

(2 Years Course M.Sc. Biotechnology)

Course Structure and Syllabus

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VISION

- ❖ To strive for all round development of students for attainment of scientific empowerment both in teaching and research and self-reliant as well.
- ❖ To establish multi-institutional, inter disciplinary and international collaborations in Thrust areas of scientific research so as to acquire national and international recognition.
- ❖ To develop advanced characterization facilities for cutting edge research with a Road map towards the establishment of Centre for plant tissue culture.
- ❖ To strive for transformation of laboratory research towards industrial scale so as to acquire industrial collaboration and funding as well.

MISSION

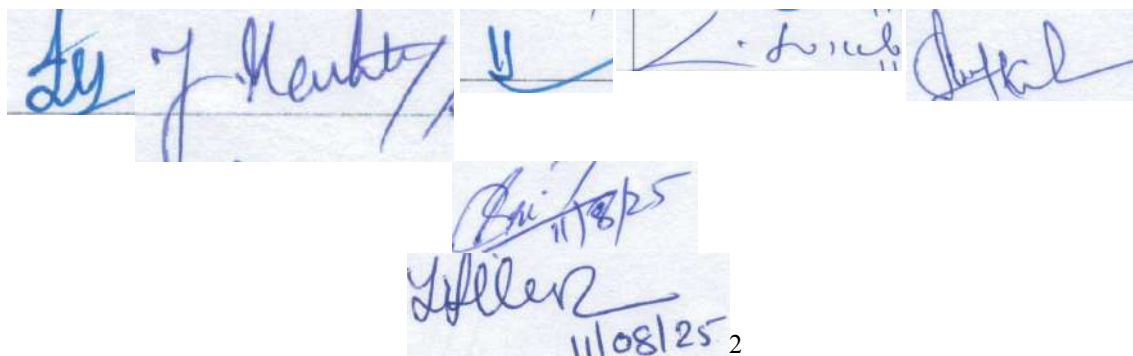
- ❖ Dissemination of knowledge through research-based teaching and learning processes with a motive to inculcate strong research attitude in student community.
- ❖ Build good character and educate students so as to become enlightened individuals, improving the living standards of their families and society.

PROGRAMME OBJECTIVES

- ❖ To develop the basic concepts in core areas of Biotechnology.
- ❖ To perform the experiments in order to inculcate the critical thinking with proper interpretation and analysis of results with logical thinking.
- ❖ To develop the critical analysis and problem-solving skills of students required in the application of principles of Biotechnology.
- ❖ To undertake small academic and research projects in the area of Biotechnology and Preparation of document/present a technical report/dissertation/document.
- ❖ To prepare the students with a working knowledge of experimental techniques required to work independently.
- ❖ To strengthen student's capability in organizing and presenting the acquired knowledge both in oral and written discourse.

PROGRAMME OUTCOMES

- ❖ To Acquire knowledge and understanding of fundamental concepts, principles and theories related to the identified subject areas.
- ❖ To Develop skills to interpret and explain the limits of accuracy of experimental data in



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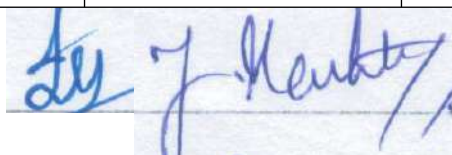
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terms of significance and underlying theory.

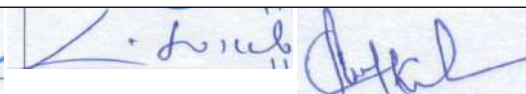
❖ To Demonstrate written and oral communication skills for dissemination of scientific results in report, article, or oral presentation formats, which helps to develop his/her professional development.

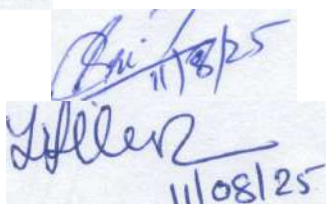
**COURSE STRUCTURE AND REQUIREMENTS FOR M.Sc. BIOTECHNOLOGY
(REGULATION: R22)**

1	Title of the Program	M.Sc. BIOTECHNOLOGY
2	Duration of the Program	2 years (Four Semesters)
3	Eligibility criteria for admission	The candidate seeking admission into M.Sc. Biotechnology Program should have passed bachelor's degree Examination not less than three years duration in any discipline with Biotechnology as one of the subjects and biological sciences at 10+2 level.
4	Level of the Program	Postgraduate.
5	Mode of Admission	The mode of admission is through APPGCET conducted by Andhra Pradesh State Council of Higher Education or KRUCET conducted by Krishna University.
6	Objectives of the Program	The Objective of M.Sc. Biotechnology Program is to impart knowledge in basic concepts in core areas of Biotechnology as well as recent advances in Biotechnology, training in experimental skills with an aim to develop research in commercial and







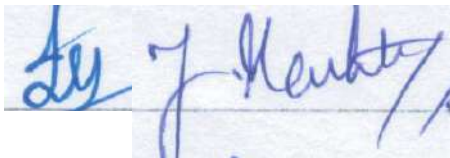


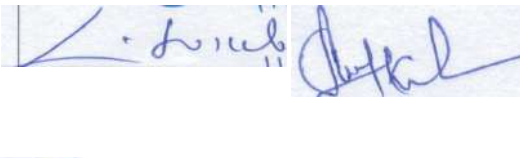
		scientific applications.
7	Program requirements	The Program shall include theory (core as well as non-core, open electives, specializations) papers, Laboratories, Tests, Seminars and Project Work.
8	Number of working days	In each semester at least ninety (90) working days must be dedicated for theory classes, practical classes seminars and project work.

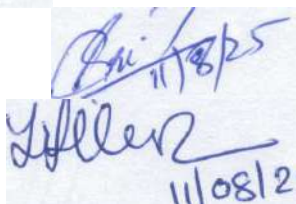
KRISHNA UNIVERSITY :: MACHILIPATNAM
COURSE STRUCTURE FOR M.Sc. BIOTECHNOLOGY
UNDER CHOICE BASED CREDIT SYSTEM (CBCS) & OUTCOME BASED EDUCATION (OBE)
W.E.F 2022-23 (R22 Regulations)

I SEMESTER

Course Code	Course Name	Teaching Hours/ week			CORE/ IDC/DSE/SEC/ OEC/MOCS	Internal Marks	External Marks	No. of Credits
		Lecture	Practical	Tutorial				
25BIT101	Cell Biology	4	0	0	Core	30	70	4
25BIT102	Genetics	4	0	0	Core	30	70	4
25BIT103	Biomolecules	4	0	0	Core	30	70	4
25BIT104	Microbial Biochemistry & Physiology	4	0	0	Core	30	70	4
22 BIT 105 COMPULSORY	Personality Development through Life Enlightenment Skills	3	1	0	Core	30	70	3
25BITL101	Cell Biology & Genetics	0	6	0	Core	30	70	3
25BITL102	Biomolecules and Microbiology	0	6	0	Core	30	70	3








TOTAL FOR FIRST SEMESTER	210	490	25
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II SEMESTER

Course Code	Course Name	Teaching Hours/ week			CORE IDC/DSE/ SEC/OEC/MO OCS	Internal Marks	External Marks	No. of Credits
		Lecture	Practical	Tutorial				
25BIT201	Bio-analytical Techniques	4	0	0	Core	30	70	4
25BIT202	Introduction to Enzymes & Hormones	4	0	0	Core	30	70	4
25BIT203	Intermediary Metabolism	4	0	0	Core	30	70	4
25BIT204	Research Methodology & IPR	3	1	0	SEC	30	70	3

DOMAIN SPECIFIC ELECTIVE COURSES (CHOOSE ANY ONE)

25BITDSE201	Molecular Biology	4	0	0	DSE	30	70	4
25BITDSE202	Environmental Biotechnology	4	0	0	DSE	30	70	4
25BITDSE203	Ecology & Evolution	4	0	0	DSE	30	70	4

LAB PRACTICALS

25BITL201	Bio-analytical Techniques & and Enzymology Lab	0	6	0	Core	30	70	3
25BITL202	Intermediary Metabolism and Molecular Biology Lab	0	6	0	Core	30	70	3
25BITOM201	Foundations of Quantum Science for Life Sciences	0	4	0	OM	30	70	4

TOTAL FOR SECOND SEMESTER	210	490	25
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At the end of 2nd semester, every student must undergo summer Internship/ Apprenticeship/Project work/Industrial training/research-based Project work for Six weeks and must prepare a report concerned as per approved project guidelines and submit the same to the University 14 days before the commencement of third semester end examinations.

