information about the different mechanisms which occur in each system.

Goals: It enables the students to get a better knowledge about the structure and function of different tissues and the different systems which function in their own body.

Objectives:
On successful completion of the course the students should have understood

1. The types of tissues present in our body,
2. Structure and function of digestive, respiratory, circulatory, nervous and excretory system,
3. The different hormones secreted by the endocrine system, their role and regulation.

CONTENTS:

UNIT I
Types of tissues: epithelial, connective, muscular, and nervous. Digestive system: components and functions of the digestive system, digestive enzymes, digestion & absorption of carbohydrates, proteins, lipids, mechanism of absorption, regulation of digestion.

UNIT II
Respiratory system: structure and functions, process of ventilation of lungs, transport of gases. Circulatory system: Structure of heart and function, blood components, types of blood cells, homeostasis, electrocardiogram, types of blood vessels, factors affecting blood pressure.

UNIT III
Nervous system: structure of neurons & function, synaptic function, membrane potential, neurotransmitters, brain structure and function, sensory and motor nerves. Muscular activity: smooth, cardiac, and skeletal muscle, myofibrils, actin and myosin filaments, muscle contraction, sliding filament theory, neuromuscular junction.

UNIT IV
Endocrine system: polypeptide/ protein hormones, steroid hormones, tyrosine-based hormones, transport of hormones in blood, mode of action of hormones, different types of glands associated with hormones, control of hormonal secretion.

UNIT V
Excretory system: structure of kidney, nephron and its functions, glomerular filtration, mechanism of tubular excretion. Reproductive system: anatomy of male reproductive system

- spermatogenesis, hormonal control of male reproductive system; anatomy of female reproductive system – oogenesis, hormonal control of pregnancy.

REFERENCES

TEXT BOOKS

1. **Review of Medical physiology**. William F. Ganong (1995) 23rd edition, Appleton & Lange, California.
2. **Functional physiology**. Foster PC, Hick VE (1993) Butterworth and Heinemann publication.

REFERENCE BOOKS

1. **Medical Physiology**. Guyton & Hall (2010) 12th edition, Elsevier publication.

Semester I

COURSE: M.Sc., BIOTECHNOLOGY

SUBJECT TITLE: PRACTICAL I: CELL BIOLOGY, BIOCHEMISTRY AND MICROBIOLOGY

Total practical hours/week: 5

Subject description
This lab course deals and covers laboratory techniques in cell and molecular biology, biochemistry, & microbiology.

Goals
To learn various cell biology, biochemical, & microbiological techniques

Objectives
After the successful completion, students will be aware of:

1. Handling of microorganisms, and isolation and maintenance of pure cultures
2. Various cell & molecular techniques
3. Routine biochemical tests

EXPERIMENTS

I. Cell and Molecular Biology:

1. Mitosis - Onion root tip
2. Meiosis - Grasshopper testis/ plant
3. Microtomy & cell staining of plant/ animal cell
4. Subcellular fractionation and marker assay (Mitochondria / Peroxisome / Chloroplast)
5. Karyotyping of human buccal epithelial cells.

II. Biochemistry:

1. Biochemical calculations for Biotechnology and Molecular biology.
2. Estimation of proteins – Lowry and Bradford method.
3. Estimation of sugars – Anthrone method.
4. Estimation of alkaloids/steroids.
5. Estimation of Vitamin C.
6. Determination of quality and quantity of nucleic acids by UV Spectrophotometry.
7. Determination of molecular weight of a protein by SDS-PAGE.
8. Protein staining methods: Coomassie brilliant blue / silver staining technique.
9. Enzyme activity determination – Human salivary amylase / Alkaline Protease.
10. Enzyme kinetics: Determination of Km and Vmax.

Demonstration:

11. Molecular visualization of levels of Protein structure, prediction of active site of an enzyme by *in silico* tools.
12. Thin layer chromatography (Analytical and preparative TLC) – Separation of secondary metabolites.
13. Paper chromatography (Circular and planar) – Separation of Amino acids
14. Isolation of plant pigments by column chromatography.

