RATHINAM COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)

(Affiliated to Bharathiar University, Re-Accredited by NAAC, Approved by AICTE & ISO9001:2008 Certified)

Eachanari, Coimbatore – 641021

DEPARTMENT OF BIOTECHNOLOGY

Curriculum for

M.Sc. Biotechnology

(I, II, III &IV Semester)

2021 to 2022 Batch on wards

RATHINAM COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)

Eachanari, Coimbatore – 641021

DEPARTMENT OF BIOTECHNOLOGY

VISION AND MISSION OF THE INSTITUTION

VISION

To emerge as a world renowned Institution that is integrated with Industry to impart knowledge, Skills, Research Culture and Values in youth who can accelerate the overall development of India.

MISSION

The impart superior quality education at affordable cost, nurture academic and research excellence, maintain eco-friendly and future ready infrastructure, and create team of well qualified teaching professionals who can build global competency and employability.

VISION AND MISSION OF THE DEPARTMENT

VISION

To create a competent center of excellence in Biotechnology research and provide technically sound graduates to serve as valuable resource for Industry and society; towards excellence and pride to be an Indian.

MISSION

To impart a holistic education and impetus to research through implementation of anintegrated approach in the design of a global curriculum.

PROGRAM EDUCATIONAL OBJECTIVE (PEO)

PEO 1: Graduates will establish themselves in various sectors of Biotechnology related industries such as Pharma, Clinical diagnostics, Agriculture, Food, Textiles etc..

PEO 2: Graduates will exhibit their effective skills in Research & Development in Biotechnology field at the National and International level.

PEO 3: Graduates gain through knowledge in the subject develop effective communication skills and be good academicians.

PEO 4: Recognition of the need for and an engage in lifelong learning process for productive career.

PEO 5: Graduates are encouraged and motivated to become entrepreneur with strong ethics.

PROGRAM SPECIFIC OUTCOME (PSO)

After the successful completion of Biotechnology program, the graduates

PSO1: Demonstrate the ability to design, conduct experiment and analyze data in the field of biotechnology

PSO2: Demonstrate the ability to independently carry out the research and development work in biotechnology.

PSO3: Learn to apply appropriate modern tools and techniques in genome modifications for the welfare of mankind.

PSO4: Acquire knowledge of norms and ethics in biotechnology/product development/patent writing.

PSO5: Will develop effective entrepreneurial skills winning business opportunity

PSO6: Develop skills to resolve scientific and technological problems in biotechnology-based industries.

PROGRAM OUTCOMES (PO)

On successful completion of the MSc Biotechnology program

PO1: Acquires scientific knowledge on the various subjects related to Biotechnology field.

PO2: Develops skills pertaining to various fields of Biotechnology

PO3: Trained to implement their knowledge in research

PO4: Understand the implications on the environment and society at large.

PO5: Understand the ethical issues pertaining to the subject.

PO6: Students will be able to design new biotechnological products or processes by applying innovative knowledge of different disciplines of biotechnology.

PO7: Develops ability to successfully carryout advanced tasks and projects independently in various streams of biotechnology discipline.

PO8: Demonstrate the ability to carry out the research projects independently.

PO9: Develops the ability to conceptualize and carry out collaborative ventures across the disciplines.

PO10: Develop skill sets for employability in diverse areas of biotechnology as well as for the higher studies.

Correlation between the PEO's, PO's and PSO's

Programme outcomes	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	3	2		1	
PO2		3	2	2	1
PO3		3	1	2	
PO4		2	3	2	
PO5		2		1	3
PO6		1		3	2
PO7		1		2	3
PO8	1		2		3
PO9		1		2	3
PO10	3		2	1	
PSO1	3		2	1	
PSO2	2	3	1		
PSO3	2	2	3		1
PSO4		2	3	1	3
PSO5		2	1		3
PSO6		1		2	3

Mapping of PEO's, PO's and PSO's Components are:
3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

Components consider for Course Delivery is listed below:

1. Class room Lecture
2. Laboratory class and Demo
3. Assignments
4. Case study
5. Project
6. Online Course
7. External Participation
8. Seminar
9. Internship

Correlation between PO's with Course Delivery

Programme outcomes	**Course Delivery**								
	1	2	3	4	5	6	7	8	9
PO1	3	2	2	1	1			1	1
PO2	3	3	2	2	1	1		2	1
PO3		3	2		2	2	1	1	2
PO4	2	3		2	3	1	1	1	2
PO5	1		1		3	2			3
PO6	3	1	2		2	1		2	
PO7	3	1	1	2		2		1	
PO8	3		2	1	2	2		2	
PO9	2			3		1	2		1
PO10	1			3		2	1	2	

Mapping of PO's and Course Delivery Components are:
3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

S.No	Sem	Sub Type	Sub Code	Subject	Credit	Hours	INT	EXT	Total
1	I	CORE	21MBT1CA	Molecular Biology and Genetics	4	4	50	50	100
2	I	CORE	21MBT1CB	Biochemistry	4	4	50	50	100
3	I	CORE	21MBT1CC	Applied Microbiology	4	4	50	50	100
4	I	CORE	21MBT1CD	Bioinstrumentation & Biostatistics	4	4	50	50	100
5	I	PRACTICAL	21MBT1CQ	Lab in Biochemistry and Microbiology	4	5	50	50	100
6	I	PRACTICAL	21MBT1CP	Lab in Molecular Biology and Genetics	4	5	50	50	100
7	I	ELECTIVE	21MBTE01	Elective paper I	4	4	50	50	100
1	II	CORE	21MBT2CA	Immunology &Immunotechnology	4	4	50	50	100
2	II	CORE	21MBT2CB	Genetic Engineering	4	4	50	50	100
3	II	CORE	21MBT2CC	Plant Biotechnology	4	4	50	50	100
4	II	CORE	21MBT2CD	Animal Biotechnology	4	4	50	50	100
5	II	PRACTICAL	21MBT2CQ	Lab in Genetic Engineering and Plant Biotechnology	4	5	50	50	100
6	II	PRACTICAL	21MBT2CP	Lab in Immunology and Animal Biotechnology	4	5	50	50	100
7	II	ELECTIVE	21MBTE02	Elective paper II	4	4	50	50	100
1	III	CORE	21MBT3CA	Bioprocess Technology	4	4	50	50	100
2	III	CORE	21MBT3CB	Pharmaceutical Biotechnology	4	4	50	50	100
3	III	CORE	21MBT3CC	Genomics & Proteomics	4	4	50	50	100
4	III	CORE	21MBT3CD	Bio-entrepreneurship	4	4	50	50	100
5	III	PRACTICAL	21MBT3CQ	Lab in Bioprocess Technology	4	5	50	50	100
6	III	PRACTICAL	21MBT3CP	Lab in Pharmaceutical Biotechnology and Genomics	4	5	50	50	100
7	III	ELECTIVE	21MBTE03	Elective Paper III	4	4	50	50	100
8	III			Industrial Training	2		50*		50
1	IV	PROJECT		Project	8	16**		200***	200
2	IV	ELECTIVE	21MBTE04	Elective Paper IV	4	4	50	50	100
					96				2450

S.No	ELECTIVE PAPERS
I	Occupational health and industrial safety
II	Bioethics, biosafety and IPR
III	Biotechniques
IV	Conservation biology
V	Plant system Physiology
VI	Animal System Physiology
VII	Developmental Biology
VIII	Evolution and behavior

*****Industrial Training has to be undergone during II semester vacation period. Mark shall be given based on training report and presentation

******Sixteen hours should be allotted for Project Guidance to the respective guides. As per the university norms 16 hours of project guidance should be considered equivalent to 8 hrs of teaching while calculating the workload of respective guides.

******* For Project report – 160 marks, Viva-voce – 40 marks.

PROJECT GUIDELINES

1) Project is pertained to the field of Biotechnology
2) Three review meetings should be conducted at regular intervals in the presence of HOD and respective guide. The review should evaluate for a maximum of 30 Marks

Project Mark Distribution	Maximum Marks
I Review	30
II Review	30
III Review	30
Dissertation evaluation by External Examiner	70
Viva-voce	40
Total	200

Semester: I

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBT1CA	**MOLECULAR BIOLOGY & GENETICS**	**4**	**4**	**1**	**0**	**Theory**

Introduction

Molecular biology focuses on DNA, RNA and protein synthesis in cells and is closely related to the fields of cell biology, genetics, genomics, and biochemistry.

Course Focus on: Skill Development & Research

Course Outcome: On the successful completion of the course student will be able to

CO1	:	Describe the genetic structure and type of chromatin
CO2	:	Elucidate the types, damage and repair of DNA, types of RNAs, genetic code
CO3	:	Understand the concept of mutations
CO4	:	Explicate the mechanism of gene regulation in prokaryotes
CO5	:	Understand the concept of gene expression in eukaryotes

UNIT I:

Gene Structure: Fine structure of gene, split genes, pseudogenes, overlapping genes and multigene families. DNA and RNA as genetic material; Chemistry and structure of DNA.Chromosome- structure, organization, banding, karyotyping, and labeling. Special types of chromosome - sex chromosomes, B-chromosome, polytene and lambrush chromosomes; Numerical and structural changes in the chromosome, Techniques in the study of chromosomes and applications.

UNIT II:

DNA replication in prokaryotes and eukaryotes: mechanism of replication, Transcription: initiation, elongation and termination (rho-dependent and independent) of RNA synthesis; eukaryotic promoters, enhancers, transcription factors, RNA polymerases; various protein motifs involved in DNA-protein interactions during transcription. Translation: Prokaryotes and eukaryotes translation and their regulation, processing of mRNA for translation (e.g. 5' capping and splicing) and involvement of different translational factors at different stages of the process. Regulation of gene expression in prokaryotes and eukaryotes.

UNIT III:

Gene Mutation and its mechanism; Types of mutation: Forward; Reverse; Intragenic suppressor; Extragenic suppressor; point mutations; Missense; Nonsense; Somatic versus germinal mutation. Mutagenesis- spontaneous and induced. DNA repair mechanisms- direct reversal; Excision repair (base excision, nucleotide excision and mismatch); recombinational repair; SOS response and SOS bypass.

UNIT IV:

Recombination - Models; Rec A, RecBCD, Ruv ABC, and molecular mechanism ofrecombination. Conjugation; transformation and transduction. Transposons - simple and complexin prokaryotic and eukaryotic systems.

UNIT V:

Introduction to Epigenetics: Gene expression without a change in DNA sequence changes in gene expression arising from chemical modification of DNA or histone proteins. Genes for development in Drosophila, Genes for development in Arabidopsis, Fertilization and development; genetic control of X

inactivation; in vitro fertilization and embryo transfer.

Text Book(s)

1. Robert H. Tamarin, 2002. Principles Of Genetics, 7th Ed, TATA Mcgraw-Hill Edition, New Delhi, India
2. Daniel L. Hartl & Elizabeth W. Jones, 1999. Essential Genetics, 2nd Ed., Jones & Bartlett Publishers
3. Cell And Molecular Biology - Gerald Karp. Published By John Wiley, 2009 Edition: 6
4. Principles of Genetics – Gardner, MJ Simmons Published By John Wiley, 2012 Edition: 8

REFERENCES:

1. Genes VI - Benjamin Lewin. Published by Oxford University Press, U.K., 1997. Edition: 6.
2. Molecular Cell Biology- Darnell, Lodish, Baltimore. Published by Scientific American Books, Inc., 1994.
3. Genomes 2 -T A Brown. Published by Garland Science Publishing, New York. 2002.
4. Genetics: A Conceptual Approach by Benjamin A Pierce. Published by Freeman and Company, New York. 2005. Edition: 2.
5. Molecular Biology of the Cell - Alberts, Bruce et al. Published by Garland Science, Taylor & Francis, 2002, Edition: 4.
6. William S. Klug & Michael R. Cummings 1996. Essentials of Genetics, 2nd Ed, Prentice Hall Internationals.