By 7. Kumbh *11/08/25* *11/08/25* *11/08/25*

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III SEMESTER

Course Code	Course Name	Teaching Hours/ week			CORE/ IDC/ DSE/SEC/ OEC/MOOCs	Internal Marks	External Marks	No. of Credits
		Lecture	Practical	Tutorial				
25BIT301	Genetic Engineering	4	0	0	Core	30	70	4
DOMAIN SPECIFIC ELECTIVE COURSES (CHOOSE ANY THREE)								
25BITDSE301	Bioprocess Engineering	4	0	0	DSE	30	70	4
25BITDSE302	Immunology and Immune Technology	4	0	0	DSE	30	70	4
25BITDSE303	Cell and Tissue culture	4	0	0	DSE	30	70	4
25BITDSE304	Quality Analysis, Control & Assurance	4	0	0	DSE	30	70	4
25BITDSE305	Bio-safety, Bioethics & IPR	4	0	0	DSE	30	70	4
25BITDSE306	Thermodynamics & Bioenergetics	4	0	0	DSE	30	70	4
LAB PRACTICALS								
25BITLAB301	Genetic Engineering and Bioprocess Engineering Lab	0	6	0	Core	30	70	3
25BITLAB302	Immunology and Cell and Tissue culture Lab	0	6	0	Core	30	70	3
OPEN ELECTIVE (INTERDISCIPLINARY/MULTIDISCIPLINARY) COURSES (CHOOSE ANY ONE)								
25BITOEC301		3	0	0	OEC	30	70	3
25BITOEC302		3	0	0	OEC	30	70	3
25BITOEC303		3	0	0	OEC	30	70	3
TOTAL FOR III SEMESTER							490	25

IV SEMESTER

Course Code	Course Name	Teaching Hours/ week			CORE / IDC/ DSE/SEC/ OEC/MOOCs	Internal Marks	External Marks	No. of Credits
		Lecture	Practical	Tutorial				
22 BIT401	Biostatistics and Bioinformatics	4	3	0	Core	30	70	4
DOMAIN SPECIFIC ELECTIVE COURSES (CHOOSE ANY THREE)								
25BITDSE401	Molecular Virology	4	3	0	DSE	30	70	4
25BITDSE402	Cancer Biology	4	0	0	DSE	30	70	4
25BITDSE403	Molecular Therapeutics	4	0	0	DSE	30	70	4
25BITDSE404	Nutritional Disorders	4	0	0	DSE	30	70	4
25BITDSE405	Bioengineering	4	0	0	DSE	30	70	4
25BITDSE406	Developmental Biology	4	0	0	DSE	30	70	4
LAB PRACTICALS								
25BITL401	Biostatistics & Bioinformatics lab and Molecular Virology	0	6	0	Core	30	70	3
ENTREPRENEURIAL & INNOVATION/IT SKILL RELATED TO DOMAIN SPECIFIC ELECTIVE COURSES (CHOOSE ANY ONE)								
25BITSEC401	Agrofarming	3	0	0	SEC	30	70	3
25BITSEC402	Fermented Foods and Dairy technology	3	0	0	SEC	30	70	3
25BITSEC403	Fundamentals of Medical	3	0	0	SEC	30	70	3

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	Coding							
* CHOOSE MOOCs FROM SWAYAM/NPTEL SOURCES								
22 BIT MOOCS 401								4
22 BITP401-PROJECT WORK EVALUATION AND VIVA-VOCE						100	4	
TOTAL FOR IV SEMESTER						180	520	30

Open electives offered by Biosciences & Biotechnology to the other departments

25BITOEC301	Entrepreneurship in Biotechnology
25BITOEC302	Gender based Health & Education
25BITOEC303	Food & Nutrition

L–Lecture, T–Tutorial & P–Practical's

Note: Students may be allowed to register and appear for MOOCS from the third semester itself. However, students are to complete the MOOCS successfully and submit pass certificate of the same to the University through the Principal of the College concerned for approval and endorsement of the same on grade cards and PCs and ODs as per the regulations of the University.

22BITP401: PROJECT WORK EVALUATION AND VIVA-VOCE

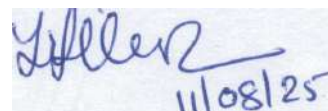
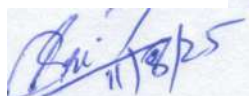
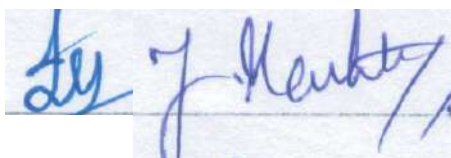
A). Research activity: A short research activity on any significant or interesting aspects of the works (preferably relevant to the students' field of study/specialization) has to be performed or observed by a student in the organization. As part of curriculum students are required to write a short report generally named as a Research activity under the guidance of supervisor.

B). Purpose of Research activity: The basic purpose of writing a Research activity is to allow students to explore the breadth of research that is performed within the organization. For students, this breadth of exposure to outside research may prove fruitful as a platform for their own research at some later point (can be extended to as a thesis topic for Ph.D. degree) and also for career connections/employment opportunities prior to post graduation through demonstrating their competences in research techniques. It is up to the student to choose/select the title/topic for Research activity from any interesting aspects of their duties they are involved. However, the supervisor may also assist the student in selecting the Research Activity Report title that can satisfy him/her expectation as well as it is related to the student's fields of study. It is expected that the supervisor stays in regular contact with the student for

monitoring and checking the smooth progress of the research activity and assuring and contributing to the assessment. Supervisor is expected to provide feedback on student performance to the HoD.

c) Project Evaluation:

Out of a total of 100marks, 20marks for Pre-Project Review, 50marks shall be for Project report/dissertation/record and 30 marks for the End Semester Examination (Viva-voce). The Viva- Voice shall be conducted by a committee consisting of HOD, Project Supervisor and an Examiner nominated by the University.



KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, I SEMESTER

Course Name	CELLBIOLOGY	L	T	P	C	IM	EM	TM
Course Code	25BIT101	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description and Purpose:**

The focus of Cell Biology is the study of the structure and function of the cell. In this course we will focus on Eukaryotic cell biology and will cover topics such as membrane structure and composition, transport, and trafficking; the cytoskeleton and cell movement; the breakdown of macromolecules and generation of energy; and the integration of cells into tissues. We will also cover important cellular processes such as cell cycle regulation, signal transduction, apoptosis (programmed cell death), and cancer cell biology.

❖ **Course Learning Objectives:**

- To make the learners understand the functional aspects of the cell at molecular level.
- To focus on the up-coming molecular mechanisms involving the membrane organization and signal transduction.
- To understand the inheritance pattern at molecular level.

❖ **Course Learning Outcomes:**

- Students will be able to explain the basic concepts of cell biology.
- Students will learn a variety of skills necessary to function as a biologist in the work place or as a candidate for an advanced degree.

❖ **Course Content**

UNIT –I: Structure and Functions of Cells

Discovery of the cell and the cell theory, exceptions to the cell theory. Cell shape, cell size and cell number.

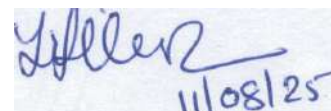
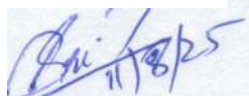
Prokaryotic vs eukaryotic cells. Cell motility in prokaryotes and eukaryotes by cilia and flagella. Cytoskeleton: Microfilaments (actin filaments), microtubules, and intermediate filaments.