III. Microbiology:

1. Microscopy : bright field, phase Contrast & Fluorescent microscope (Demo)

2. Laboratory rules for microbiology.
3. Culture media preparation –Selective and differential media
4. Enumeration of Bacteria, Fungi and Actinomycetes from soil
5. Pure culture techniques – pour, Streak and Spread plate
6. Bacterial staining – simple, Gram, Spore and Fungal wet mount – LCB
7. Motility test
8. Bacterial growth curve
9. Antibiotic sensitivity test
10. Biochemical tests- carbohydrate fermentation test. IMVIC, catalase test, oxidase test and urease test
11. Water quality test - MPN

REFERENCES:

1. **Molecular & cellular methods in Biology & Medicine**. P. B. Kaufman, W.Wu.D.Kim, (1995) CRC Press.
2. **Biochemical Methods**. Sadasivam, S. & Manickam, A. (2004) 2nd Edition, New Age International LTD Publishers, New Delhi.
3. **Practical biochemistry - principles & techniques**. Keith Willson & John Walker (2000), 2nd edition, Cambridge University press.
4. **Experimental procedures in Lifesciences** – Dr. S. Rajan, Anjaana Book house press, Chennai.
5. **Microbiology: A laboratory Manual** by James G. Cappuccino, & Natalie Sherman.
6. **Experiments in Microbiology** by K.R. Aneja.

Semester II

COURSE: M.Sc., BIOTECHNOLOGY

SUBJECT TITLE: MICROBIAL BIOTECHNOLOGY

Total teaching hours/week: 5

Subject Description
This course presents the principles and applications of microorganisms for the production of useful biological products.

Goals
To enable the students to learn the various microbial Biotechnological applications.

Objectives
On successful completion of the course, students should be aware of screening and optimization for the production of useful microbial bioproducts.

CONTENTS:

UNIT I
Isolation, screening of microorganisms: strain selection and improvement methods; Principles of microbial nutrition, and media formulations for cell growth and product formation, Factors influencing the choice of various carbon, nitrogen sources; vitamins, minerals, precursors, and antifoam agents. Importance of medium, pH and temperature. Development of inocula for industrial fermentations.

UNIT II
Microbial synthesis of biological products: Aminoacids - L-glutamate, Lysine. Vitamins – vitamin B2, vitamin B12 and vitamin C. Organic acids - citric acid, lactic acid, acetic acid. Solvents - ethanol, acetone and butanol.

UNIT III
Antibiotics: Penicillin, Tetracycline and Streptomycin. Production of industrial enzymes and applications: amylase, lipase and protease. Food microbiology: different types of Fermented foods, dairy products – Cheese and Yogurt.

UNIT IV
Biomass production - different types of SCP production, applications. Mushroom production, cultivation, types of edible mushrooms, nutritional values, and preservation techniques. Biofuel production - role of microbes in hydrogen production, production of biopolymers & advantages.

UNITV
Biofertiliser production - rhizobial, azotobacter, azolla, frankia, mycorhiza, biological nitrogen fixers and applications. Biopesticide production - bacterial, fungal, viral insecticides and advantages. Role of microbes & immobilized microbes in environmental management - remediation of contaminated lands, waste water treatment, Biomining.

REFERENCES:

TEXT BOOKS

1. **Microbial Biotechnology**. Glazer *et al*., (1995) W.H. Freeman & Co. New York.
2. **Principles of Fermentation Technology**. Stanbury, P, F. and H. Whitaker (1997), Aditya Books (P) Ltd, New Delhi.