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1							3	2	1			
CO2			3	2		1					2	3	1			
CO3	3	2			1						3		1	2		
CO4		3		2	2	1					2	3	1			
CO5		3					2	1			2	1		3		

Mapping of CO's and PO's Components are:

3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

Semester: I

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBT1CB	**BIOCHEMISTRY**	**4**	**4**	**1**	**0**	**Theory**

Introduction: On the successful completion of the course the students will get an overall understanding of structure of atoms, molecules and chemical bonds, enzyme kinetics, bio polymers and metabolic reactions in a living system.

Course Focus on: Skill Development & Research

Course Outcome (CO): On the successful completion of the course, students will be able to

CO1	:	Classify Carbohydrates Based on their structure, Characteristics and various metabolic pathway.
CO2	:	Describe the structure, properties and metabolism of Amino Acids and Proteins.
CO3	:	Acquire the knowledge on categorization, structure and catabolism of Lipids.
CO4	:	Explicate classification of Enzymes and Mechanism of their action
CO5	:	Appreciate the structure, Biosynthesis, Degradation of Nucleic Acids Types, Properties and deficiency of vitamins.

UNIT I

Structure of atoms, molecules and chemical bonds; Classes of organic compounds and functional groups. Covalent and Non-covalent interactions - Van der Waals, Electrostatic, Hydrogen bonding and hydrophobic interactions; Respiration and photosynthesis. Energy metabolism (concept of free energy); Principles of thermodynamics; Kinetics, dissociation and association constants; bioenergetics.

UNIT II

Carbohydrates, Polysaccharides - classification and reactions: occurrence, isolation, purification, properties and biological reactions. Structural features of homoglycans, heteroglycans and complex carbohydrates Glycolysis and TCA cycle; Glycogen breakdown and synthesis; Gluconeogenesis; interconversion of hexoses and pentoses:

UNIT III

Oxidation of fatty acids. Biosynthesis of fatty acids; Triglycerides; Phospholipids; Sterols. Primary structure of proteins, structural comparison at secondary tertiary and quaternary levels (Ramchandran map). Purification and criteria of homogeneity-Salting out, dialysis, column chromatography.

UNIT IV

Biosynthesis of purines and pyrimidines, Nucleic acids: Structure of double stranded DNA (B, A, C, D, T and Z DNA). Physical properties of double stranded DNA, types of RNAs and their biological significance. DNA bending, DNA supercoiling. Conformational properties of polynucleotides, secondary and tertiary structural features and their analysis. Biochemistry and molecular basis of different disorders related to carbohydrate, protein fat and nucleic acids, Inborn errors of metabolism.

UNIT V

Enzyme kinetics (negative and positive co-operativity); Regulation of enzymatic activity; Enzyme catalysis in solution, kinetics and thermodynamic analysis, effects of organic solvents on enzyme catalysis and structural consequences. Active sites; Enzymes and coenzymes: Coenzymes interactions: activators and inhibitors, kinetics of enzyme inhibitors, isoenzymes, allosteric enzymes; Ribozyme, hammer head, hair

pin and other ribozymes. Abzyme: structure and drug targets (enzymes and receptors).

Text Books

1. Biochemistry- Donald Voet, Judith G. Voet, Published by J. Wiley & Sons, 2010, Edition:4.
2. Lehninger principles of biochemistry- Albert L. Lehninger, David Lee Nelson, Michael M. Cox, Published by W.H. Freeman, 2008, Edition:5.
3. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry-Trevor Palmer, Published by Horwood Publishing Limited, 2001, Edition:5.
4. Teitz text book of clinical biochemistry 3rd edition – Burtis et al., William Heinmann medical books, Ltd.,1999

REFERENCES:

1. Harper's Illustrated Biochemistry- Robert K. Murray, Darryl K. Granner, Peter A. Mayes, Victor W. Rodwell, Published by McGraw-Hill Professional, 2012, Edition:29.
2. Biochemistry- Geoffrey L. Zubay, Published by Wm.C. Brown Publishers, 1993, Edition:3.
3. Biochemistry- Jeremy Mark Berg, John L. Tymoczko, LubertStryer, Published by W. H. Freeman, 2006, Edition:6.
4. Fundamentals of clinical chemistry – Teitz, W.B.Saunders company,1994
5. Practical clinical biochemistry, volume I and II, 5th edition – Varley et.al.,CBS Publishers,1980.

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1							3	2	1			
CO2			3	2		1					2	3	1			
CO3	3	2			1						3		1	2		
CO4		3		2	2	1					2	3	1			
CO5		3					2	1			2	1		3		

Mapping of CO's and PO's Components are:

3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

Semester: I

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBT1CC	**APPLIED MICROBIOLOGY**	**4**	**4**	**1**	**0**	**Theory**

Introduction: On successful completion of the subject, the students will be aware of basic microbiology, and production of useful biomaterials from microorganisms.

Course Focus on: Skill Development & Research

Course Outcomes (CO): On the successful completion of the course students will able to

CO1	:	Identify microbiological techniques the defining characteristics of the major groups of microorganisms and apply to study microbial phylogeny
CO2	:	Classify the nutritional types of microorganisms and measure microbial growth.
CO3	:	Evaluate How microorganism interact with the environment in Beneficial or Detrimental ways.
CO4	:	Assess impact of plant microbe interaction on Agriculture in both beneficial and detrimental ways. Identify industrial important microbes.
CO5	:	Determine ways in which microorganisms plays an integral role in disease and the microbial and immunological methodologies are used in disease treatment and prevention.

UNIT I: Introduction to Microbiology

History of Microbiology - Ultra structure of Bacterial cell - Growth phases - Generation time. Kinetics of growth, Batch culture, Continuous culture, Synchronous culture (definition and brief description). Physical factors influencing growth - Temperature, pH, osmotic pressure, salt concentration. Classification of algae, protozoa and fungi. General properties and outline classification of viruses - structure and properties of T4 phage, Tobacco mosaic virus and HIV. Pure culture techniques. Control of growth of microorganisms. Principle and construction of bright field, dark field, phase contrast and Electron microscopy.

UNIT II: Food Microbiology

Normal microflora in milk, meat, poultry, eggs, fruits and vegetable; Fresh food, canned food and stored grains; Milk quality tests; Preservation of food: High temperature (Boiling, Pasteurization, Appertization), Low temperature (Freezing), Dehydration, Osmotic Pressure. Chemical Preservations, Radiation. Microbiologically Fermented food: Cheese and Yogurt. Microorganisms as food - SCP: Spirulina and Edible mushroons; Food borne diseases: Salmonellosis -Shigellosis.

UNIT III: Industrial Microbiology

Primary screening & secondary screening of industrially important strains; Strain improvement through random mutation (random & rational selection). Microbial production of organic acids - citric acid; antibiotics - Penicillin & Streptomycin; enzymes- amylase and Lipase; vitamins - B12; Alcoholic beverage - Beer; Production of recombinant proteins in bacteria and yeast - vaccine production inmicrobes

UNIT IV: Environmental Microbiology

Brief account of microbial interactions (symbiosis, neutralism, commensalism, competition, ammensalism, synergism, parasitism, and predation); Biological nitrogen fixation - symbiotic and asymbiotic; Biofertilizers, Biological Pest control. Plant disease (brown spot of rice, black stem rust of wheat) dissemination and control. Different types of microorganisms in the air, aerosols, sampling techniques. Coliform test - detection of faecal and non-faecal coliform.

UNIT V: Xenobiotics

Ecological considerations, decay behaviour and degradative plasmids; hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides. Bioremediation of contaminated soils and wastelands. Mineral leaching by microorganisms.

Text Book(s)

1. Principles of Microbiology - Atlas R M, WCB McGraw Hill Publications, New Delhi, 1997, Edition: 2.
2. Microbiology: Principles and Explorations - Black J G, Prentice Hall International, Inc.1999, Edition: 4.
3. Microbiology - Presscott L M, Harley J P and Klein D A, Tata Mc Graw Hill, New Delhi. 2005, Edition: 6.
4. Fundamentals of Microbiology - Alcamo E, Jones and Bartlett Publishers, New Delhi, 2001, Edition: 6

REFERENCES:

1. Environmental Microbiology - Mitchell R., John Wiley and Sons, New York.1992.
2. Microbial Ecology - Fundamentals and Applications - Atlas R N and Bartha R, Redwood City C A Benjamin / Cumming. 1998, Edition:4.
3. Microbial Ecology - Campbell R., Blackwell Scientific Publication, London. 1983, Edition: 2.
4. Modern Food Microbiology - Jay J M, Chapman and Hall Inc, New York,1992.Edition:
5. Food Microbiology – Frazier W C and West Hoff D C, Tata McGraw Hill Ltd, New Delhi, 1989, Edition: 8.
6. Principles of fermentation Technology – Stanbury P F, Whittaker A and Hall S J, Aditya Books (P) Ltd., New Delhi. 1997.
7. Biotechnology - A Textbook of Industrial Microbiology, Cruegar and Cruegar, Panima publishing Corporation, New Delhi. 2002, Edition:2.

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1							3	2	1			
CO2			3	2		1					2	3	1			
CO3	3	2			1						3		1	2		
CO4		3		2	2	1					2	3	1			
CO5		3					2	1			2	1		3		

Mapping of CO's and PO's Components are:

3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

Semester: I

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBT1CD	**BIOINSTRUMENTATION & BIOSTATISTICS**	**4**	**4**	**1**	**0**	**Theory**

Introduction: On successful completion of the subject, the students will be aware of the devices and mechanics used to measure, evaluate, and treat biological systems.

Course Focus on: Skill Development & Employability

Course Outcomes (CO): On the successful completion of the course students will able to

CO1	:	Know the theory behind fundamental bioinformatics analysis methods
CO2	:	Apply the various chromatography technique for the biomolecule analysis
CO3	:	Evaluate the biomolecules samples by the use of bio instruments
CO4	:	Know basic concepts of probability and statistics.
CO5	:	Describe statistical methods and probability distributions relevant for molecular biology data

UNIT -I

pH, pK, acids, bases and buffers, Henderson - Hasselbachequation,pH meter, Colorimetry & Spectrophotometry: Principles, types and applications, UV-VIS double beam spectrophotometry, Spectroflurometry, Mass spectroscopy, IR spectroscopy, Flame photometry. NMR Spectroscopy, Circular Dichroism and X- ray diffraction studies.

UNIT – II

Principles, types and applications of chromatography, size exclusion, Ionexchange chromatography, affinity chromatography. High performance liquid chromatography (HPLC), Gas chromatography (GC), Thin layer chromatography (TLC), Paper chromatography, Mass spectrometry,MALDI TOF .