UNIT–II: Structure and Function of Major Cellular Organelles

Structure and function of cell wall, plasma membrane, endoplasmic reticulum, Golgi apparatus, lysosomes, peroxisomes, mitochondria and chloroplast. Structure and role of ribosomes.

UNIT–III: Nucleus and Chromatin

Structure and function of nuclear membrane. Organization of nuclear material in prokaryotes



and eukaryotes. Eukaryotic chromosome – Histone proteins and nucleosomes.

Organization of metaphase chromosome in eukaryotes. Chromosome banding pattern, polytene and lamp brush chromosomes. Organization of nucleolus.

UNIT –IV: Cell cycle, apoptosis and cancer

Phases of cell cycle-Cell division by mitosis and meiosis, Regulation of cell cycle: Discovery of MPF, cyclins and cyclin dependent kinases, Check points- role of Rb and p53.

Apoptosis- caspases, Pathways of apoptosis.

Cancer- Types and stages of cancer, characteristics of cancer cell, carcinogens, carcinogenesis, protooncogenes, oncogenes, & Tumor suppressor genes,

Molecular basis of cancer, cell senescence.

UNIT – V: Cell –Cell Interactions and Signaling

Cell to cell interaction–Micro villi, tight junctions, gap junctions, desmosomes. Cell adhesion and cell signaling (autocrine, paracrine, synaptic and endocrine).

Second messengers–Types (Cyclic AMP, Cyclic GMP, IP3, DAG, Calcium ions) and mechanism of action.

Textbooks:

1. Verma P. Sand Agarwal V. K. 2006. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd
2. Lewin B. 2008. Genes IX. Jones and Bartlett publishers
3. Satyanarayana U. 2007. Biotechnology. Books and allied (P) Ltd
4. Darnell J, Lodish H, Baltimore D. 1986. Molecular Cell Biology. Scientific American Books.
5. Watson JD, Hopkins NH, Roberts JW et al. 1987. Molecular Biology of the Gene (4th ed.) The Benjamin/Cummings Publishing Company, Inc.
6. Alberts B, Bray D, Lewis J et al. 1989. Molecular Biology of the Cell. Garland publishing Inc.
7. Pasupuleti M. 2006. Molecular Biotechnology. MJP Publishers.
8. Hartl DL and Jones EW. 2000. Genetics–Analysis of Genes and Genomes (5th ed.) Jones and Bartlett Publishers.
9. Tamarin RH. 1999. Principles of Genetics (6th ed.) WCB McGraw-Hill.
10. Karp G. 1998. Cell and Molecular Biology (2nd ed.) John Wiley and Sons, Inc.
11. Lodish H, Berk A, Matsudaira P et al. 2004. Molecular Cell Biology (5th ed.) W. H. Freeman and Company, New York.

12. Becker MW, K leinsmith LJ and Hardin J.2007. The world of the Cell (6thEd.) Tata Mc Graw Hill Publications.
13. Raven PH ,Johnson GB, Losos JB and Singer SR.2006. Biology (7thEd.) Tata Mc Graw Hill Publications.
14. Smith & Wood, Cell Biology, 2ndEdition, Chapman & Hall, London, 1996.

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DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, I SEMESTER

Course Name	GENETICS	L	T	P	C	IM	EM	TM	L-
Course Code	25BIT102	4	0	0	4	30	70	100	

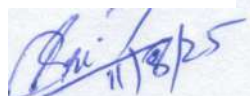
Lecture,T-Tutorial,P-Practical,C-Credits,IM-InternalMarks,EM-ExternalMarks, TM-Total Marks

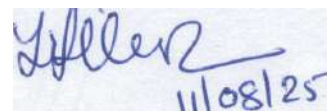
❖ **Course Description and Purpose:** Th is course provides an introductory overview of major and timely topics in genetics. The objective is to provide students with a broadly- based and fundamental understanding of genetics, and to present selected challenges and issues that currently face the genetics research and communities. This course provides students with an understanding of the principles and concepts of genetics and introduces transmission, nature and action of genetic material in organisms.

❖ **Course Learning Objectives:**

- Use the principles of chromosome transmission to predict patterns of inheritance.
- Evaluate scientific data using the rules of probability.
- Understand how the structure of DNA enables it to function as genetic material.
- Explain the relationship between genotype and phenotype.
- Understand the molecular basis of mutation, and its role in genetic variation.
- Explain how the genetic code enables protein synthesis to be directed by genetic information.







- Understand how genomes are replicated, repaired, organized and pack aged.
- Describe the modes of gene regulation in prokaryotes and eukaryotes.
- Use a computer to search public databases and manage bibliographic information.

❖ **Course Learning outcomes:**

By completing Genetics course, students are expected to have achieved the following skills and capabilities.

- Comprehensive, detailed understanding of the chemical basis of heredity
- Comprehensive and detailed understanding of genetic methodology and how quantification of heritable traits in families and populations provides insight into cellular and molecular mechanisms.
- Understanding of how genetic concepts affect broad societal issues including health and disease, food and natural resources, environmental sustainability, etc.
- Understanding the role of genetic mechanisms in evolution.
- The knowledge required to design, execute and analyze the results of genetic experimentation in animal and plant model systems.
- The ability to evaluate conclusions that are based on genetic data.

❖ **Course Content:**

UNIT–I: Mendelian Laws of Inheritance

Mendel's laws – Monohybrid and dihybrid cross. Test cross and back cross. Sex chromosomes and determination. Sex-linked inheritance. Linkage and crossing over. Interference. Recombination frequency. Numerical changes in chromosomes –euploidy, haploidy, and their fundamental and practical significance. Polyploidy – induction. Aneuploidy – type and genetic significance. Population genetics –Hardy and Weinberg law.

UNIT–II: Nature of Genetic Material

Evidence to prove DNA and RNA as genetic material. Gene as a unit of expression. Colinearity of gene and polypeptide. Modern concept of gene. Fine structure analysis of rII locus of T4 bacteriophage –Establishment of recon, muton and cistron. Complementation test. Types of genes – Pseudo genes, House-keeping genes, homeotic genes and regulatory genes.

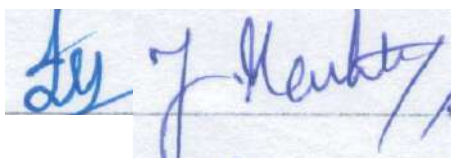
UNIT–III: Plasmids and Transposons

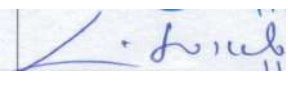
Plasmids: Types, copy number, replication, amplification and curing. Regulation of col E1 plasmid replication. Methods of plasmid transfer – Microinjection, electroporation, calcium chloride treatment, tri-parental mating.

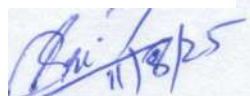
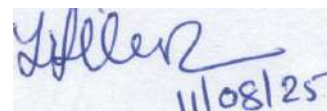
Transposons: Types of bacterial transposons - insertional sequences, complex transposons. Retroposons. Transposons of eukaryotes – Copia, P3 and TY elements. Mechanism of transposition – Replicative and non-replicative.

UNIT–IV: Genetic Recombination in Bacteria

Genetic recombination in bacteria. Models of genetic recombination (Break-join, Copy-choice, Break-





copy). Role of recA protein. Genetic transfers in bacteria. Discovery and mechanism of transformation. Discovery and mechanism of Transduction (generalized, specialized and abortive). Discovery of sex among bacteria. Genetic transfer by Conjugation (F^+ and F^- , F' and F^- (sexduction), and Hfr and F^-). Mapping of bacterial chromosome by genetic recombination, transformation, conjugation and transduction.