REFERENCES

1. **Industrial Microbiology**. Casida LE, New Age International Publishers
2. **Industrial Microbiology**. A.H. Patel, 1st edition, Macmillan publication Ltd
3. **Biotechnology**. W. Crueger and A. Crueger (2004) Panima Publication, New Delhi

Semester II

COURSE: M.Sc. Biotechnology

SUBJECT TITLE: GENETIC ENGINEERING

Total teaching hours/week: 5

Subject Description
This course presents the principles of Genetic Engineering, cloning strategies and applications.

Goals
To enable students to learn various molecular biology techniques, & principles of Genetic Engineering.

Objectives
On successful completion of the course the students will be aware of:
1. The guidelines for Genetic Engineering research and necessary molecular Biology techniques
2. Cloning strategies
3. Key applications of Genetic Engineering

CONTENTS:

UNIT I
Basic steps in gene cloning and manipulation, Isolation and purification of nucleic acids, Gel electrophoresis (Agarose and PAGE), Southern, Northern and Western Blotting, restriction enzymes –type I, II, III, DNA ligases, polymerase, reverse transcriptase, use of linkers & adaptors.

UNIT II
Cloning vectors: Plasmids - pBR322, pUC, Bacteriophages, Phagemids, Cosmids, Yeast vectors, Ti and Ri Plasmid, Plant and Animal viral vectors, transposons, Cloning in *E.coli*, Cloning in organisms other than *E.coli*, Specialized vectors (Expression vectors, shuttle vectors, fusion vectors). Vector engineering, Codon optimization.

UNIT III
Restriction mapping of DNA fragments and map construction, DNA sequencing and synthesis. Genomic Library and cDNA library (types & screening), PCR: principle, methods and recent advancements, RFLP & RAPD, selection & detection of recombinants.

UNIT IV
DNA foot printing and finger printing, Nucleic acid micro arrays, Site Directed Mutagenesis, Detection of mutation by SSCP and Heteroduplex Analysis, RNA interference, Gene silencing, Gene targeting: Principle and applications in medicine and agriculture.

UNIT V
Genetic engineering for human welfare, Gene therapy and applications (ADA, FH, Cystic fibrosis, DHA, Neoplastic disorders and infectious diseases). Salient features of Human Genome Project: Chromosome jumping & walking. Ethical issues in Genetic Engineering & transgenics.

REFERENCES:

TEXT BOOKS

1. **Gene cloning an introduction**. T. A. Brown, 3rd edition, Stanley Thomas pub Ltd.1995
2. **Principles of Gene Manipulation and Genomics** .S.M. Primrose and R.M Twyman, 7thedition, Blackwell Publishing, Australia 2006

REFERENCES

1. **From Genes to Clones**. Ernst. L. Winnacker, 22nd edition, Panima publishing Corporation, New Delhi.
2. **Genes VIII**. Benjamin Lewin (2003), Pearson Education Corporation, New Jersy.
3. **Freifelder's Essentials of Molecular Biology**. George M. Malacinski, (2008) 4th Edition, Narosa Publishing House, New Delhi.
4. **Recombinant DNA technology**. J.D. Watson(2001), 2nd edition, WH Freeman and Company, New York.
5. **Molecular Biotechnology**. Glick and Pasternak (1996),Panima Publishing Corporation, New Delhi.
6. **Molecular Cloning**: a Laboratory Manual, Sambrook J, Fritsch EF, and Maniatis T (2000), Coldspring Harbor Laboratory Press, New York.

Semester II

COURSE: M.Sc., Biotechnology

SUBJECT TITLE: IMMUNOLOGY AND IMMUNOTECHNOLOGY

Total teaching hours/week: 5

Subject Description
This subject describes the defense mechanisms of the higher vertebrates against invading pathogens, tumor immunology and autoimmunity.

Goals
To understand human defense mechanisms and their regulations.

Objectives
On successful completion of the subject, the student will be aware of what immunity is, how the immune system discriminates self from non-self antigens, how it is regulated, as well as basic immunological techniques and their applications.