UNIT -III

Centrifugation: Principles, types and applications of centrifuges; Principles, types and applications of Electrophoresis. Agarose gel electrophoresis PAGE (SDS/Native), Gradient gel, Isoelectric focusing, 2-D gel electrophoresis (2-D PAGE), cellulose, Capillary electrophoresis. Flowcytometry Nature & detection of radio isotopes; Applications of Radio isotope techniques; Detection based on gas ionization - Geiger Muller counter; Detection based on excitation - Liquid Scintillation counter; Supply, storage, purity, specific activity and safety aspects of radiolabelled compounds;

Unit – IV

Biostatistics – Scope of Biostatistics, Measures of Central tendency – Arithmetic mean, Median and Mode. Calculation of mean, median, mode in series of individual observation discrete series, continuous open end classes.

Unit – V

Classification and tabulation of data – Graphical and diagrammatic representations – scale diagrams – Histograms – frequency polygon - Frequency curves. Measures of Dispersion – standard deviation and Range. Chi – square test, student t test, regression, correlation, one way and two way ANOVA. Application of statistical software for biological research.

Text Book(s)

1. Introductory Practical Biochemistry – S. K. Sawhney and Randhir Singh. Narosa Publishing House
2. Principles of Applied Biomedical Instrumentation- Gedder A and L. E. Balsar, John Wiley and Sons.
3. Modern Experimental Biochemistry 2nd Edition- Boyer, Rodney F.Benjamin and Cummins.
4. Introductory Biostatistics by chap. T.Lee (Wiley – Interscience

REFERENCES:

1. Statistical methods edited by Stephen W.Looney (Humana publications)
2. Biostatistics: A Methodology for the Health Sciences, Second Edition, by Gerald Van belle (Wiley – Interscience publication)
3. http://www.itl.nist.gov/div898/handbook/prisection3/pri3.htm(online e book)
4. http://www.statease.com/de7_man.html(software tutorial website)

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1							3	2	1			
CO2			3	2		1					2	3	1			
CO3	3	2			1						3		1	2		
CO4		3		2	2	1					2	3	1			
CO5		3					2	1			2	1		3		

Mapping of CO's and PO's Components are:

3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

Semester: I

Subject Code	Subject Title		Credit	Lecture	Tutorial	Practical	Type
21MBT1CQ	**LAB IN BIOCHEMISTRY AND MICROBIOLOGY**		**4**	**0**	**0**	**4**	**Core Practical**

Course Focus on: Skill Development & Research

Course Objective: This practical session students able to know the macromolecules estimation and microbial media preparation, isolation and characterization.

1. Estimation of reducing sugars by Nelson - Somogyi method
2. Estimation of total carbohydrates by Anthrone method
3. Estimation of acid value, saponification value, Iodine number of fat
4. Estimation of total free amino acids
5. Protein estimation by Absorbance at 280nm, Lowry's method and Bradford method.
6. Separation of LDH isozymes from serum by SDS-PAGE.
7. Paper Chromatography - separation of pigments
8. Thin Layer Chromatography - separation of amino acids
9. Ion Exchange Chromatography
10. Extraction and purification of peroxidase from soy bean seeds
11. Estimation of ascorbic acid and riboflavin
12. Microscopy- care and use of microscope
13. Sterilization
14. Sample collection - clinical and Environmental samples
15. Culture media preparation
16. Pure culture techniques
17. Staining of Bacteria: simple, negative, differential, micro chemical staining
18. Staining of fungi - Lacto phenol cotton blue
19. Isolation, purification and biochemical identification of bacteria
20. Antibiotic sensitivity test

REFERENCE

1. Principles of Instrumental Analysis by D. A. Skoog, F. J. Holler and T.A. Nieman, Published by Saunders. 1998. Edition: 5.
2. Laboratory Manual of Biochemistry by J. Jayaraman, Published by Willy Eastern. 1981. Edition: 2.
3. Protein Methods by Daniel M. Bollag*et al*. Published by Wiley-Liss, Inc. 1996. Edition: 2.
4. Biochemical Methods by S. Sadasivam and A. Manickam, Published by Reprint New age international (P) Ltd. 1996. Edition: 2.
5. An Introduction to practical Biochemistry by David T Plummer, Published by Tata Mcgraw hill Publication. 1971. Reprinted 2004. Edition: 3.
6. Manual of Microbiology Tools and Techniques by Kanika Sharma, Published by Ane Books, 2007. Edition: 4.
7. Laboratory Manual on Biotechnology- Prof. P.M. Swamy, Published by Rastogi Publications.

	8. Microbial Technology: Fermentation technology - Henry J. Peppler, D. Perlman, Published by Academic Press, 1979. Edition: 2. 9. Microbiology: A laboratory Manual by James G. Cappuccino, & Natalie Sherman, Published by Benjamin/Cummings, 1996. Edition: 7. 10. Experiments in Microbiology, Plant pathology and Biotechnology by K.R. Aneja, Published by New age International Publishers, 2003. Edition: 4

Semester: I

Subject Code	Subject Title		Credit	Lecture	Tutorial	Practical	Type
21MBT1CP	**LAB IN MOLECULAR BIOLOGY & GENETICS**		**4**	**0**	**0**	**4**	**Core Practical**

Course Focus on: Skill Development & Research

Course Objective: This practical session students able to know the macromolecules estimation and microbial media preparation, isolation and characterization.

1. Study of Drosophila and its mutants.
2. Isolation of genomic DNA from Bacteria/plant cells / animal cells.
3. Isolation of plasmid DNA from different type of bacteria by adopting different methods , purification and calculation of molecular weight of plasmid DNA. , plasmid curing (acridine orange, heat shock).
4. Determination of Tm of Nucleic acid.
5. Estimation of DNA by Di-Phenylamine/C-TAB method.
6. Estimation of RNA by Orcinol method.
7. Study of conjugation in E. coli
8. Study of transduction in E. coli
9. Study of transformation in E. coli
10. Study of mutation in E.Coli (antibiotic resistance).
11. Restriction mapping of genomic/plasmid DNA (E.coli).
12. Study of Mutation by Ames test.

REFERENCES:

1. S.R. Maloy, J.E. Cronan, D. Friefelder, Microbial Genetics, 2nd Edition, Jones and Bartlett Publishers, 1994.

2. N. Trun and J. Trempy, Fundamental Bacterial Genetics, Blackwell publishing, 2004.
3. Strachan T and Read A P, Human molecular genetics, 3rd Edition Wiley Bios, 2006.
4. Mange E J and Mange A. P., Human genetics, 2nd Edition, Sinauer Associates publications, 1999.
5. Hartl L D and Jones B, Analysis of genes and genomes, 3rd Edition, Jones and Bartlett Publishers, 1994.
6. Molecular Biology of the Cell:-Alberts et al., 1983.
7. Molecular Biology of the Gene:J.D. Watson.
8. Molecular Cell Biology : Darnell et al.,
9. Recombinant DNA :- Watson et al.,1983.
10. Principle of Genetics:-Snusted, Simmons and Jenkins, Hohn Wiley and Sons Inc. 1997.
11. Essentials of Molecular Biology, Fourth Edition (2002) by G. M. Malacinski, Jones & Bartlett Publishers.
12. Microbial Genetics (2006) by S.R. Maloy, J. E. Cronan Jr., and D. Freifelder, Jones and Bartlett Publishers, Sudbury, Massachusetts.
13. Genetics – A Molecular Approach, 2nd Edition (2006) by Peter J. Russel.

Semester: II

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBT2CA	**IMMUNOLOGY AND IMMUNOTECHNOLOGY**	**4**	**4**	**1**	**0**	**Theory**

Subject description: this course presents the defense system of the higher vertebrates against invading pathogen.
Goals: to make the student to understand the defense mechanism and their regulations

Course Focus on: Skill Development & Research
Objectives: on successful completion the subject student should have understand: What is immunity, how it discriminates self and non-self, how it is regulated and what are the applications
Course Outcomes (CO): On the successful completion of the course students will able to

CO1	:	Compare and contrast the mechanism of innate and adaptive immunity
CO2	:	Explain the overall organization of the immune system
CO3	:	Describe the structure and genetic basis of immunogens and immunoglobin
CO4	:	Investigate the adverse effects of the immune system including allergy and hypersensitivity
CO5	:	Explain the production and types various vaccines

Unit – I

History and scope of immunology. Types of Immunity: Passive, Active and Acquired immunity. Humoral, Cell Mediated immunity. Cells and organs of immune response and their functions. Antigens Types, haptens, epitopes and Factors influencing antigenicity. Antibodies Structure types, properties and functions of immunoglobulins.

Unit – II

Cells of immune system. T-Cells, B-Cells, antigen presenting cells, cell mediated subset of T- Cells helper and suppressor cells, natural killer cells. Lymphoid organs (primary and secondary) MHC molecules, Antigen presentation, B cell and T cell activation, cytokines Complement system. Structure, components, properties and functions.

Unit –III

Antigen antibody reactions: in vitro tests- precipitation, immune-electrophoresis, Heamagglutination, Labeled antibody (RIA ELISA and immuno – fluroscenttechniques) Hypersensitivity and Allergic reactions Blood cell components, ABO blood grouping RH typing. Application of immunological techniques: hybridoma technology:- Fusion of myeloma cells with lymphocytes, production of monoclonal antibodies and their applications. Human monoclonals catalytic antibodies and planti bodies.

Unit IV

Hyper sensitivity reactions, auto immuno disorders, deficiencies (Primary and secondary) and immuno tolerance. Tumor immunology: tumor antigens, immune responses and terapy \, tissue and organ transplant.

Unit V

Immunity to bacteria, viruses and parasites vaccines and immunization: passive and Active immunization Types of vaccines – Inactivated, attenuated and Recombinant Vaccines – Peptide and DNA vaccines, Synthetic vaccines, epitope mapping.
Text Book(s) 1. Essentials of Immunology (6th Edition): Ivan Riot – Blackwell Scientific Publications, Oxford, 1988 2. Fundamentals of Immunology: Paul W.E (Eds) Ravanprss, New York, 1988 3. Antibodies A laboratory Manual: Harlow and David Lane (1988), cold spring harbor laboratory.
REFERENCES: **1.** Janis Kuby (1997) Immunology, WH Freeman & Company, New york. 2. Tizard (1995) Immunology IV Ed Saunders college publishers, New York.

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1							3	2	1			
CO2			3	2		1					2	3	1			
CO3	3	2			1						3		1	2		
CO4		3		2	2	1					2	3	1			
CO5		3					2	1	2	1	2	1		3	2	1

Mapping of CO's and PO's Components are:
3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

Semester: II

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBT2CB	**GENETIC ENGINEERING**	**4**	**4**	**1**	**0**	**Theory**

SUBJECT DESCRIPTION: This paper provides the student a thorough knowledge in principles and methods in genetic engineering, vectors in gene cloning, transformation in higher organisms.

GOALS: To enable the students to grasp of the latest advances in genetic engineering, which is a powerful tool in modern Biotechnology.

OBJECTIVES: On successful completion of the course the students will be aware of the techniques and the applications of genetic engineering in various fields of biotechnology, medicine and research areas.

Course Outcomes (CO): On the successful completion of the course students will able to

CO1	:	Provide basic concepts in Genetic Engineering and Biotechnology
CO2	:	Explain the different types of vectors and their cloning strategies
CO3	:	Describes the techniques for constructing recombinant DNA
CO4	:	Acquire knowledge on advanced recombinant techniques
CO5	:	Learn about the various applications of genetic engineering

UNIT I:

Gene Manipulation Enzymes used in manipulation: Polymerases and types; nucleases: endonucleases, exonucleases and restriction enzymes; ligases; topoisomerases, methylases; other modifying enzymes. Electrophoresis. Blotting techniques- Southern, Northern, Western, Dot and Slot blot.