UNIT –V: Mutations and Mutagenesis

Mutations and mutagenesis: Types of mutations, Mutagenic agents, Molecular basis of mutations, Mechanism of Mutagenesis. Transposon mutagenesis, Site-directed mutagenesis and their applications. Evaluation of mutagens by Ames test and micro nuclei test. Thymine dimerization. Repair of T-dimers: Photo-reactivation, Excision repair, Post-replication, Recombination and SOS repair mechanisms. Heat-shock and adaptive responses, role of recA in DNA repair.

➤ Textbooks:

1. Cell Biology: De Robertis and De Robertis
2. Molecular biology of cell: B. Alberts et al Cell
3. Molecular biology: G. Karp
4. Molecular Biology of the cell: J.D. Watson et al
5. Genes VII: B. Lewin
6. Lehninger's Principles of Biochemistry: Nelson and Cox. Biochemistry: L. Stryer
7. Biochemistry: Voet and Voet.

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc.– BIOTECHNOLOGY, I SEMESTER

L- T- P- C-	Course Name	BIO- MOLECULES	L	T	P	C	IM	EM	TM
	Course Code	25BIT 103	4	0	0	4	30	70	100

Lecture,
Tutorial,
Practical,
Credits,

IM-Internal Marks, **EM**-External Marks, **TM**-Total Marks

❖ **Course description & Purpose:** In this course you will learn about molecules of life. Biomolecules are important for the functioning of living organisms. These are building blocks of living organisms, so the presence of appropriate concentration of biomolecules are important for structure and proper function of living cells. Macro biomolecules are built from small organic compounds the same way a railroad train is built. By linking a lot of smaller units together into long chain. The course encompasses the structure, monomer, examples, functions, bonds of biomolecules. The overall goal of this course is to give students knowledge of biomolecules.

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❖ Course Learning Objectives:

- To provide details about the importance of the Biomolecules present in our system and the regulation of metabolic pathways.
- To expose the students to the biochemical methods used to study the biomolecules.

❖ Course Learning Outcomes:

-Students will be able to demonstrate an understanding of fundamental biochemical principles, such as the structure and functions of Biomolecules structures and the functions of biological/biochemical processes.

-They will gain proficiency in basic laboratory techniques in both chemistry and biology, and be able to apply the scientific method to the processes of experimentation and hypothesis testing.

❖ Course Content:

UNIT-I: Carbohydrates

Definition and Classification of carbohydrates, reactions of monosaccharides, acid Derivatives of monosaccharides, Amino sugars, disaccharides, oligosaccharides, mucopolysaccharides, bacterial cell polysaccharides, starch, cellulose, lectins, glycoproteins.

UNIT-II: Amino acids

Classification, structure and physico-chemical properties of amino acids, stereo isomerism, chemical reactions of amino acids and chemical procedures affecting amino acid side chains.

Peptides: Structure and confirmation of peptide bond; Peptide synthesis - reactive ester method and modified Merrifield solid phase peptide synthesis. Non-ribosomal peptide synthesis - glutathione cyclic antibiotics(gramicidin). Identification of peptide sequence-protease treatment, site directed mutagenesis.

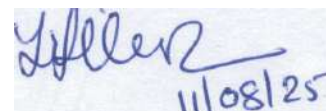
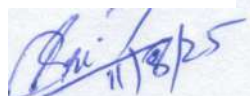
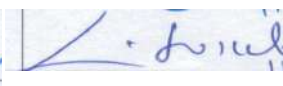
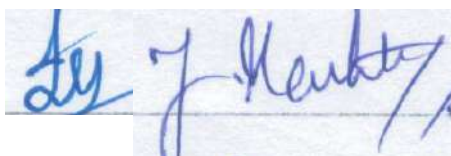
UNIT-III: Proteins

Classification and biological functions of proteins (Eg:RuBisCo,LegHemoglobin).Structural organization of proteins – primary, secondary, tertiary and quaternary structure of proteins. Protein folding and significance. Ramachandran plot.

UNIT- IV: Fatty acids & Lipids

Classification, physical and chemical properties of fatty acids. Characterization of natural fats, oils. Structure and biological role of triacylglycerol, phospholipids, sphingolipids, prostaglandins, thromboxanes, leukotrienes, and steroids. Lipids as signaling molecules. Porphyrins- Structure and functions of porphyrins, protoporphyrin, cytochrome, heme, chlorophyll

UNIT-V: Nucleic acids



Structure of purines and pyrimidines, modified bases. Structure of DNA (Primary, Secondary and Tertiary). Structure of RNA- mRNA, tRNA, rRNA (Primary, Secondary and Tertiary) Physico-chemical properties of nucleic acids, denaturation, hyper chromic effect, T_m, kinetics of reassociation, cot values.

➤ **Textbooks:**

1. Textbook of Biochemistry. West and Todd. 1968. MacMillan.
2. Principles of Biochemistry. A. L. Lehninger. 1993. Nelson and Cox. C. B. S., India.
3. Principles of Biochemistry General Aspects. Smith et al, 1983. McGraw hill
4. Biochemistry Donald Voet and Judith Voet. 2nd Edn.
5. Biochemistry. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer 2002. 5th Edn. Freeman
6. Textbook of Biochemistry with Clinical Correlation. Thomas M. Devlin. 4th Edn
7. Biochemistry. Zubay
8. Nucleic acid Biochemistry and Molecular Biology by Main Waring et al, Blackwell.
9. Biochemistry, 2nd Edn. by Albert L. Lehninger. 1978. Kalyani Publishers, New Delhi
10. Biochemical calculations, Irwin H. Segel, John Wiley and sons Inc.
11. Biochemistry, Reginald A. Garrett, Charles M. Grisham. 1995. National Academy of Sciences, USA. 2nd Edn.
12. Organic Chemistry, D.J. Cram and G.S. Hammon.
13. Biochemistry. Mathews
14. Biochemistry. B.D. Hames, N.M. Hooper
15. Practical Biochemistry. Wilson and Walker.

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, I SEMESTER

Course Name	MICROBIAL	BIOCHEMISTRY	&	L	T	P	C	IM	EM	TM
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	PHYSIOLOGY							
Course Code	25BIT104	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ Course Description and Purpose:

This course provides the basic information on the structural and metabolic diversity of microorganisms. To familiarize students with different conditions and requirements associated with microbial growth and reproduction. This course spot lights on microbial metabolism, physiology, biochemistry and genetics.

❖ Course Learning Objectives:

To make understand the

- Great biodiversity existing in the microbial world and relate the eco physiological aspects of microorganisms to the functioning of the biogeochemical cycles that govern the terrestrial ecosphere.
- Know the possibilities of environmental application presented by the biotechnology of higher organisms.

❖ Course Learning Outcomes:

The intended subject specific learning outcomes. On successfully completing the module students will be able to:

- Demonstrate comprehensive knowledge and understanding of the structural and metabolic diversity of microorganisms.
- Demonstrate critical understanding of genetic biochemical and physiological regulation in microorganisms.
- Demonstrate thorough knowledge and understanding of the experimental approaches used to investigate physiological and genetic control in microorganisms.
- Demonstrate the ability to work individually to solve biological problems. Analyze and evaluate complex experimental data confidently.

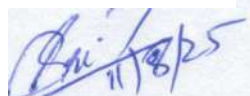
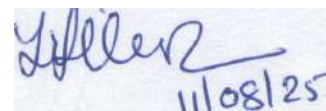
❖ Course Content

UNIT-I: Over view of prokaryotic cell: structure & functions, Cell wall synthesis, flagella structure and synthesis, Endospore synthesis, Exopolysaccharide synthesis.

Membrane transport in bacteria-simple, group translocation, ABC transporters, Protein export in bacteria, Protein export pathways& Iron transport-siderophores.

UNIT-II: Overview of Microbial Physiology: Microbial Cell division machinery, Microbial Growth kinetics (Chemostat, Turbidostat),

Microbial Nutrition, Factors affecting Nutrition, Microbial Photosynthesis (Oxygenic and anoxygenic).