UNIT I
Introduction to Immunology, History of Immunology, Innate immunity- Different barriers involved in innate immunity, Acquired immunity, Primary and Secondary immune response, Humoral and Cell Mediated Immunity. Antigens- Factors influencing immunogenicity, Adjuvants, Epitopes, Haptens, Super antigens, mitogens. Antibodies- Structure and functions of different immunoglobulin classes, Overview of gene rearrangement for Antibody diversity.

UNIT II
Cells of immune system- Hematopoiesis and differentiation, Lymphocytes- T cells (T_H cells, T_C cells, T_S cells), B cells and NK cells, Monocytes and Macrophages, Neutrophils, Eosinophils, Basophils and Mast cells, Lymphocyte traffic, Organization and structure of lymphoid organs.

UNIT III
Biology of Complement system, MHC, Antigen recognition and presentation, Structure and Function of BCR and TCR, Activation of B and T Lymphocytes, Cytokines and their role in immune recognition, Hybridoma technology for the production of monoclonal antibodies and catalytic antibodies.

UNIT IV
Hypersensitivity reactions- Type I, II, III and IV, Autoimmune disorders, Tumor immunology- tumor antigens, immune response to tumors, cancer immunotherapy, Transplantation immunology- Graft Vs Host reaction, MLR, HLA typing, Organ transplantation, Immunosuppressive therapy.

UNIT V
Immunity to bacteria, viruses and parasites, AIDS and other Immunodeficiency diseases, Immunological techniques: Salient features of antigen- antibody interactions, *In vitro* tests – Precipitation and Agglutination reactions: Bacterial, Passive and Haemagglutination, ABO blood grouping, RH typing, Coomb's test, Radio Immuno Assay, ELISA, Western Blotting, Complement Fixation Test, Immunofluorescent techniques, FACS. Vaccination and

Immunization: Passive immunization, Types of vaccines: Killed, Attenuated and Subunit Vaccines.

TEXT BOOKS

1. **Kuby's Immunology**., Thomas J. Kindt, Richard A. Goldsby, Barbara A.Osborne (2007) 6th edition, W.H. Freeman & Company, New York.

REFERENCES

1. **Essentials of Immunology**. Ivan Riot (1988), 6th edition, Blackwell Scientific Publications, Oxford.
2. **Fundamentals of Immunology**. Paul W.E. (1988) Raven Press, New York
3. **Cellular and Molecular Immunology**. Abul K. Abbas, Andrewtt, Lichtman & Jordan S. Pober (2000) W.B.Saunder's Company, A Harcourt Health Sciences Company, NY.
4. **Immunology**. Tizard (1995) ,4th Edition, Saunders College Publishers, New York
5. **Roitt's Essential Immunology**. Peter J. Delves, Seamus J. Martin, Dennis R. Burton & Ivan M.
6. **Janeway's Immunobiology**- Kenneth Murphy, Paul Travers, Mark Walport (2008), Garland Taylor & Francis group, New York.

Semester II

COURSE: M.Sc., Biotechnology

SUBJECT: BIOPROCESS TECHNOLOGY

Total teaching hours/week: 5

Subject description
This paper presents the basics of fermentation technology applied to lab scale, pilot scale and industrial scale, as well as upstream & downstream processing.

Goals
To provide information on the design and use of bioreactors, downstream processing, production of biopolymers.

Objectives
On successful completion of the course the students should have:

1. Understood the basics of fermentation technology & immobilization techniques
2. Learnt the concepts of upstream & downstream processing & biopolymer production

CONTENTS:

UNIT I
Applications of fermentation technology in various fields, Basic function, design and body construction of a fermenter. Peripheral parts and accessories of fermenter - Impeller types, types of sparger, temperature control; pH and foam control, Sterilization of fermenter, air supply and media, Aseptic inoculation and sampling methods and sensors.

UNIT II
Types of fermenters - CSTR, Tower fermenter, Air lift, Packed bed, Tubular fermenter. Immobilized bioreactor. Types of fermentation – Solid state fermentation – Tray fermenter, Column fermenter, and Drum fermenter, Submerged fermentation – Batch, fed-batch, continuous fermenter.