UNIT II:

Biology of Cloning Vectors Biology and construction of plasmid vectors: pBR 322; pUC 18. Phages as vectors: Lambda phage; cosmids; phagemids. Expression vectors; shuttle vectors; artificial chromosomes: YAC, PAC, BAC, HAC.

UNIT III:

Basic Recombinant DNA Techniques Construction of a recombinant molecule. Bacterial transformation: principle and methods; Physical methods of transformation. Analysis of cloned genes: direct and indirect methods. Molecular Marker techniques: RFLP, RAPD, STS, SSR, ISSR, SCAR, SSCP and AFLP. Importance of molecular markers, molecular marker assisted selection, aided plant breeding. Selectable marker and reporter genes.

UNIT IV:

Advanced Recombinant Techniques: Genomic and cDNA libraries; PCR: principle and types; Site directed mutagenesis; DNA sequencing. Microarrays - cDNA and protein chips. DNA fingerprinting; SNPs; VNTRs and microsatellites.

UNIT V:

Applications: Gene therapy: Exvivo,Invivo,germlinr and somatic gene therapy,Vectors in gene therapy. Viral gene delivery system- Adeno associated virus vector- Retero virus vector –HSV vector system ; DNA forensics. Recombinant Products: blood products; vaccines; interferons; interleukins and therapeutic proteins. Molecular Pharming - Hirudin (Plant), Antibodies (Animal) and tissue plasminogen activator (Bacteria).

Text Book(s)

1. Principles of Gene Manipulation by Primrose by S.B., Twyman R.M., Old. R.W. Published by Blackwell Science Limited. 2001. Edition: 6.
2. DNA Science, A First Course in Recombinant Technology by D.A.Mickloss and G A Freyar, Published by Cold Spring Harbor Laboratory Press, New York, 1990.
3. Molecular Biotechnology by S. B. Primrose. Published by Blackwell Scientific Publishers, Oxford, 1994. Edition: 2.
4. Route Maps in Gene Technology by M.R.Walker and R.Rapley. Published by Blackwell Science Ltd., Oxford, 1997.
5. Genetic Engineering. An Introduction to Gene Analysis and Exploitation In Eukaryotes by S.M. Kingsman and A.J. Kingsman. Published by Blackwell Scientific Publications, Oxford, 1998.

REFERENCES:

1. Human Molecular Genetics by Tom Strachan and Andrew P. Read. Published by Bios Scientific Publishers, 1996.
2. Gene Cloning and DNA Analysis by Brown TA. Published by Garland Science. 2006. Edition: 5.
3. www.blackwellpublishing.com/genecloning/pdfs/chapter7.pdf.
4. From Genes to Clones: Introduction to Gene Technology by Ernst L. Winnacker. Published by VCH, 1987.
5. Recombinant DNA by James D. Watson, Michael Gilman, Jan Witkowski, Mark Zoller. Contributor James D. Watson, Mark Zoller. Published by Scientific American Books, 1992, Edition: 2.
6. Genetic Engineering: Concepts and Applications by R. Suganthi and C.S. Shobana, Published by KalaikathirAchchagam, Coimbatore - 37, 2013, Edition:1

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1							3	2	1			
CO2			3	2		1					2	3	1			
CO3	3	2			1						3		1	2		
CO4		3		2	2	1					2	3	1			
CO5		3					2	1	1	1	2	1		3		1

Mapping of CO's and PO's Components are:

3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

Semester: II

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBT2CC	**PLANT BIOTECHNOLOGY**	**4**	**4**	**1**	**0**	**Theory**

SUBJECT DESCRIPTION: This paper provides the student a thorough knowledge in principles and methods in genetic engineering, vectors in gene cloning, transformation in higher organisms.

GOALS: To enable the students to grasp of the latest advances in genetic engineering, which is a powerful tool in modern Biotechnology.

OBJECTIVES: On successful completion of the course the students will be aware of the techniques and the applications of genetic engineering in various fields of biotechnology, medicine and research areas.

Course Focus on: Employability & Research

Course Outcomes (CO): On the successful completion of the course students will able to

CO1	:	Determine the factors influencing plant cell differentiation and thereby execute proper techniques/ procedures for the maintenance of sterile condition and proper plant growth
CO2	:	Know about the techniques that followed in plant transformation technology
CO3	:	Understands the applications of genetic transformation techniques in plants.
CO4	:	Able to analysis the secondary metabolites of plants for vaccine production
CO5	:	Learn about the techniques used for the phytochemical extractions.

Unit – I

Tissues culture media – Composition and preparation; Plant Propagation – Conventional &In vitro techniques; Conventional plant breeding methods – Selection, hybridization, mutation and polyploidy; Cell and tissue culture techniques for plants – Micropropagation, Callus culture, somatic embryogenesis, suspension culture, embryo culture, haploid culture, protoplast culture, protoplast fusion; Somaclonal variation; Artificial seeds; hardening.

Unit –II

Plant transformation technology: Ti and Ri plasmids, binary & co-integrated vector systems; viral vectors and their applications; 35S and other promoters; genetic markers; reporter genes; virulence genes; Cloning Strategies; Gene transfer methods in plants – Direct DNA transfer methods, Agrobacterium mediated nuclear transformation, Chloroplast transformation.

Unit –III

Application of genetic transformation techniques for improving productivity and performance of plants: herbicide resistance, insect resistance, virus resistance, disease resistance, PR Proteins, antifungal proteins, nematode resistance, abiotic stress tolerance.

Unit – IV

Secondary metabolic pathways in plants. Industrial phytochemical products from plants: Alkaloids, Biodegradable Plastics, Therapeutic proteins, antibodies, plant vaccines, herbal drugs, bioethanol and biodiesel.

Unit –V

Extraction & purification of phyto-chemicals. phytoremediation; Green house and green home technology. Arid and semiarid technology. Proteomics and Plant biotechnology: Proteomics in plant breeding and genetics.

Text Book(s)

1. An Introduction to genetic engineering in plants, Mantel. S.H, Mathews. J.A, Mickee, R.A, 1985 Black well Scientific Publishers,London.
2. In Vitro culture of plants by R.L.M. pierik, 1987. MartinusNijhoff publishers ,Dordrecht
3. Palnt cell culture, A practical approach,(2nd ed). Edited by R.A. Dixon and R.A. Gonzales. 1994. Oxford University Press,Oxford.
4. Plant Molecular Biology by Grierson and son Ltd, Newyork
5. Palnt Molecular Genetics by Monica. A.Hughes,1999, Pearson Education Ltd,England

REFERENCES:

1. Plant Biotechnology by Mantell and Smith, 1983, Cambridge UniversityPress
2. Plants, Genes and agriculture by M.J. Chrispeels and D.F.Sadava .2000. the American scientificpublishers.
3. practical Application of plant molecular biology by R.J.Henry, 1997, Chepmans andHall
4. Elements of Biotechnological by P.K.Gupta, 1996. Rastogi andCo.Meerut
5. Plant Biotechnology by J.Hammond, P.Mcgarey and V.Yusibov (Eds) 2000 Springerverag
6. Plant cell and tissue culture in the production of food ingredients by T.J. Fu. G.Singsand W.R. Curtis kluwer Academic/plenum press
7. Biotechnology in crop improvement by H.S Chawla. 1998 International Book Distributor Company.

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1							3	2	1			
CO2			3	2		1					2	3	1			
CO3	3	2			1				1	1	3		1	2	1	
CO4		3		2	2	1					2	3	1			
CO5		3					2	1			2	1		3		

Mapping of CO's and PO's Components are:

3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

Semester: II

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBT2CD	**ANIMAL BIOTECHNOLOGY**	**4**	**4**	**1**	**0**	**Theory**

Scope: The study of animal cells has helped us gain an insight not only in the structure and function of cells and tissues but also in different physiological, biochemical and immunological processes. Biotechnologists explore and develop new technologies using molecular biology, embryo manipulation and cell and tissue culture. Research on gene regulation and early embryo development has resulted in novel techniques to manipulate and explore the genomes of domestic animals for ways to increase healthier food production as well as to develop biomedical applications.

Objective: The major objective is to provide a world-class training experience for these students in an interdisciplinary research program connecting animal genomics with animal reproduction and biotechnology.

Goal: This paper will help students interested in careers as laboratory, research or animal care technicians in the fields of veterinary and human health or biotechnology

Course Focus on: Skill Development & Research

Course Outcomes (CO): On the successful completion of the course students will able to

CO1	:	Recall the basic concepts of Biotechnology and explain fundamental cellular events during the process of animal cell culture development and the media preparation
CO2	:	Examine the primary cell culture and characterization of cell lines
CO3	:	Understand about the contaminations of animal cell culture and the preservation
CO4	:	Apply the learned techniques for the production of transgenic animals
CO5	:	Learn the IVF and ET techniques and the ethical issues in animal biotechnology

UNIT I

Introduction to Animal Tissue Culture: Background, Advantages, Limitations and applications. Culture Environment, Cell Adhesion, Cell Proliferation and Cell differentiation. Essential Equipments required for animal tissue culture, Aseptic Technique and general safety. Media: Physicochemical Properties, Balanced Salt Solutions, Complete Media, Serum, Disadvantages of Serum supplemented media, Serum-Free Media, Advantages of Serum-Free media.

UNIT II

Primary Culture: Isolation of Tissue, Steps involved in primary cell culture, Cell Lines, Nomenclature, Subculture and Propagation, Immortalization of cell lines, Cell line designations, Routine maintenance. Characterization of Cell Line: Need for characterization, Morphology, Chromosome Analysis, DNA, RNA and Protein Content, Enzyme Activity and Antigenic Markers. Transformation of animal cell.

UNIT III

Contamination: Source of contamination, Type of microbial contamination, Monitoring, Eradication of Contamination, Cross-Contamination. Cryopreservation: Need of Cryopreservation. Apoptosis and its determination; Cytotoxicity assays. Application of animal cell culture; Vaccine production; Tissue engineering; Engineered cell culture as source of valuable products and therapeutic protein production.

UNIT IV

Transgenic Animals: Production Methodology-Embryonic Stem Cell method, Microinjection method; Applications of transgenic animals-in therapeutic protein production; live stock improvement; Transgenic animals as disease models. Gene targeting, silencing and knockout technologies. Animal cloning

UNIT V

In vitro Fertilization and Embryo Transfer: Composition of IVF media, Steps involved in IVF, Fertilization by means of micro insemination, PZD, ICSI, SUZI, MESA. Stem cell culture, embryonic stem cell and their applications. Ethical issues in animal biotechnology.

Text Book(s)

1. Animal cell culture; A practical approach, 4th Edition, by Freshney. R.I. John Wiley publication.
2. Methods in cell biology; Volume 57, Animal cell culture methods, Ed. Jennie P.Mather, David Barnes, Academic press.
3. Mammalian cell biotechnology; A practical approach, Ed. M. Butler,Oxford universitypress.

REFERENCES:

1. Exploring genetic mechanism; Ed. Maxine Singer and PaulBerg.
2. Principles of genetic manipulation; Ed. Old and Primrose, 6th Edition.Blackwell sciencepublication.