UNIT-III: Physiological Adaptations and Intercellular signaling: Regulation of gene expression & responses to changing environments, Heat-Shock responses

Stress Adaptations in thermophiles, halophiles, alkaliphiles, acidophiles, Extremophiles-adaptations & significance in biotechnology

UNIT-IV: Two component signal transduction in prokaryotes: Introduction to two component system, Chemotaxis, Quorum sensing & Biofilms, Sporulation inducing signals & events in sporulation. Regulatory systems sporulation in *Bacillus subtilis*,

Osmolarity porin regulation in *E.coli* (Omp system) Phosphate assimilation in *E.coli* (Pho system), Nitrogen fixation in *Rhizobium* (Ntr system).

UNIT-V: Microbial genetics: Recombination in prokaryotes, Gene Transfer: Transformation, conjugation & transduction. Mapping of prokaryotic genes.

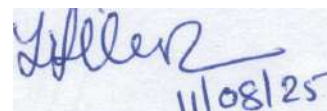
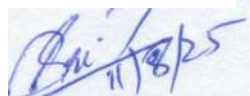
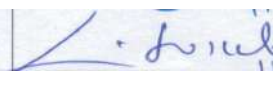
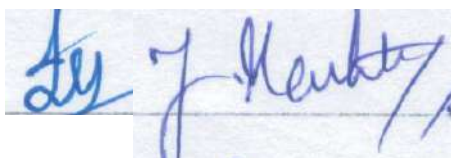
Transposons and mechanism of transposition. Biology and types of plasmids. Extrachromosomal genetic material.

➤ **Text Books:**

1. Textbook of Microbiology by Pleczar and Reid (Mc GrawHill).
2. Microbiology by Tortora, Funk & Case.
3. Microbiology by Prescott.
4. Principles of Genetics by Sinnet et.al, (Mc Graw Hill).
5. Principles of Heridity by Robert Tumarin.
6. Genetics by M. W. Strick Berger (MacMillan).
7. Cell and Molecular Biology by E, D. P. De Roberties (International edition).

➤ **Reference Text Books:**

1. Moat A.G. and Foster S.W. *Microbial Physiology* (4th Ed.) (2004). John Wiley and Sons, New York.
2. Gerald Karp. *Cell Biology*(3rdEd.) (2003).Mc Graw Hill Book Company, New York.
3. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. *General Microbiology*. (5th Ed.)(1987).McMillan Press.UK.
4. Dubey RC and Maheswari DK. *A Textbook of Microbiology*. (2005).S. Chand & Company Ltd., New Delhi.
5. Nelson D. L. & Cox M. M. *Lehninger's Principles of Biochemistry*, 4th edition. (2005).W. H. Freeman & Co. NY.



6. Pelczar Jr, MJ, Chan E CS., Krieg N R, Microbiology, (5thEd.), (2001). Mc Graw Hill Book Company, NY.

by J. Henkley

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KRISHNA UNIVERSITY:: MACHILISSPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc.– BIOTECHNOLOGY, I SEMESTER

Course Name	Personality Development Through Life Enlightenment Skills	L	T	P	C	IM	EM	TM
Course Code	22 BOT105	3	0	1	3	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description and Purpose:**

Personality development is the development of your behavior patterns and attitude. It is the result of where we are born, the circle we interact with and our personal temperament. Every person is different. There are some characteristic traits that make you „you“. Personality development through life enlightenment course aims to help students identify negative behaviors which may be stopping them from reaching their desired goals. This course will help students both in their personal and desired professional life. The other purposes of personality development through life enlightenment course are to enable you lead stress-free and healthier life, ethical decision-making ability, enhanced confidence level, and building a more pleasing personality.

❖ **Course Objectives:**

The Course will introduce the students to

- 1) Learn to achieve the highest goal happily.
- 2) Become a person with stable mind, pleasing personality and determination.
- 3) Learn to build positive attitude, self-motivation, enhancing self-esteem and emotional intelligence
- 4) Learn to develop coping mechanism to manage stress through Yoga and meditation techniques
- 5) Awaken wisdom among them.

❖ **Course Learning Outcomes:**

At the end of this course the students should be able to:

- Develop their personality and achieve their highest goals of life.
- Lead the nation and mankind to peace and prosperity
- Practice emotional self regulation.
- Develop a positive approach to work and duties
- Develop a versatile personality

Course Content:

UNIT-I: Introduction to Personality Development

The concept of personality- Dimensions of Personality- Theories of Personality development (Freud & Erickson)– The concept of Success and Failure –Factors responsible for Success– Hurdles in achieving Success and Overcoming Hurdles-Causes of failure-Conducting SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis.

Dr. J. K. K. K.

Dr. J. K. K. K.

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Dr. J. K. K. K.

Dr. J. K. K. K.

UNIT-II: Attitude, Motivation and Self-esteem

Conceptual overview of Attitude– Types of Attitudes– Attitude Formation– Advantages/ Disadvantages of Positive/Negative Attitude - Ways to Develop Positive Attitude.

Concept of motivation: Definition and Nature of Motivation/Motive– Internal and external motives- Theories of Motivation – Importance of self- motivation- Factors leading to de-motivation.

Self-esteem - Definition and Nature of self-esteem – Do's and Don'ts to develop positive self-esteem- Low self-esteem –Personality having low self-esteem - Positive and negative self-esteem.

UNIT -III: Other Aspects of Personality Development

Body language - Problem-solving - Conflict Management and Negotiation skills - Decision-making skills - Leadership and qualities of a successful leader – Character building -Team-work – Time management - Work ethics – Good manners and etiquette – Emotional Ability/Intelligence –Dimensions of Emotional Intelligence–Building Emotional Intelligence.

UNIT-IV: Neeti satakam – Holistic Development of Personality

Verses-19,20,21,22(wisdom)–Verses-29,31,32(pride and heroism)–Verses-26,28,63,65(virtue)

Personality of Role Model –Shrimad Bhagwadgeeta

Chapter2-Verses17,Chapter3-Verses36,37,42–Chapter4-Verses18,38,39Chapter18–

Verses37,38,63

UNIT -V: Yoga & Stress Management

Meaning and definition of Yoga- Historical Perspective of Yoga-Principles of Astanga Yogaby Patanjali-Meaning and Definition of Stress - Types of Stress - Eustress and Distress –Stress Management– Pranayama-Pranayama: Anulom and Vilom Pranayama- Nadishudhi Pranayama– Kapalabhati- Pranayama - Bhramari Pranayama – Nadanu sandhana Pranayama-Meditation techniques: Om Meditation - Cyclic meditation: Instant Relaxation technique (QRT), Quick Relaxation Technique(QRT), Deep Relaxation Technique(DRT) (Theory & Practical).

PRACTICALCOMPONENTS:

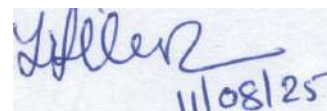
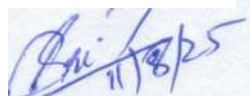
Students should identify different types of personality to know their own personality. Students are to describe the characteristics of their personalities and submit the same for assessment.

Students are to form in groups (a group consists of 4-6 students) to identify and write a brief note on famous personalities of India and World.

Students are required to identify different types of attitudes and give any five examples of each.

Students are expected to check their attitudes and develop ways to improve their attitudes at workplace and home.

Students are required to identify keys to self-motivation to achieve their goals.



Students are expected to identify atleast seven types of body language and conduct activities with the following:

S.No.	Pose	Possible Interpretations
1	Standing with your hands on your hips	Aggressive , disgusted
2	Standing upright	Confidence
3	Arms crossed on your chest	Defensive
4	Resting your hand on your cheek	Thinking
5	Touching or rubbing your nose	Doubt, lying
6	Resting your head in your hands	Boredom, tired
7	Tapping your fingers	Impatience
8	Biting your nails	Nervous, insecure
9	Playing with your hair	Insecure
10	Rubbing your eyes	Disbelief, doubt

Conduct the following exercise to develop communication skills –Negotiation Skills and Empathy

Exercise: Card Pieces

In this activity, team members trade pieces of playing cards to put together complete cards.