UNIT III
Major types of organisms used in fermentation, Growth kinetics of microbes, Transport phenomena in bioprocess- rate of oxygen mass transfer , rheological properties of fluid, culture, effect of medium and culture rheology, effect of foam and antifoam in oxygen transfer, scale up and scale down process and fermentation economics.

UNIT IV
Downstream processing: coagulation and flocculation, foam separation, precipitation methods, Cell disruption – enzymatic, chemical, physical methods, different types of filtration-frame, pressure leaf, rotary vacuum filter, types of centrifugation-basket, tubular bowl , disc, multichamber centrifuge, liquid-liquid extraction, chromatography-adsorption, ion exchange, gel permeation, affinity, HPLC, membrane process, drying, crystallization, lyophilization, packaging and quality assurance.

UNIT V

Production of Biodegradable plastics – Biopol and biolac, biosurfactant production, production of immobilized cells and advantages in various fields, Production of various types of microbial Biomass, production of Dextran, Xanthan gum, Pullulan, Zeaxanthin, Production of enzymes used in diagnostics and clinical medicine, production of industrially important enzymes, production of human peptide hormones, vaccines and secondary metabolites.

REFERENCES:

TEXT BOOKS:

1. **Principles of Fermentation Technology**. Stanbury, P.F. and H. Whitaker, (1997). Aditya Books (P) Ltd, New Delhi.
2. **Microbial Biotechnology**. Glazer *et al*., (1995.) W.H. Freeman & Co. New York.
3. **Biotechnology**. W. Crueger and A. Crueger. (2004.) Panima Publication, New Delhi.
4. **Fermentation Microbiology & Biotechnology**. E.M.T. El Mansi, Bryce.C.F.A, 2nd edition, Taylor & Francis group

REFERENCES BOOKS:

1. **Comprehensive Biotechnology**: Vol. I-III- M. Moo-Young, H.W. Blanch, S. Drew, and D.I.C. Wang.
2. **Bioprocess Engineering Principles**- P. M. Doran (1995) Academic Press.
3. **Biochemical Engineering Fundamentals**, J.E. Bailey and D.F. Ollis (1986), 2nd edition. McGraw Hill

Semester II

COURSE: M.Sc., BIOTECHNOLOGY

SUBJECT TITLE: ELECTIVE PAPER IV: BIOINFORMATICS

Total teaching hours/week: 5

SUBJECT DESCRIPTION:

This paper presents the basics of Bioinformatics, Concepts applied to Structural and functional analysis of genomes and proteomes and Drug discovery**.**

GOALS:
This paper is introduced to impart advanced training to the students with graduate qualification in Biotechnology to carry out characterization of genomes and proteomes leading to the design and development of novel drugs.

OBJECTIVES:
On successful completion of the course the students should have:

1. Understood the Basics of Genomes and Proteomes.
2. Learnt the concepts of structural and functional analysis of Genomes, Proteomes and Transcriptomes.

CONTENTS:

UNIT I:
An Over view of Bioinformatics: Scope, Bioinformatics and internet, useful bioinformatics sites on WWW. Data acquisition – Overview of sequencing of DNA, RNA and proteins, determination of protein structure, Gene and protein expression data, protein interaction data. Introduction to biological databases: Types of databases, biological databases, information retrieval from biological databases, file formats, annotated sequence databases, genome and organism specific databases. Retrieval of biological data - ENTREZ and DBGET/LinkDB, SRS.

UNIT II:
Sequence alignment:
Pair wise sequence alignment, sequence homology vs sequence similarity; sequence similarity vs sequence identity, methods, scoring matrices.
Database Similarity Searching: Heuristic Database searching, BLAST, FASTA, comparison of FASTA and BLAST, database searching with the Smith – Waterman method.