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1							3	2	1			
CO2			3	2		1					2	3	1			
CO3	3	2			1						3		1	2		
CO4		3		2	2	1			1	1	2	3	1			1
CO5		3					2	1			2	1		3		

Mapping of CO's and PO's Components are:

3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

Semester: II

Subject Code	Subject Title		Credit	Lecture	Tutorial	Practical	Type
21MBT2CP	**LAB IN GENETIC ENGINEERING & PLANT BIOTECHNOLOGY**		**4**	**0**	**0**	**4**	**Core Practical**

Course Focus on: Employability & Research

Course Objective: This practical session students able to know the phytochemical analysis and genetic transformation

1. Isolation of genomic DNA from bacteria and animal tissue. Purification and Quantification.
2. Agarose gel electrophoresis
3. Isolation of plasmid DNA from bacteria
4. Restriction digestion and ligation of Lambda phage DNA and gel analysis
5. Transformation of plasmid DNA in E.coli, expression and selection
6. Polymerase chain reaction
7. Southern Hybridization using non-radioactive detection
8. Northern Blotting
9. Composition and preparation of media and sterilization
10. In vitro Seed Germination
11. Micropropagation - Nodal and apical meristems.
12. Callus induction, regeneration and Acclimatization
13. Somatic Embryogenesis and Synthetic Seeds
14. Suspension cultures and somatic embryogenesis
15. Anther culture
16. Embryo culture
17. Protoplast Isolation and Viability Testing
18. Isolation of plant genomic DNA
19. Qualitative and quantitative analysis of plant genomic DNA
20. Isolation of plasmid DNA from Agrobacterium spp.

REFERENCE

1. Plant Tissue Culture Concepts and Laboratory Exercise - Robert Nicholas Trigiano, Dennis John Gray, Published by CRC Press, 1999 Edition: 2.
2. Introduction to Plant Tissue Culture - M. K. Razdan, Published by Science Publishers, 2003, Edition:
3. An Introduction to Practical Biotechnology - S. Harisha, Published by Firewall Media, 2006.
4. Novo's Handbook of Practical Biotechnology - C. O. L. Boyce, Boyce, Published by Novo Industri A/S, 1986.
5. Genetic Engineering Principles and Practice, Sandhya Mitra, Published by Macmillan India, 1996.
6. Molecular Cloning: A Laboratory Manual - Joseph Sambrook, E. F. Fritsch, Tom Maniatis, Chris Nolan Published by Cold Spring Harbor Laboratory, 1989 Edition: 2.
7. Molecular Cloning: A Laboratory Manual - Joseph Sambrook, David William Russell, Published by CSHL Press, 2001, Edition: 3.

Semester: II

Subject Code	Subject Title		Credit	Lecture	Tutorial	Practical	Type
21MBT2CQ	**LAB IN IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY**		**4**	**0**	**0**	**4**	**Core Practical**

Course Focus on: Employability & Research

Course Objective: This practical session students able to know the animal cell culture and diagnosis disease by antigen antibody techniques.

1. Demonstration of animal handling for experimental purposes, cervical dislocation, dissection of mice, cardiac puncture, blood sample preparation and its handling
2. Immunization and generation of antiserum in animals against antigen
3. Separation of IgG using affinity chromatography
4. Blood grouping and counting of blood cells
5. Antigen-Antibody Interactions: Radial Immunodiffusion, Ouchterlony double diffusion Precipitin ring test
6. Immunoelectrophoresis and rocket immunoelectrophoresis.
7. Antibody titre by ELISA
8. SDS-PAGE and Immunoblotting
9. Separation of mononuclear cells from Human peripheral blood
10. Sterilization techniques
11. Preparation of culture media and sera
12. Preparation of primary cell culture
13. Trypsinizing and sub culturing cells from a monolayer
14. Passaging cells in suspension culture
15. Determining cell umber and viability with a hemocytometer and Trypan blue staining
16. Preservation of cells

REFERENCE

1. Animal Cell Culture: A Practical Approach- R. Ian Freshney, Published by IRL Press, 1986.
2. Practical Immunology - Leslie Hudson, F.C. Hay, Published by Blackwell Scientific Publications, 1981, Edition: 2.
3. Animal Cell Culture: A Practical Approach- John R. W. Masters Contributor John R. W. Master, Published by Oxford University Press, 2000, Edition: 3.
4. Practical Immunology- Leslie Hudson, Frank C. Hay, Published by Blackwell (Oxford), 1976.
5. Analytical Microbiology by Frederick Kavanagh Volume I & II. Published by Academic Press New York.
6. Analytical Microbiology by Frederick Kavanagh Volume I & II. Published by Academic Press New York.
7. Manual of Clinical Laboratory and Immunology by Noel R. Rose, Published by ASM Publications, 2002, Edition: 6.

Semester: III

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBT3CA	**BIOPROCESS TECHNOLOGY**	**4**	**4**	**1**	**0**	**Theory**

Subject description: This paper presents the basics of fermentation technology, media components as applied to lab scale, pilot scale and industrial scale upstream and down stream processing.

Goals: This paper is introduced to acquire requisite skills for the design and development of bioreactors, production optimization, and preparation of sterile base materials for downstream processing.

Objectives: On successful completion of the course the students should have understood the basics of fermentation technology and learnt the concept of screening, optimization and maintenance of cultures.

Course Focus on: Employability & Entrepreneurship

Course Outcomes (CO): On the successful completion of the course students will able to

CO1	:	Understand the basics of fermentation and bioprocess engineering
CO2	:	Designing of bioreactors and control necessary for maximizing production
CO3	:	Select and optimize media for maximum production of microbial metabolites.
CO4	:	Evaluate the bioprocess instruments and the controlling systems
CO5	:	Designing of protocols for strain improvement and separation of molecules after fermentation process

UNIT I:

Introduction to Bioprocess Engineering Fermentation a Historical perspective. Biotechnology and bioprocess engineering, Bioprocess regulatory constraints, Basic of Biology - an engineering perspectives - cell construction, cell nutrients. Stochiometry of microbial growth and product formation. Alteration in cellular information.

UNIT II:

Bioreactor - Designs Introduction to fermentation process. Sterilization. Thermal death kinetics. Design of continuous sterilization process, Fibrous filters. Bioreactor design, parts and their functions, Alternative vessel designs - CSTR, Tower, Airlift, Loop jet, Bubble Column, Packed bed. Immobilized cells.

UNIT III:

Kinetic Studies Microbiology of Industrial fermentation, Fermentation kinetics, Rheological properties of the medium Theory of mixing. Oxygen transfer rate, Oxygen transfer coefficient and correlation. Biological heat transfer and heat transfer coefficient.

UNIT IV:

Instrumentation Controls Different types of instrumentation, common measurement and control systems, Additional sensors, Feedback control, PID control, Computers in Bioprocess control systems, Biosensors in bioprocess monitoring and control.

UNIT V:

Upstream and Downstream Processing Upstream processing**,** Removal of microbial cells, cell disruption – enzymatic, chemical and physical methods; purification of fermentation products - precipitation methods, membraneprocess, centrifugation – Ultracentrifugation; Chromatography -Ion exchange and gel permeation chromatography, HPLC; crystallization, drying, lyophilisation, packaging and quality assurance.

Text Book(s)

1. Bioprocess Engineering Basic concepts by Michael L. Shuler FikretKarg. Published by Prentice Hall International services, 2001. Edition: 2.
2. Fermentation Microbiology and Biotechnology by E.M.T El-Mansi and C. F. A.Bryce. Published by Taylor & Francis. Reprinted 2002.
3. Biotechnology-A Textbook of Industrial Microbiology by Wulf Crueger and Anneliese Crueger. Published by Panima Publishing Corporation New Delhi. 2000. Reprinted 2005. Edition: 2.

REFERENCES:

4. Principles of Fermentation Technology by Peter. F. Stanbury, Allan Whitaker, Stephen. J. Hall. Published by Elsevier Science Ltd., reprinted 2007, Edition: 2.
5. Bioprocess Engineering Principles by Pauline M. Doran, Published by Elsevier, Reprinted 2006.

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1							3	2	1			
CO2			3	2		1			1	1	2	3	1			1
CO3	3	2			1						3		1	2		
CO4		3		2	2	1					2	3	1			
CO5		3					2	1			2	1		3		

Mapping of CO's and PO's Components are:

3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

Semester: III

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBT3CB	**PHARMACEUTICAL BIOTECHNOLOGY**	**4**	**4**	**1**	**0**	**Theory**

Subject description: This paper presents the basics of biopharmaceutical industry and their process.
Goals: This paper is introduced to acquire requisite skills for the design and development of drug, production optimization, and preparation of vaccine.
Objectives: On successful completion of the course the students should have understood the basics of drug discovery and development.

Course Focus on: Skill Development & Employability
Course Outcomes (CO): On the successful completion of the course students will able to

CO1	:	Acquire knowledge in basic principles of drug discovery and generic medicines
CO2	:	Describe the concept of immunity and production of vaccine
CO3	:	Explain the concepts of rDNA technology in pharmaceuticals and its applications
CO4	:	Apply the principles of GLP and protein engineering in Pharmaceutical Industry
CO5	:	Knowledge on genetic multiplication for vaccine production and biotransformation

UNIT I
History of pharmaceutical industry, Drugs discovery, Development phases and Drug- Manufacturing Process. Drugs and Cosmetics ACT and regulatory aspects. Definition: Generics and its advantages .Biogenerics and Biosimilars. Protein-based biopharmaceuticals.

Unit II
Introduction to pharmaceuticals of animal, plant and microbial origin. Hemotopoietic growth factors and coagulation factors. Interferons and cytokines for anti-infective and cancer therapy. Insulin and growth hormones. Vaccine: genetically improved vaccines, synthetic peptide based vaccines, nucleic acid vaccines.

Unit III
Recombinant thrombolytic agents: tissue type plasminogen activator, first and second generation of thrombolytic agents. Xenotransplantation in pharmaceutical biotechnology. Estimation of toxicity: LD50 and ED50. Pre-clinical and clinical trails

Unit IV
Introduction to pharmacopoeia, good microbiological techniques and good laboratory practice (GLP). Basic principles of quality control (QA) and quality assurance (QC), Guidelines for QA and QC: raw materials, sterilization, media, stock cultures and products, Validation study and toxicity testing. Role of culture collection centre, public health laboratories and regulatory agencies Concept of biotech process validation, Cell lines culture process validation and characterization.

Unit V
Issues of DNA vaccines and plasmid DNA vaccines. Analytical methods in protein formulation: concentration, size, purity, surface charge, identity,structure/sequence, shape, activity. Introduction to

drug designing and Search of database. Biosafety guidelines; Risk and risk assessment- Biosafety levels, laboratory biosecurity concepts Introduction to drug design- Pre- clinical and clinical trials. Basics of bioethics principles, international codes and guidelines in India. Ethics in post-genomic era.

Text Book(s)

1. Gareth Thomas. Medicinal Chemistry. An introduction. John Wiley.2000.
2. Katzung B.G. Basic and Clinical Pharmacology, Prentice Hall of Intl.1995.
3. T.V.Ramabhadran. Pharmaceutical Design and Development: A Molecular Biology Approach, Ellis Horwood Publishers, New York,2005
4. Goodman & Gilman's The Pharmacological Basis of Therapeutics,11th edition, Mc Graw-Hill Medical Publishing Division New York,2006.