Uses-This exercise is useful for showing team members others 'perspectives. It builds communication and negotiation skills, and helps people to develop empathy.

People and Materials

- Enough people for at least three teams of two.
- Playing cards – use between four and six for each person.
- A private room.

Time -15 minutes.

Instructions:

1. Cut each playing card into half diagonally, then in half diagonally again, so you have four triangular pieces for each card
2. Mix all the pieces together and put equal numbers of cards into as many envelopes as you have teams.
3. Divide people up into teams of three or four. You need at least three teams. If you're short of people, teams of two will work just as well.
4. Give each team an envelope of playing card pieces.
5. Each team has three minutes to sort its pieces, determine which ones it needs to make complete cards, and develop a bargaining strategy.
6. After three minutes, allow the teams to start bartering for pieces. People can barter on their own or collectively with their team. Give the teams eight minutes to barter.
7. When the time is up, count each team's completed cards. Whichever team has the most cards wins the round.

Advice for the Teacher/Facility or

After the activity, ask your team members to think about the strategies they used. Discuss these questions

- 1) Which negotiation strategies worked? Which didn't?
- 2) What could they have done better?
- 3) What other skills, such as active listening or empathy, did they need to use?

Conduct following Time management activity – Ribbon of Life

Take a colored ribbon length of approximately 1meter/100cm and scissors. Start with the following questions:

1. If the life span of an individual is say, 100 years. Consider that each cm represents one year. The response will be that



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few live that long. Assuming a life of 75 to 90 years ,cut 10 to 25 cm off the ribbon, accordingly.

2. What is the average age of the participants sitting here, the response would be 25 to 30 depending on the group, in that case, cut another 25 cms of the ribbon and say that is gone you can not do anything.
3. What is left is 50 years? People will say, " Yes," but the answer is NO.
4. Every year we have 52 weeks, that is 52 Sundays. If we multiply that by 50 years ,it comes to 7.14years. Reduce the ribbon by another 7.14cm.
5. We also usually have Saturdays off, so reduce another 7cms.
6. Public/National holidays are 10 multiple with 50 years. That comes to another 1.5years. Reduce ribbon by another 1.5 cms.
7. Your casual leave , sick leave, and annual holidays approx. 40 days a year, multiplied by 50.Cut off another 5 cms. Now you are left with about 29.5 years. But, the calculation is not over yet.
8. You sleep an average of 8 hours daily; multiply that by 365 days and again by 50 years(i.e.122 days X50 = almost 17 years). Cutoff another 17cm.
9. You spend time eating lunch, breakfast, snacks, and dinner total 2 hours daily (i.e.30days a year X 50 years=4 years or so).Cut off another 4cm.
10. Last , let's figure we spend about 1 hour a day traveling from place to place for activities and such.(that's about 2 more years). We're down to 6 (SIX) years of life to make it or break it.

- **Exercise Decision making skills - Create Your Own**

In this exercise ,teams must create their own, brand new, problem-solving activity.

Uses: This game encourages participants to think about the problem-solving process. It builds skills such as creativity, negotiation and decision making, as well as communication and time management. After the activity, teams should be better equipped to work together, and to think on their feet.

What You'll Need

- Ideally four or five people in each team.
- A large, private room.
- Paper, pens and flip charts.

Time -Around one hour.

Instructions:

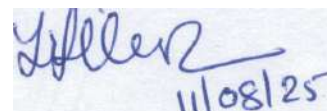
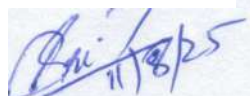
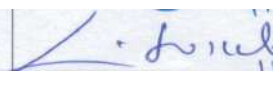
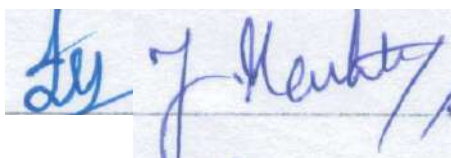
1. As the participants arrive, you announce that, rather than spending an hour on a problem-solving team building activity, they must design an original one of their own.
2. Divide participants into teams and tell them that they have to create a new problem-solving team building activity that will work well in their organization. The activity must not be one that they have already participated in or heard of.
3. After an hour, each team must present their new activity to everyone else, and outline its key benefits.

Advice for the Teacher/Facilitator:

There are four basic steps in problem solving : defining the problem, generating solutions, evaluating and selecting solutions and implementing solutions. Help your team to think creatively at each stage by getting them to consider a wide range of options. If ideas run dry, introduce an alternative brain storming technique, such as brain writing . This allows your people to develop one others' ideas, while everyone has an equal chance to contribute.

After the presentations, encourage teams to discuss the different decision- making processes they followed. You might ask them how they communicated and managed their time . Another question could be about how they kept their discussion focused. And to round up, you might ask them whether they would have changed their approach after hearing the other teams 'presentations.

- Students are asked to recite verses: 26, 28, 63, 65(virtue)of Neeti satakam-Holistic Development of personality.



- Students are asked to identify personality of role M models from Shrimad Bhagwadgeeta and portray the roles of the same.
- Students are asked to practice Yoga and meditation techniques

Text and Reference Books:

1. Hurlock, E.B. Personality Development, 28th Reprint. New Delhi: Tata Mc Graw Hill, 2006.
2. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti- sri ngar-vairagya, New Delhi, 2010
3. Swami Swarup ananda, Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.
4. Lucas, Stephen. Art of Public Speaking .New Delhi. Tata-Mc-Graw Hill. 2001
5. Mile, D.J Power of positive thinking. Delhi. Rohan Book Company, (2004).
6. Pravesh Kumar. All about Self- Motivation .New Delhi .Good will Publishing House. 2005.
7. Smith, B .Body Language. Delhi: Rohan Book Company. 2004
8. Yogic Asanas for Group Training- Part-I :Janardhan Swami Yoga bhyasi Mandal, Nagpur.
9. Raja yoga or Conquering the Internal Nature by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata.
10. Nagendra H. Rnad Nagaratna R ,Yoga Perspective in Stress Management, Bangalore, Swami Vivekananda Yoga Prakashan.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_ge04/preview
2. <https://freevidelectures.com/course/3539/indian-philosophy/11>

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc.– BIOTECHNOLOGY, I SEMESTER

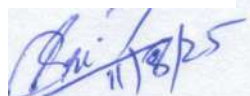
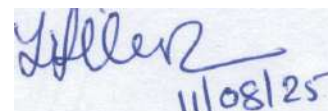
Course Name	Cell Biology & Genetics	L	T	P	C	IM	EM	TM
Course Code	22 BITL101	0	0	6	3	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

➤ List of experiments

➤ Cell Biology

1. Light microscopic examination of various plant tissues
2. Determination of cell size (ocular micrometer)
3. Stages of mitosis and meiosis

4. Squash preparation.
5. Sub-cellular fractionation- separation of macromolecules
6. Study of polytene chromosomes.
7. Karyotypic study.