UNIT III:
Multiple Sequence alignment: Scoring function, Exhaustive algorithms, Heuristic algorithms, practical issues.
Profiles and Hidden Markov model: Position specific scoring matrices, profiles, Markov model and Hidden Markov model.
Protein motifs and domain prediction: Identification of Motifs and domain in multiple sequence alignment, protein family databases, motif discovery in Unaligned sequences.

UNIT IV:

Gene and promoter prediction: Gene prediction, categories, Gene prediction in prokaryotes and eukaryotes. Promoter and regulatory element prediction in prokaryotes and eukaryotes.
Molecular Phylogenetics: Gene phylogeny vs Species phylogeny, Phylogenetic tree construction methods and programs- distance based, character based methods.

UNIT V:

Structural Bioinformatics: Protein structure database, Protein structural visualization, comparison and classification, An Overview of protein structure prediction- Secondary (Globular and transmembrane proteins) and Tertiary (homology modeling, threading and fold recogisition, abinito, CASP. RNA structure prediction – Types, Methods of secondary structure prediction, Ab initio approach.
Genomics applications: Genome annotation, Comparative genomics. Functional genomics – Comparision of SAGE and Microarrays.
Proteomics applications: Protein expression analysis and protein-protein interactions.

REFERENCES:

TEXT BOOKS:

1. **Instant Notes Bioinformatics** - D. R. Westhead, J.H. Parish and R.M. Twyman (2002)
2. **Introduction to Bioinformatics**-Attwood. T. K. and Parry Smith. D.J. (2004), Pearson.
3. **Proteomics** – Pennington & Dunn (2002).Viva Books Pub. New Delhi.
4. **Genomes 3**, - T. A. Brown (2002) Garland Science, Taylor & Francis Group, NY & London.
5. **Principles of genome analysis and genomics** - S.B. Primrose and Twyman. (2003) Third Edition, Blackwell Publishing.

REFERENCE BOOKS:

1. **Essential Bioinformatics -** Jin Xiong (2006), Cambridge University Press.
2. **Bioinformatics Sequence and genome Analysis** – David W. Mount, (2005) Second Edition, CBS Publishers & Distributors.
3. **Bioinformatics: a practical guide to the analysis of genes and proteins -** Andrew D.Baxevanis, B.F.Francis Ouellette. Second edition.(2002), John Wiley and Sons, inc.

Semester II

COURSE: M.Sc., BIOTECHNOLOGY

SUBJECT TITLE: ELECTIVE PAPER IV: ENZYME TECHNOLOGY

Total teaching hours/week: 5

Subject description:

This paper presents the basics of enzyme properties, production, extraction, purification and application of enzymes in different fields

Goals
This paper is introduced to impart advanced training to the students with post graduate qualification in biotechnology to know about the different types of enzymes, its production and uses

Objectives
On successful completion of the course the students should have:
1. Understood the basics enzyme technology
2. Learnt the concepts of immobilization of enzymes and its uses
3. Learnt the modern trends in production and purification of enzymes

CONTENTS:

UNIT I
An over view of Enzymology: Properties of enzymes, Classification of enzymes, Structure of enzymes: active site, apoenzyme and holoenzyme. Structure based classification of enzymes - Monomeric enzymes, Oligomeric enzymes and membrane bound enzymes. Mechanism of enzyme action, enzyme substrate complex formation, specificity of enzyme action, factors affecting enzyme activity, inhibitors of enzymes, Enzyme kinetics and nontraditional enzymes

UNIT II
Enzyme Bioprocessing: Upstream Processing of enzymes: Different types of sources for the production of enzymes- enzyme production from bacteria, fungi- production of protease, amylase, cellulase. Extraction of enzyme by physical & chemical methods- sonication, freezing, solid & liquid shear, cold & osmotic shock; alkali, lysozyme, EDTA, detergents. Bioreactors used for enzyme production-CSTR, packed bed and fluidized bed reactor.