REFERENCES:

1. Sarfaraz K. Niazi, Handbook of Biogeneric Therapeutic Proteins: Regulatory, Manufacturing, Testing, and Patent Issues, CRC Press,2006.
2. Rodney J Y Ho, MILO Gibaldi, Biotechnology & Biopharmaceuticals Transforming proteins and genes into drugs, 1st Edition, Wiley Liss,2003.
3. Brahmankar D M, Jaiswal S B, Biopharmaceutics and Pharmacokinetics A Treatise, Vallabh Publisher, (1995, reprint2008)

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1							3	2	1			
CO2			3	2		1					2	3	1			
CO3	3	2			1					1	3		1	2		1
CO4		3		2	2	1					2	3	1			
CO5		3					2	1	1	1	2	1		3	1	

Mapping of CO's and PO's Components are:

3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

Semester: III

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBT3CC	**GENOMICS & PROTEOMICS**	**4**	**4**	**1**	**0**	**Theory**

Subject description: This paper presents the basics of genome and protein.
Goals: This paper is introduced to acquire requisite skills for the design and development of ligands, genome and protein database.
Objectives: On successful completion of the course the students should have understood the basics of fermentation technology and learnt the concept of screening, optimization and maintenance of cultures.

Course Focus on: Course Focus on: Skill Development
Course Outcomes (CO): On the successful completion of the course students will able to

CO1	:	Develop basic skills and techniques involved in Genome Mapping and Sequencing
CO2	:	Understand and build skills for separation and amplification of DNA
CO3	:	Analyze the data available in databases
CO4	:	Familiarize the techniques involved in protein-protein interaction
CO5	:	Understand the repositories of Biological Data Knowledge

Unit-I: Genome mapping, assembly and comparison.
Genome mapping, Genome sequencing, Genome sequence assembly: Base calling and assembly programs, Genome annotation: Gene ontology, Automated genome annotation. Comparative genomics: Whole genome alignment, Finding a minimal genome, Lateral gene transfer.

Unit-II: Functional Genomics.
Sequence based approaches: EST, EST index construction and SAGE. Microarray based approaches: Oligonucleotide design, Data collection, Data transformation and normalization, Statistical analysis to identify differentially expressed genes and Microarray data classification. Comparison of SAGE and DNA Microarrays.

Unit-III: Proteomics
Technology of protein expression analysis: 2D-PAGE, Mass spectrometry protein identification, protein identification through database searching, Differential in-gel electrophoresis and Protein Microarrays. Post translational modification: Prediction of disulphide bridges and Identification of posttranslational modifications in proteomics analysis. Protein sorting.

Unit-IV: Protein-protein interactions.
Experimental determination of protein-protein interaction, Prediction of protein-protein interactions: predicting interactions based on phylogenetic information and prediction interactions using hybridmethods.

Unit-V: Applications of proteomics.
Medical proteomics-disease diagnosis: Biomarkers, Biomarker discovery using 2DGE and mass spectrometry and Biomarker discovery and pattern profiling using protein chips. Pharmaceutical proteomics-drug development: Proteomics and target validation, Proteomics in the development of lead compounds and Proteomics and clinical development.

Text Book(s)

1. Xiong J. (2006). Essential bioinformatics. Cambridge, UK: Cambridge UniversityPress.
2. Goodman N. (2002). Biological data becomes computer literature: New Advancesin Bioinofrmatics. Curr. Opin. Biotechnol. 13:68-71.
3. Hagen J.B. (2000).The origin of bioinformatics. Nat. Rev. Genetics. 1:231-236.
4. Apweiler R. (2000). Protein sequence databases. Adv. Protein Chem. 54:31-71.
5. Hughes A.E. (2001). Sequence databases and the internet. Methods Mol. Biol. 167: 215- 223.
6. Stein L.D. (2003). Integrating biological databases. Nat. Rev. Genet. 4:337-45.
7. Batzoglou S. (2005). The many faces of sequence alignment. Brief. Bioinformatics. 6: 6- 22.
8. XuangX.(1994). On global sequence alignment. Comput. Appl. Biosci. 10:227-235.
9. Pearson, W.R. (1996). Effective protein sequence comparison. Methods Enzymol.266: 227-258.
10. Spang R. and Vingron M. (1998). Statistics of large scale sequencesearching. Bioinofrmatics. 14:279-284.

REFERENCES:

1. Mullan L.J. (2002). Multiple sequence alignment- The gateway to further analysis.Brief. Bioinform. 3: 303-305.
2. Brenden C, and ToozeJ.(1999). Introduction to protein structure, 2nd ed. NewYork: Garlandpublishing.
3. Baker D. and Sali A. (2001). Protein structure prediction and structuralgenomics. Science 294:93-96.
4. Stekel D. (2003). Microarray bioinformatics. Cambridge, UK: Cambridge universitypress.
5. Huynen M.A., Snel B., Mering C. and Bork P.(2003). Function prediction andprotein networks. Curr. Opin. Cell Biol. 15:191-198.
6. Attwood T.K. and Parry-Smith D.J. (2003). Introduction to bioinformatics, Singapore, Pearsoneducation.

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1							3	2	1			
CO2			3	2		1					2	3	1			
CO3	3	2			1						3		1	2		
CO4		3		2	2	1			1		2	3	1			1
CO5		3					2	1			2	1		3		

Mapping of CO's and PO's Components are:

3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

Semester: III

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBT3CD	**BIO-ENTREPRENEURSHIP**	**4**	**4**	**1**	**0**	**Theory**

Course Focus on: Entrepreneurship

Course Outcomes (CO): On the successful completion of the course students will able to

CO1	:	Account for the theoretical approaches to business venture creation in biotech, and apply the theoretical perspectives in composing a business plan.
CO2	:	Discuss and assess the particular business conditions affecting commercialization of life sciences, hereunder, strategic choices, business models, financing, corporate governance, sales, marketing, regulatory affairs, and be able to assess and conduct a market-analysis, a distribution- and sales analysis, as well as a marketing plan
CO3	:	Conduct IP analysis, hereunder initial freedom to operate, novelty and patentability searches
CO4	:	Compose and write a business plan offering a convincing presentation of a biotech venture. The element of the business plan should reflect skillful application of theories and tools
CO5	:	Demonstrate understanding of the biotech and business concepts

UNIT-I

Principles of management: Introduction, definition – Management principles of Henry Foyal - setting and managing biotechnology industry: principles and decisions on starting a venture; sources of financial assistance – making a business proposal, approaching loan from bank and other financial institutions, budget planning and cash flow management, basics in accounting practices - balance sheet, P&L account, and double entry bookkeeping; estimation of income, expenditure, profit, income tax etc.

UNIT -II

Human Resource Development (HRD): Recruitment and selection process; leadership skills; managerial skills; organization structure; training; team building; teamwork; Marketing: Assessment of market demand for potential product(s) of interest; Market conditions, segments; prediction of market changes; identifying needs of customers including gaps in the market.

UNIT -III

Entrepreneur: Meaning of entrepreneur, evaluation of the concept, function of an entrepreneur types of entrepreneurs, evolution of entrepreneurship, development of entrepreneurship, stages in entrepreneurial process, role of entrepreneurs in economic development entrepreneurship in India, entrepreneurship - its barriers

UNIT -IV

Small Scale Industry: Definition, characteristics, need and rationale, objectives, scope, role of SSI in economic development, advantages of SSI, steps to start an SSI – Govt policy towards SSI, different policies of SSI, Govt support for SSI during 5 year plans. Impact of liberalization, privatization, globalization on SSI, effect of WTO/ GATT, supporting agencies of Govt for SSI, meaning; nature of support, objectives, and functions, types of help, ancillary industry and tiny industry (Definition only)

UNIT -V

Institutional Support: Different Schemes, TECKSOK, KIADB, KSSIDC, KSIMC, DIC single window

Agency SISI, NSIC, SIDBI, KSFC.Preparation of Project-Meaning of Project; Project Identification Project Selection.Project Report, Need and significance of Report, Contents, Formulation Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report,Project Appraisal, Identification of Business Opportunities. Market Feasibility Study,Technical Feasibility study, Financial Feasibility Study & Social Feasibility study.

Text Book(s)

1."Principles of Management",PCTripati,PN Reddy,–Tata Mc Graw Hill, (Chapter 1,2,3,4,5,15,16,17)

2. "Dynamics of Entrepreneurial Development & Management" Vasant Desai Himalaya Publishing House (Chapter 1,2,4,8,9,10,13,15,16,17,18,19,20,21,22,42,46,47)

3. "Entrepreneurship Development – small Business Enterprises" Poornima M Charanthmath Pearson Education – 2005 (2 & 4)

REFERENCES:

1. "Management Fundamentals ", Robert Lusier,– Concepts, Application, Skill Development" Thomson (Chap 1,4,12)

2. "Entrepreneurship Development" S S Khanka S Chand & Co (Chapter1,2,5,11,12,13,16,18,20)

3. "Management" Stephon Robbins Pearson Education/PHI 17th Edition 2003.

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	2		1					3	2		2	1		3	1
CO2			1	1		1			2	3	2		1		3	2
CO3	2	1			1			1	3	2				2	2	3
CO4	1	2		1	2	1			3	2			1		2	3
CO5			1				2	1	2	3	2	1	2		3	2

Mapping of CO's and PO's Components are:

3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

Semester: III

Subject Code	Subject Title		Credit	Lecture	Tutorial	Practical	Type
21MBT3CP	**LAB IN BIOPROCESS TECHNOLOGY**		**4**	**0**	**0**	**4**	**Core Practical**

Course Focus on: Employability & Research

Course Objective: This practical session students able to know the fermentation techniques and microbial media preparation, isolation and characterization.

1. Media formulation - Sterilization of bioreactors.
2. Study of fermenters-Demonstration only.
3. Media standardization (C: N ratio) for maximum biomass production of an industrially important microorganism.
4. Detection and quantification of sideorophores produced by Psuedomonas spp
5. Isolation of industrially important microorganisms (amylase, pectinase, cellulase) for Microbial process & maintenance of bacterial & fungal cultures.
6. Determination of thermal death point and thermal death time of microorganisms.
7. Study of alcohol fermentation-alcohol from different substrates-estimation of percentage of alcohol, total acidity and volatile acidity.
8. Production and analysis of SCP and SCO.
9. Microbial production of citric acid using Aspergillus *niger*.
10. Microbial production of pectinase by Aspergillus *niger* by agro wastes.
11. Microbial production and assay of vitamins and amino acids.
12. Cell disruption by sonication and product recovery.
13. Microbial production of Penicillin and product recovery.
14. Citric acid production by Aspergillus *niger* and Penicillium *citrianum*
15. Production of amylase, cellulose, pectinase in a bioreactor.

REFERENCE

1. Biochemical engineering, Alba.S, Humphrey,A.Eand Millis
2. Biochemical reactors, Atkinson,B.
3. Principles of fermentation technology, Stanbury,P.F and Whitaker
4.Process engineering in biotechnology, Jackson, A.T., Prentice Hall,Engelwood
5. Bioreaction engineering principles, Nelson,J and Villdsen, J. Plen
4. Comprehensive Biotechnology Vol. 1- 4: M.Y. Young (Eds.), Pergamon Press.
5. Biotechnology: A Text Book of Industrial Microbiology: T.D. Brock, Smaeur Associates, 1990.
6. Industrial Microbiology: L.E. Casida, Willey Eastern Ltd., 1989.
7. Industrial Microbiology: Prescott & Dunn, CBS Publishers, 1987.