➤ **Genetics**

1. Demonstration of chromosomal (structural and numerical) aberrations.
2. Effect of colchicine on chromosomes.
3. Demonstration of Mendelian laws using color marbles or beads.
4. Evaluation of segregation and random assortment using Chi-square test or test of fitness.
5. Construction of genetic maps based on problems in two and three factor crosses.

by 7. Kumbhar

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KRISHNA UNIVERSITY :: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, I SEMESTER

Course Name	Biomolecules and Microbial Biochemistry & Physiology	L	T	P	C	IM	EM	TM
Course Code	22 BITL102	0	0	6	3	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

➤ **List of experiments**

➤ **Biomolecules**

1. Titration of Amino acids
2. Calorimetric determination of P_{ka}
3. Model building using space, filling/ ball and stick models
4. Reactions of amino acids, sugars and lipids, including diagnostic tests
5. Isolation, purity determination and quantization of cholesterol DNA and RNA
6. Quantization of proteins and sugars
7. Analysis of oils-iodine number, saponification value and acid number

➤ **Microbial Biochemistry & Physiology:**

1. Introduction of media and its constituents for microbial growth.
2. Different methods for isolation and maintenance of microorganisms.
3. Isolation of microbes using differential media.
4. To study and plot the growth curve of E.coli using turbidometric method and to calculate specific growth rate and generation time.
5. To study and plot the growth curve of E.coli by radial growth measurements.
6. To study the effect of temperature of E.coli by dry weight method.
7. Demonstration of the thermal death time and decimal reduction time of E. coli

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KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, II SEMESTER

Course Name	BIOANALYTICAL TECHNIQUES	L	T	P	C	IM	EM	TM
Course Code	25BIT201	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course description and Purpose:**

This course is introduced to bridge the gap between academics, research and industry. This course begins with a review of basic bio analytical technique and an introduction to general terminologies. This course contains bioanalytical techniques along with their theory, working principal, common instrumentation and possible applications. This course will be equally beneficial to various scientific areas including, life science, chemical science, material science and environmental science.

❖ **Course Learning Objectives:**

- To understand about the canonical structure of bio-instrumentation systems.
- To learn the qualitative functions of the primary system components.
- To learn the technical information's associated with instrumentation and design and basic signal analysis.

❖ **Course Learning Outcomes:**

- Describes and explains the principles of various bio-instrumental devices and sensors.
- Demonstrate an ability to use appropriately and safely the techniques, sensors, and

❖ **Course Content:**

UNIT-I: Study of Solvents & Centrifugation

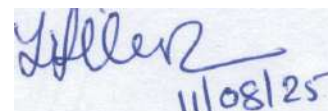
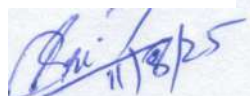
Measurement of pH, Ph meter, biochemical buffers. Basic principles of centrifugation, types of centrifuges and rotors. Preparative ultracentrifugation-differential centrifugation, density- gradient. Analytical ultracentrifugation and applications.

UNIT-II: Chromatography

General principles of Chromatography. Methods based on polarity - partition chromatography (paper chromatography). Adsorption chromatography (thin layer chromatography). Gas liquid chromatography, reverse phase liquid chromatography. Methods based on size- Gel filtration chromatography. Methods based on affinity: Affinity chromatography. High performance liquid chromatography and Ion-exchange chromatography.

UNIT-III: Electrophoresis

General principles of Electrophoresis and Factors affecting electrophoretic mobility. Types, methodology and applications of Electrophoresis.



PAGE (Native–PAGE, SDS-PAGE). 2-dimensional electrophoresis Agarose gel electrophoresis Pulse field gel electrophoresis.

UNIT – IV: Spectrophotometry

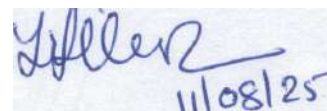
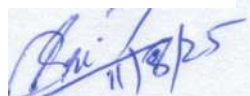
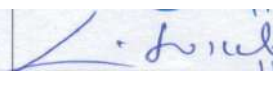
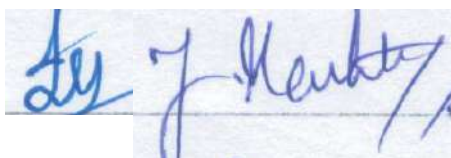
Basic principles – law of absorption (Beer– Lambert law). UV – visible spectrophotometry Infrared spectroscopy, Fluorescence Spectroscopy, Atomic absorption spectrophotometry Mass spectrophotometry and NMR spectrophotometry.
Basic principles and application of X- ray diffraction and X-ray crystallography.

UNIT–V: Radioactivity

Nature and types of radioactivity, radioactive decay. Preparation of labeled biological compounds. Detection and measurement of radioactivity (GM counter, scintillation counter, Cerenkov radiation, autoradiography, gamma- ray counter).
Production, biological uses and safety measures in handling of radio isotopes.

➤ Text books:

1. Nuclear Magnetic Resonance: Williams
2. Biochemical Techniques theory and practice: White R
3. Analytical Chemistry: Christion G.D.
4. A Biologist Guide to Principle and Techniques: Wilson K and Gounding K.H.
5. An Introduction to Practical Biochemistry: Plummer D.T.



KRISHNA UNIVERSITY: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, II SEMESTER

Course Name	INTRODUCTION TO ENZYMES & HORMONES	L	T	P	C	IM	EM	TM
Course Code	25BIT202	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course description and Purpose:**

The course is designed to give students an understanding of procedures involved in purification of enzymes, enzymes assays and quantitative evaluation of the influencing parameters such as concentrations of substrate / enzyme, pH, temperature and effects of inhibitors on enzyme activity. This course has been designed to teach the student majoring in science all the major aspects of the study of enzymes. The course focuses on the theories of enzyme kinetics, the mechanisms of enzyme catalysis, and the mechanisms of enzyme regulation in the cell. This course is designed to provide a broad overview of vertebrate endocrinology. Course topics will include the various classes of hormones, sources of hormones, production and synthesis of hormones, receptors and target tissues, mechanisms of action and regulation, and methods used in endocrinology. Lecture and readings from the primary literature will focus on classical endocrine systems.

❖ **Course Learning Objectives:**

Enzymology: To understand the kinetics and mechanisms of action of enzymes, to become familiar with the basic methods of studying enzymes, and to appreciate how individual reactions are controlled and integrated into the metabolic pathways of the cell. Acquired theoretical and experimental knowledge will enable students to find appropriate employment in different development, scientific-research laboratories, or to continue their further studies in biochemistry or related disciplines.

Hormones: Upon completion of this course students should be capable of effectively communicating how endocrine systems function. Students should develop the ability to integrate across multiple endocrine systems to better understand the complexity of endocrine-related disorders. Students should also be capable of critically evaluating information provided by the media and literature on the topic. Lastly, students should gain a general understanding of the approaches used to study various facets of endocrinology.

❖ **Course Learning Outcomes:**

The major learning objective of the course is to understand the theories of enzyme kinetics, the mechanisms of enzyme catalysis, and the mechanisms of enzyme regulation in the cell. At the conclusion of the course students should be able to:

- Describe the mechanism of enzyme action and factors affecting EA Describe the principles of enzyme inhibition.
- Describe the mechanisms of enzyme catalysis.

Hormones:

- ❖ Demonstrate/illustrate how the homeostatic model applies to every endocrine system in normal

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physiology and disease.

- ❖ Demonstrate/illustrate how every aspect of our physiology and behavior is directly controlled or modified by hormones using reproduction, growth, development, stress, and metabolism as examples.
- ❖ Demonstrate/illustrate that the same biochemical and cellular processes of chemical communication are involved in endocrinology as they are in any other biological systems, i.e., all chemical communicators (hormones, neurocrines, cytochromes, etc.) work in essentially the same manner.

❖ **Course Content:**

Unit-I: Introduction to Enzymes: Apoenzyme Holoenzyme,, coenzyme and cofactor, prosthetic groups, turnover number, enzyme activity units (I.U and Katal), and specific activity.

Classification of enzymes (IUB), Remarkable properties of enzymes-catalytic power and specificity, formation of enzyme substrate complex-Lock-and-key hypothesis, Induced-fit hypothesis.

Unit-II: Enzyme Kinetics: Velocity of a reaction, order of a reaction, progress curve for enzyme catalyzed reaction, Factors affecting enzyme catalysis- pH, Temperature and substrate on enzyme kinetics. Enzyme kinetics of single substrate reaction- Derivation of Michaelis- Menton equation. Linear transformations of Michaelis-Menton equation, Significance of K_m and V_{max} values.

Enzyme inhibition: Reversible (competitive, non-competitive, and uncompetitive) and irreversible (affinity labels and suicide inhibitors) enzyme inhibition.