UNIT III
Downstream processing of enzymes: Purification of enzymes-concentration by ammonium sulphate precipitation, dialysis, organic solvent, ultra filtration, freeze drying, gel, ion exchange chromatography and criteria of purity – Zymogram, SDS-PAGE, Size-exclusion chromatography, Analytical ultracentrifugation and construction of purification table. HPLC, Preparative HPLC & FPLC. GE- AKTA systems of enzyme purification, Stabilization of enzymes, concentation of enzymes and packaging.

UNIT IV

Immobilization of enzymes: Different methods of immobilization of enzymes-adsorption, covalent binding, cross linking, gel entrapment, fibre entrapment, micro encapsulation, carrier binding, chelation. Effect of immobilization on enzyme activity and applications of immobilized enzymes.

Biosensors: Enzymes as biosensors - Enzyme electrode, colorimetric, potentiometric, amperometric, optical, piezo-electric and immunosensors (Principle only).

UNIT V

Applied Enzymology:

Applications of enzymes in biochemistry, organic chemistry, biotechnology, clinical assays, medicinal use, production of aminoacids, flavouring agents, detoxifying enzymes, and enzyme based detergents. Applications of immobilized enzymes in different fields. Enzymes used in Biotransformation. Applications of enzymes in industries - food, dairy, paper, textile, leather. Applications of enzymes in bioremediation, bioaugmentation, waste water treatment. Safety & regulatory aspects of enzymes.

TEXT BOOKS

1. **Enzymes -Biochemistry, Biotechnology, Clinical chemistry**-Trevor palmer, First edition, East West press Pvt Ltd.
2. **Enzymes biotechnology hand book**- NIIR Board, Asia pacific business press.
3. **Enzyme Technology** – Martin Chaplin (http://www.lsbu.ac.uk/biology/enztech/).

REFERENCE BOOKS

1. **Enzyme biotechnology**-Wiseman, First edition, Ellis Horwood Publishers.
2. **Fundamentals of Enzymology**-Nicholas C. Price, Lewis Stevens, Third edition, Oxford University press.
3. **Enzyme technology**-Chaplin & Bucke, Cambridge University press.

Semester II

COURSE: M.Sc. BIOTECHNOLOGY

SUBJECT TITLE: ELECTIVE PAPER II: PLANT AND ANIMAL PHYSIOLOGY

Total teaching hours/week: 5

Subject description
This paper presents the basics of the classification and physiology of plant & animal kingdom

Goals
This paper is introduced to impart advanced training to the students with post graduate qualification in biotechnology to know about the difference in physiology of plants , lower and higher animals

Objectives
On successful completion of the course the students should have:
1. Understood the basics of physiology of plants & animals
2. Learn the basics in behavior of plants & animals

CONTENTS:

UNIT I
Structure of plant cell- diffusion, osmosis, absorption of water and mineral elements- passive and active transport, transpiration & its types, antitranspirants, significance of transpiration. Structure and function of chloroplast- photosynthesis I, II- Light and dark phase (Calvins cycle), CAM plants, Translocation- mechanism of phloem and xylem.

UNIT II
Mechanism and respiration- glycolysis, Krebs cycle, electron transport chain, respiration and oxidative enzymes. Primary and secondary metabolites of plants. Nitrogen metabolism & fixation. Plant growth regulators- auxin, gibberlin, cytokinin. Seed physiology & dormancy, seed senescence & death. Stress physiology- stress to moisture, drought, temperature, water, radiation, salt, Role of plant physiology in agriculture and industry.

UNIT III
Comparative study of the physiological systems in Fishes, Amphibian, Reptiles Aves and Mammals-Digestive system-structure and function, mechanism of absorption. Respiratory system: structure and functions, transport of gases. Circulatory system: Structure of heart and function.

UNIT IV
Comparative study of the Fishes, Amphibian, Reptiles, Aves & Mammalian nervous system: structure of neurons & function, synaptic function, brain structure and function, sensory and motor nerves.