Semester: III

Subject Code	Subject Title		Credit	Lecture	Tutorial	Practical	Type
21MBT3CQ	**LAB IN PHARMACEUTICAL BIOTECHNOLOGY & GENOMICS**		**4**	**0**	**0**	**4**	**Core Practical**

Course Focus on: Employability & Research

Course Objective: This practical session students able to know the drug administration and animal model study

1. Various modes of administration of drugs: Intravenous, Intramuscular, Intraperitoneal, Intradermal.
2. Acute toxicity testing of drugs
3. Determination of analgesic and anti-inflammatory activity of a compound
4. Spectrophotometric determination of Allantoin and Griseofulvin
5. Microbial analysis of pharamaceuticals (syrups)
6. Chemical assays for antimicrobial drugs.
7. Testing for antibiotic/drug sensitivity/resistance.
8. Determination of MIC value for antimicrobial chemicals.
9. Microbiological assays for antibiotics (Liquid tube assay, agar tube, agar plate assays)
10. Toxicity tests in lab animals; Pyrogenicity tests in lab animals.
11. Extraction and estimation of total proteins from plants/animal/microorganisms.
12. Estimation of protein by Micro-Kjeldahl's method.
13. Estimation of total amino acid composition.
14. Estimation of amino acid by ninhydrin method.
15. Separation of proteins by electrophoretic method SDS-PAGE.
16. 2D-Gel Electrophoresis of protein and imaging.
17. Physical mapping of the alpha amylase gene.

REFERENCE

1. Pharmaceutical Microbiology by W. B. Hugo & A. D. Russell Published by Blackwell scientific Publications.2009,Edition: 6.
2. Analytical Microbiology by Frederick Kavanagh Volume I & II. Published by Academic Press New York.
3. Quality control in the Pharmaceutical Industry by Murray S. Cooper Volume.II. Published by Academic Press New York.
4. Manual of Clinical Laboratory and Immunology by Noel R. Rose, Published by ASM Publications, 2002, Edition: 6.
5. Pharmaceutical Biotechnology- K Sambamurthy and Ashutosh Kar, New age International Publishers-New Delhi 2006.
6. Pharmaceutical Biotechnology-S P Vyas and V K Dixit, CBS Publishers, 2007
7. Drug Delivery and Targeting for Pharmacists and Pharmaceutical Scientists by Anya M.Hillery et.,al. 2005.
8. A Text Book of Modern Toxicology by Ernest Hodgson 3 rd Edn. John Wiley & Sons, Inc. 2004.
9. Twyman, R.M. Principles of Proteomics. BIOS Scientific Publisher, New York. 2004.
, USA.

ELECTIVE - GROUP A

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBTE01	**Occupational Health & Industrial Safety**	**4**	**5**	**0**	**0**	**Theory**

Subject Description: This course deals with the study of industrial safety, various safety measures and its applications. It also gives emphasis on prevention and control methods.
Goals: Students get on idea about the advantages and disadvantages of occupational & Industrial safety applications, principles & functions in safety management.
Objectives: To impart knowledge on various occupational health hazards and also safety measures to be taken in the work place.

Course Focus on: Skill Development
Course Outcomes (CO): On the successful completion of the course students will able to

CO1	:	Recognize and evaluate occupational safety and health hazards in the workplace
CO2	:	Determine appropriate hazard controls following the hierarchy of controls
CO3	:	Select appropriate control methodologies based on the hierarchy of controls
CO4	:	Identify relevant regulatory and national consensus standards along with best practices that are applicable
CO5	:	Analyze injury and illness data for trends.

UNIT -I
Parameters of safety - Factors affecting the conditions of occupational and Industrial safety - Concept of safety organization and Management - Safety Regulations. Definition and Role of Ergonomics in Designing Work-Place

UNIT -II
Work Environment - Effects of Light, Ventilation, Vibration, Noise etc - The Work Physiology and their Relevance to Safety - Performance Evaluation of Man - Environment systems.

UNIT -III
Occupational Health and Safety – Occupational Health and Hazards – Physical, Chemical and Biological hazards. Occupational Diseases and their Prevention and Control. Health Protection Measures for Workers. Principles of Arthropod Control.

UNIT -IV
Health Education Medical First-Aid and Management of Medical Emergencies Industrial Safety management Techniques - Industrial Safety Standards. Accidents-Definition, Frequency Rate, Prevention and Control. Work Study - Method of Study and Measurement. Measurement of Skills. Safety - Cost of Expenses.

UNIT - V
Principles of Functions in Safety Management Case Study - Visit to an Industry - Preparation of report on safety measures followed in Airport/Industry.

REFERENCE:

1. Environmental Strategies–Hand Book, Kolluru R. V, (1994) Mc Graw Hill Inc., New York.
2. A B C of Industrial Safety, Walsh, W and Russell, L, (1984) Pitma Publishing United Kingdom (1984)
3. Environmental and Industrial Safety, (1989) Hommadi, A. H (1989). I.B.B Publication, New Delhi (1989)

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1							3	2	1			1
CO2			3	2		1				1	2	3	1		1	
CO3	3	2			1						3		1	2		
CO4		3		2	2	1			2	1	2	3	1		2	1
CO5		3					2	1		2	2	1		3	1	2

Mapping of CO's and PO's Components are:

3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBTE02	**BIOETHICS, BIOSAFETY AND IPR**	**4**	**5**	**0**	**0**	**Theory**

Scope: This course has been designed to provide the students insights into the valuable areas of biotechnology, which plays a crucial role in determining its future use and applications.
Objective: Students get an idea about the advantages and disadvantages of biotechnological applications, ethical implications and intellectual property rights.
Goal: To study the diversity of plants and animal life in a particular habitat, ethical issues and potential of biotechnology for the benefit of mankind.

Course Focus on: Skill Development
Course Outcomes (CO): On the successful completion of the course students will able to

CO1	:	Gain awareness about Intellectual Property Rights (IPRs) to take measure for the protecting their ideas
CO2	:	Devise business strategies by taking account of IPRs
CO3	:	Assists in technology upgradation and enhancing competitiveness.
CO4	:	Knowledge in the use of genetically modified organisms and its effect on human health
CO5	:	Gain more insights into the regulatory affairs

Unit I
Introduction to ethics/bioethics – framework for ethical decision making; biotechnology and ethics –benefits and risks of genetic engineering – ethical aspects of genetic testing – ethical aspects relating to use of genetic information – genetic engineering and biowarfare

Unit II
Ethical implications of cloning: Reproductive cloning, therapeutic cloning; Ethical, legal and socioeconomic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research-GM crops and GMO's – biotechnology and biopiracy – ELSI of human genome project

Unit III
Introduction to biosafety – biosafety issues in biotechnology – risk assessment and risk Management – safety protocols: risk groups – biosafety levels – biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulations – types of biosafety containment

Unit IV
Introduction to intellectual property and intellectual property rights – types: patents, copy rights,Trade marks, design rights, geographical indications – importance of IPR - world intellectual Property rights organization (WIPO)

Unit V
What can and what cannot be patented? – Patenting life – legal protection of biotechnological Inventions – Patenting in India: Indian patent act.

References:

1. Principles of cloning, Jose Cibelli, Robert P. lanza, Keith H. S . Campbell, Michael D.West, Academic Press, 2002
2. http://books.cambridge.org/0521384737.htm
3. http://online.sfsu.edu/%7Erone/GEessays/gedanger.htm
4. http://www.actahort.org/members/showpdf?booknrarnr=447_125
5. http://www.cordis.lu/elsa/src/about.htm

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1							3	2	1			
CO2			3	2		1					2	3	1			
CO3	3	2			1						3		1	2		
CO4		1		2	2	1				3	2	3	1			1
CO5							2	1		1	2	1		3	1	

Mapping of CO's and PO's Components are:

3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBTE03	**BIOTECHNIQUES**	**4**	**5**	**0**	**0**	**Theory**

Subject description : This course presents the principles and applications of Biotechnology explaining the biomolecules and applications of biophysical methods.

Goals : To enable the students to learn the immuno techniques and radio labeling techniques.
Objectives : On successful completion of the course the students will be aware of

1. Microscopic techniques
2. Electro physiological methods.
3. Biomolecules structure determination using x-ray diffraction and NMR

Course Focus on: Skill Development & Employability
Course Outcomes (CO): On the successful completion of the course students will able to

CO1	:	Discuss the applications of biophysics and principle involved in bioinstruments
CO2	:	Describe the methodology involved in biotechniques
CO3	:	Demonstrate knowledge and practical skills of using instruments in biology and medical field
CO4	:	Perform techniques involved in molecular biology and diagnosis of diseases
CO5	:	Update current knowledge regarding biomedical engineering involving new methods and the instrumentation

UNIT - I
Histochemical and immunotechniques: Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, floweytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH.

UNIT - II
Biophysical methods: Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy, structure determination using X-ray diffraction and NMR; analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.

UNIT - III
Radiolabeling techniques: Properties of different types of radioisotopes normally used in biology, their detection and measurement; incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.

UNIT - IV
Microscopic techniques: Visulization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy.

UNIT - V
Electrophysiological methods: Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT

References:

1. Biotechniques: Theory & Practice, S V S Rana,. Rastogi Publication -2018.
2. Biotechniques, P Ponmurugan & B Gangathara Prabhu. MJP Publishers.

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1							3	2	1			
CO2			3	2		1					2	3	1			
CO3	3	2			1						3		1	2		
CO4		3		2	2	1				1	2	3	1			
CO5		3					2	1			2	1		3		1

Mapping of CO's and PO's Components are:

3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBTE04	**CONSERVATION BIOLOGY**	**4**	**5**	**0**	**0**	**Theory**

Subject description : This course presents the principles and applications of Biotechnology explaining the biomolecules and applications of biophysical methods.

Goals : To enable the students to learn the immuno techniques and radio labeling techniques.
Objectives : On successful completion of the course the students will be aware of

1. Microscopic techniques
2. Electro physiological methods.
3. Biomolecules structure determination using x-ray diffraction and NMR

Course Focus on: Skill Development
Course Outcomes (CO): On the successful completion of the course students will able to

CO1	:	Ecological and evolutionary processes that are important for conservation of biodiversity
CO2	:	Analyzing and evaluating the importance of biological processes on conservation of biodiversity
CO3	:	Critical reading and understanding of scientific results in conservation biology
CO4	:	Planning management of biodiversity and biological resources in the light of ecological and evolutionary dynamics.
CO5	:	Advanced understanding of biodiversity and conservation biology that is highly valuable both for scientific and management purposes

UNIT I - BIODIVERSITY; SPECIES CONCEPTS; ANIMAL DIVERSITY
What is Biodiversity- Components of Biodiversity (Ecosystem, Genetic and Species diversity) - Assigning values to biodiversity - Species concepts - Animal diversity: (Distribution, inventory, species richness) - Biodiversity Hotspots (Western Ghats, Indo-Burma region).

UNIT II - LOSS OF ANIMAL DIVERSITY, STATUS OF SPECIES
Extinctions: Past rates of Extinctions - Concepts of Island biogeography and extinction rates on Islands - Human induced, Modern and local extinctions - Population reduction-threats to wildlife (examples)- Habitat loss, degradation and fragmentation. Threats to animal diversity in India - Status of species: Rare, endemic and threatened species - Measuring status of species in the wild - IUCN Red list (Assessments and methodologies) - Status of Indian animals.

UNIT III - CONSERVATION: TOOLS IN ANIMAL CONSERVATION
What is conservation biology? - In situ and Ex situ conservation of Indian animals (Case studies) - Population management -Project Tiger and Elephant - Captive breeding programme - peoples participation in conservation - Successes and failures of conservation actions in India (Case study) -Tools in Conservation: Interpretation of various data on wildlife - GIS - remote sensing - Landscape model – PVA and CAMP processes.

UNIT IV - ANIMAL LAWS AND POLICIES IN INDIA; ECONOMICS OF BIODIVERSITY CONSERVATION
Wildlife (Protection) Act of India (1972) - Protected Area network - forest policy - Prevention of cruelty to Animal Act - Convention on Biological diversity, International Trade in endangered species - Zoo policy-

Laws and their applications in Zoological parks, wildlife sanctuaries and biosphere reserves - Economics of biodiversity conservation.

UNIT V - CONSERVATION EDUCATION AND AWARENESS

Wildlife / Animal magazines, Journals- How to write popular and Scientific articles - Magazine and Journal information - Wildlife, nature, environment games (examples) – Role of NGO's and Government organizations in wildlife conservation - Wildlife celebration days in India - Biotechnology in conservation

References:

1. R. B. Primack 1993. Essentials of Conservation Biology, Sinauer Associates, USA
2. G. K. Meffe and C. R. Carroll 1994. Principles of Conservation Biology, Sinauer Associates, USA
3. B. Groom bridge 1992. Global Biodiversity. Status of the Earth's Living Resources. Chapman and Hall, London.
4. R. A. Mittermeier, N. Meyers, P.R. Gil and C. G. Mittermeier 2000. Hotspots: Earth's Biologically richest and most endangered Terrestrial Ecoregions. Cemex/Conservation International, USA
5. M.E. Soule 1986. Conservation Biology: The Science of Scarcity and Diversity, Sinauer Associates Inc., USA.
6. M. L. Reaka - Kudla, D. E. Wilson and E. O. Wilson 1997. Biodiversity II: Understanding and Protecting our Biological Resources. Joseph Henry Press, Washington, DC.
7. T. W. Clark, R. P. Reading and A.L. Clarke 1994. Endangered Species Recovery: Finding the Lessons, Improving the process. Island Press, Washington, DC.
8. http://www.redlist.org
9. W. V. Reid and K.R. Miller 1989. Keeping options Alive. World Resources Institute. 10. Anon. 1997. Wildlife (Protection) Act of India, Nataraj Publishers, Dehradun
11. K. J. Gaston 1996. Biodiversity: Biology of numbers and Difference. Blackwell Science, Oxford.

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1							3	2	1			
CO2			3	2		1					2	3	1			
CO3	3	2			1						3		1	2		
CO4		3		2	2	1				1	2	3	1			
CO5		3					2	1			2	1		3		1

Mapping of CO's and PO's Components are:

3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

ELECTIVE – GROUP B

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBTE05	**PLANT SYSTEM PHYSIOLOGY**	**4**	**5**	**0**	**0**	**Theory**

Course Focus on: Skill Development

Course Outcomes (CO): On the successful completion of the course students will able to

CO1	:	Impart an insight into the various plant water relations
CO2	:	Higher levels of learning about the mineral nutrition in plants
CO3	:	Understand the mechanism of various metabolic processes in plants
CO4	:	Acquire basic knowledge about growth and development in plants
CO5	:	Equip students with skills and techniques related to plant physiology so that they can design their own experiments

Unit I

Photosynthesis: Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO2 fixation-C3, C4 and CAM pathways. Respiration and photorespiration: Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

Unit II

Plant hormones: Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. Sensory photobiology: Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.

Unit III

Solute transport and photoassimilate translocation: Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.

Unit IV

Secondary metabolites - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

Unit V

Stress physiology: Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress

References:

1. Frank. B. Salisbury and cleonWross.. Plant Physiology CBS publishers and distributors, New delhi.
2. Malcolm S. Wilklins. Advanced Plant Physiology.
3. Pushit., S.S., Hormonal regulation of plant growth and development.
4. Sltyar, R.G Plant water relationships.
5. Roy, G.Noggle and George J. Friltz., Introductory Plant physiology.
6. Mayer and Anderson. Plant physiology.
7. Robert M. Devlin and Francis V. Witham Plant physiology.
8. Devlin, R.M. plant Physiology.

9. Devlin and Barker, 1973 Photosynthesis. Reinholodaffliated east west press Pvt, Ltd, New Delhi.

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1							3	2	1			
CO2			3	2		1					2	3	1			
CO3	3	2			1						3		1	2		
CO4		3		2	2	1					2	3	1		1	
CO5		3					2	1		1	2	1		3		1

Mapping of CO's and PO's Components are:
3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBTE06	**ANIMAL SYSTEM PHYSIOLOGY**	**4**	**5**	**0**	**0**	**Theory**

Course Focus on: Skill Development

Course Outcomes (CO): On the successful completion of the course students will able to

CO1	:	Learn the structural and functional changes in circulatory system comparatively
CO2	:	Learn respiratory physiology and respiratory parts of the body comparatively between animal groups
CO3	:	Analyze the effects of external stimulus on the physiological functions of cells
CO4	:	Learn the structure and functions of excretion system comparatively
CO5	:	Evaluate nutrition types and digestive events in animals comparatively

Unit I

Blood and circulation: Blood corpuscles, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis. Cardiovascular System: Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure.

Unit II

Respiratory system: anatomy and structure transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

Unit III

Nervous system: Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Sense organs: Vision, hearing and tactile response.

Unit IV

Excretory system: Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

Unit V

Digestive system: Digestion, absorption, energy balance, BMR. Endocrinology and reproduction: Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, neuroendocrine regulation.

References:

1. Ganong, H, Review of Medial Physiology, 1989. 14th edition, *Appleton &Lange publisher*, New York
2. Physiology: A regulatory system approach, Fleur, and Strand, (1978). *Macmillan Publishing Company, New York; Collier Macmillan Publishers*, London.
3. Shier, D., Butler, J. and Lewis, R., Hole's Human Anatomy and Physiology, (10th edition) 2003. *WCB/McGraw Hill*, Boston. 2003.
4. Animal Physiology, EcKert, R (5th edition), 2002. W.H.Freeman.
5. Williams S. Hoar (1991) General and Comparative Physiology 3rd edition. *Prentice Hall of India*- New Delhi.

6. Neilson, K.S. Animal Physiology, 1997. *Cambridge University Press*, Pergamon Press, Oxford.
7. Prosser, C.L. and Brown-Jr. F.A.: Comparative Animal Physiology, 1961. *W.B. Saunders*, Philadelphia.
8. Barrington, E.J.W. (1975): An Introduction to General & Comparative Endocrinology 2nd ed., *Clarendon press*, Oxford.
9. Medical Physiology (4th Edition) Guyton Arthur C., Hall John E., *W. B.* ***Saunders***

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1							3	2	1			
CO2			3	2		1					2	3	1			
CO3	3	2			1						3		1	2		
CO4		3		2	2	1					2	3	1			1
CO5		3					2	1			2	1		3	1	

Mapping of CO's and PO's Components are:
3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBTE07	**DEVELOPMENTAL BIOLOGY**	**4**	**5**	**0**	**0**	**Theory**

Course Focus on: Skill Development

Course Outcomes (CO): On the successful completion of the course students will able to

CO1	:	Illustrate the structure and function of cellular organelles
CO2	:	Discuss basic embryonic development
CO3	:	Demonstrate the use of modern cell-related techniques
CO4	:	Evaluate the applications of cell and development biology to understand the basic of life
CO5	:	Explain the stress response proteins and their functions

Unit I

Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.

Unit II

Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

Unit III

Morphogenesis and organogenesis in animals: Cell aggregation and differentiation in Dictyostelium; axes and pattern formation in amphibia and chick; organogenesis – vulva formation in Caenorhabditis elegans; eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development-larval formation, metamorphosis; environmental regulation of normal development; sex determination.

Unit IV

Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in Arabidopsis and Antirrhinum.

Unit V

Programmed cell death, aging and senescence.

References:

1. Essential developmental biology – Jonathan Michael Wyndham slack, Wiley-Blackwell, 2006.
2. Current topics in developmental biology – Geral P. Schatten, Academic press, 2006.
3. The origin of animal body plans: a study in evolutionary developmental biology – Wallace Arthur, Cambridge university press, 2000.
4.Developmental biology – Werner A. Muller, Springer, 1997.

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	
CO1	3	2		1							3	2	1				
CO2			3	2		1					2	3	1				
CO3	3	2			1						3		1	2			
CO4		3		2	2	1					2	3	1			1	
CO5		3					2	1			2	1		3		1	

Mapping of CO's and PO's Components are:

3-Strong Correlation 2 – Medium Correlation 1- Low Correlation Blank – No correlation

Subject Code	Subject Title	Credit	Lecture	Tutorial	Practical	Type
21MBTE08	**EVOLUTION AND BEHAVIOUR**	**4**	**5**	**0**	**0**	**Theory**

Course Focus on: Skill Development

Course Outcomes (CO): On the successful completion of the course students will able to

CO1	:	Basic principles at an advanced level related to the evolution of behavior, the various frameworks used to study the evolution of human behavior
CO2	:	Discuss the history and controversies in the development of an evolutionary approach to the study of human behavior
CO3	:	Prepare and develop a critical perspective on an independent study topic related to the evolution of human behavior
CO4	:	Explain a topic or argument in the field orally using a selective case study approach
CO5	:	Synthesize material from a range of cutting-edge and classic scholarly sources relevant to a topic or argument in the field balancing general argument and evidence

Unit I

Emergence of evolutionary thoughts: Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; spontaneity of mutations; the evolutionary synthesis.

Unit II

Origin of cells and unicellular evolution: Origin of basic biological molecules; abiotic synthesis of organic monomers and polymers; concept of Oparin and Haldane; experiment of Miller (1953); the first cell; evolution of prokaryotes; origin of eukaryotic cells; evolution of unicellular eukaryotes; anaerobic metabolism, photosynthesis and aerobic metabolism.

Unit III

Paleontology and evolutionary history: The evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale; origins of unicellular and multicellular organisms; major groups of plants and animals; stages in primate evolution including Homo.

Unit IV

Brain, Behavior and Evolution: Approaches and methods in study of behavior; proximate and ultimate causation; altruism and evolution-group selection, kin selection, reciprocal altruism; neural basis of learning, memory, cognition, sleep and arousal; biological clocks.

Unit V

Development of behavior; social communication; social dominance; use of space and territoriality; mating systems, parental investment and reproductive success; parental care; aggressive behavior; habitat selection and optimality in foraging; migration, orientation and navigation; domestication and behavioral changes.

References:

1.Carter.G.S. Animal evolution ,1951,Sedgwick and Jackson ,London ,England.
2. Sobrig and sobrig : Population biology and evolution ,1981 Addition wiley
3.Stahl,V:vertebrate history: problems in evolution 1985,Mc GRAW-Hill,New Delhi
4.Mayer,S:Systematic and origin of species ,1942 ,University press, Colombia.

Mapping of Course Outcomes with Programme Outcomes

Course outcomes	Programme outcomes										Programme Specific Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1							3	2	1			
CO2			3	2		1					2	3	1			
CO3	3	2			1						3		1	2		
CO4		3		2	2	1					2	3	1		1	
CO5		3					2	1			2	1		3		1

Mapping of CO's and PO's Components are:
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