UNIT V
Comparative study of the Fishes, Amphibian, Reptiles, Aves & Mammalian excretory & Reproductive system: structure & functions of kidney, anatomy of male and female reproductive system.

REFERENCES:

TEXT BOOKS

1. **Textbook of Plant physiology**. V. Verma (2007), Ane books India
2. **Essentials of Animal Physiology**- S. C. Rastogi (2007), New Age International.

REFERENCE BOOKS

1. **Plant physiology** – Fundamentals and applications. Arvind Kumar % S.S. Purohit (2003), Agrobios India.
2. **Animal physiology** - PC Hurkat & PN Mathur (1976), S. Chand & Co. New Delhi.

Semester II

COURSE: M.Sc., BIOTECHNOLOGY

SUBJECT TITLE: PRACTICAL II: MICROBIAL BIOTECHNOLOGY, BIOPROCESS TECHNOLOGY AND IMMUNOTECHNOLOGY

Total practical hours/week: 5

Subject Description
This lab course deals with microbial, bioprocess and immunological techniques.

Goals
To provide adequate laboratory experience in different metabolite production starting from the screening and isolation of producer followed by the metabolite production till the purification of the product (metabolite). To enable the students to learn the determination of Antigen- Antibody interactions by different methods and also the preparation and purification of serum.

Objectives
After the successful completion, students will be aware of:

i) The screening and isolation of metabolite and antibiotic producing microbes.
ii) Production and assay of enzymes both in shake flask and fermentor.
iii) Downstream processing steps.
iv) Immobilization of organism and enzyme.
v) Production of other metabolites such as organic acid and alcohol.
vi) Serum preparation and purification of Ig from it.
vii) Various methods of detecting and quantifying Antigen Antibody interactions.

EXPERIMENTS:

Microbial Biotechnology:
1. Screening & Isolation of industrially important microbes.
2. Isolation of antibiotic producer from soil sample and production of antibiotics
3. Determination of Minimum Inhibitory Concentration (MIC) of antibiotics

Bioprocess Technology:
4. Screening & Isolation of industrially important enzyme producing organisms from soil.
5. Production & assay of protease / amylase / cellulase enzyme from microorganism.
6. Optimization of carbon / nitrogen sources on enzyme production using DOE statistical method.
7. Demonstration of a Fermenter.
8. Demonstration of production of enzyme under optimized culture conditions using fermentor.
9. Ammonium Sulphate Precipitation/Dialysis.
10. Ion Exchange / Gel filtration Chromatography.
11. Immobilization of microbes/enzyme.
12. Ethanol Production and estimation.
13. Production of citric acid & estimation.

Immunotechnology:
14. Blood smear preparation – WBC counting.
15. Immunization and Collection of Serum.

16. Haemagglutination assay.
17. Radial Immunodiffusion and Double Immunodiffusion.
18. Classical, Countercurrent and Rocket immunoelectrophoresis.
19. Purification of serum IgG.
20. ELISA.
21. Immunoblotting Technique.
22. Separation of PMNCs from blood.

REFERENCES

1. **Experimental procedures in Lifesciences** – Dr. S. Rajan, Anjaana Book house press, Chennai.
2. **Biochemical Methods**. Sadasivam, S. & Manickam, A. (2004) 2nd Edition, New Age International LTD Publishers, New Delhi.
3. **Principles of Fermentation Technology**. Stanbury, P.F. and H. Whitaker, (1997). Aditya Books (P) Ltd, New Delhi.
4. **Industrial Microbiology**. Cassida,L. E. (2005). New Age International Publishers.
5. **Industrial Microbiology**. Presscott, Dunn, (2005), 6th Edition, Agrobios (India).
6. **Biotechnology**. W. Crueger and A. Crueger. (2004). Panima Publication, New Delhi.
7. **Practical Immunology**. Frank C. Hay, Olwyn M. R. Westwood (2002) 4th Edition, Blackwell Science Publishing Company, USA.

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