Unit-III: Introduction of Endocrinology: Classification of hormones, Hormone action, Signal transduction. Receptors- Types, structure- insulin, Thyroid, steroidal receptors, Concept of Second messengers cAMP, IP₃, Calcium and NO, Protein phosphorylation and dephosphorylation.

Role of Calcium: Control of Cellular calcium levels, transport and regulation, calcium dependent proteins. Interaction between cAMP and calcium Pituitary gland hormones- functions and deficiency systems.

Unit-IV: Thyroidal Hormones: Chemistry function and metabolism, hypo and hyper thyroidism, parathyroid hormones: parathormone and calcitonin, their role in calcium and phosphate metabolism.

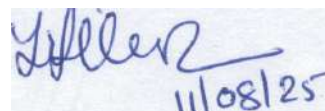
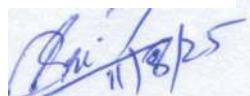
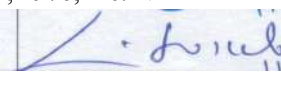
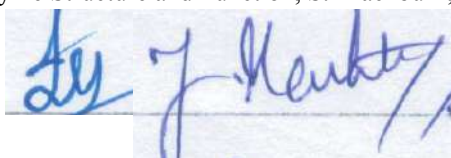
Pancreatic hormones: Chemistry, Biosynthesis and regulation of insulin and glucagon's. Role of carbohydrate, lipid and protein metabolism.

Unit-V: Adrenal Cortex: Chemistry Biosynthesis and functions of adrenal cortex hormones, Adrenal Medulla- Chemistry, Biosynthesis and functions of adrenal medullar hormones.

Gonadal Hormones: Chemistry Biosynthesis and functions of androgens, estrogens' and progesterone. Hormonal regulation of menstrual cycle and pregnancy.

➤ **Text Books:**

1. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry by Trevor Palmer, 2001, 2ndEdn. Woodhead Publishing Limited.
2. Fundamentals of Enzymology, Nicholas C Price and Lewis Stevens 1999, 3rdEdn. Oxford University Press.
3. Principles of Enzymology for Food Science, J.R. Whitaker, 1994, Marcel Dekkar Publishers.
4. Structure and Mechanism in Protein Science, Alan Fersht, 1999, 2ndEdn. W.H. Freeman and Co., NY
5. Enzyme Structure and Function, S. Blackburn, Marcel Dekkar, 1976, Inc. NY



6. Enzymatic Reaction Mechanism, Christopher Walsh, 1979. W.H. Freeman Pub, San Francisco.
7. Principles of Biochemistry. A.L. Lehninger. 1993. Nelson and Cox. C.B.S., India.
8. Textbook of Biochemistry. West and Todd. 1968. MacMillan
9. Biochemistry, Geoffrey Zubay, William W. Parson, Dennis E. Vance, 1995, McGraw-Hill Education.
10. Outlines of biochemistry by Conn and Stump.
11. Harrison's Principles of Internal Medicine, 14th ed, by Anthony S. Fauci et al. (1998) McGraw-Hill
12. Text Book of Medical physiology, 11th edition, by Guyton (2006)
13. Krause's Food, Nutrition & Diet Therapy, 11th ed, by Mahan and Stump (2000) Elsevier (U.S.A.)
14. Text book of Endocrinology-R.H. Willams.
15. Harper's review of Biochemistry
16. Text book of Biochemistry with clinical correlations Ed Thomas M. Devlin (John Wiley).
17. Mammalian biochemistry- White Handler and Smith.

KRISHNA UNIVERSITY: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, II SEMESTER

Course Name	INTERMEDIARY METABOLISM	L	T	P	C	IM	EM	TM
Course Code	25BIT203	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course description and Purpose:**

The course covers the basics of metabolism of the energy-yielding substrates carbohydrates, fatty acids, amino acids and proteins. This includes the pathways specific to the substrates that bring about their breakdown to yield intermediary molecules. The oxidation of the intermediary molecules in the citric acid cycle and the respiratory chain will be highlighted. Nucleic acid metabolism and glycogen synthesis will also be treated. Students will be exposed to the organization of networks of physiological reactions, the intermediary molecules and enzymes that maintain the energy balance of organism. The use of metabolism for the explanation of the etiology, diagnosis and cure of diseases will be discussed.

❖ **Course Learning Objectives:** This course enables the students to

- Give basic knowledge about catabolism, anabolism, regulation of metabolism and pathway analysis.
- Acquire knowledge and understanding of how enzymes and metabolites in living system work to produce energy and synthesizing different biomolecules.
- Extend comprehensive knowledge about biochemical pathways involved in intermediary metabolism of carbohydrate, protein, lipid and nucleic acid.
- Gain knowledge about the thermodynamic aspects of energetics in living system.

❖ **Course Content**

UNIT – I: Carbohydrate Metabolism: Glycolysis and its regulation. TCA cycle – function and

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regulation. Electron transport chain – Energy yield during aerobic and anaerobic conditions. Glyoxylate cycle, Gluconeogenesis and its regulation, Cori cyclic.HMP shunt and its significance. Uronic acid pathway. Glycogen metabolism and its regulation with special reference to phosphorylase and glycogen synthase.

UNIT–II: Metabolism of Amino acids: Biosynthesis of nonessential amino acids. Catabolism of tyrosine, phenylalanine, tryptophan and branched chain amino acids. Ketogenic and glucogenic amino acids. Formation of Creatinine, Ammonia, Urea cycle and its regulation. Protein turnover - Role of Ubiquitin.

UNIT–III: Metabolism of Fatty acids: Fats as energy stores. Oxidation of fatty acids. Formation and utilization of ketone bodies. Biosynthesis of fatty acids and regulation. Biosynthesis of triglycerides. Metabolism of phospholipids, sphingolipids. Biosynthesis of cholesterol and its regulation. Formation of bile acids., Metabolism of arachidonic acid–formation of prostaglandins, thromboxanes, leucotrienes, Role of liver and adipose tissue in lipid metabolism

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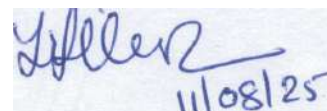
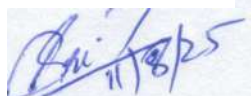
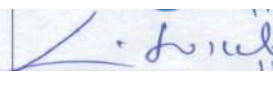
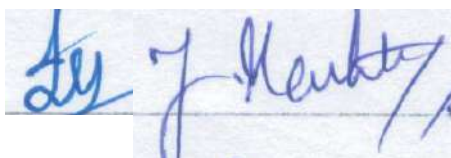
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UNIT–IV: Purine and Pyrimidine Metabolism: Biosynthesis of purines and pyrimidines. Degradation of purines and pyrimidines and their regulation. Structure and regulation of ribonucleotide reductase. Biosynthesis of ribonucleotides, deoxyribonucleotides. Inhibitors of nucleic acid biosynthesis. Biosynthesis and degradation of heme.

UNIT–V: Metabolic Disorders: Metabolic disorders: Inborn errors of carbohydrate metabolism (glycogen storage diseases, Diabetes mellitus), Inborn errors of amino acid metabolism – Alkaptonuria, Tyrosinemia. Inborn errors of lipid metabolism – Gaucher disease, hyper and hypo cholesterolemia. Inborn errors of nucleic acid metabolism– Gout, Lesch- Nyhan syndrome.

➤ **Text Books:**

1. Principles of Biochemistry- White A, Handler, Pand Smith.
2. Biochemistry- Lehninger A.L.
3. Biochemistry- David E. Metzler.
4. Biochemistry- Lubert Stryer.
5. Review of physiological chemistry- Harold A. Harper.
6. Text of Biochemistry- West and Todd.
7. Outlines of Biochemistry- Conn and Stumpf.
8. Metabolic pathways–Greenberg.
9. Mitochondria- Munn.
10. Biochemistry, 2nd Edition -G. Zubay.



KRISHNA UNIVERSITY :: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc.– BIOTECHNOLOGY, II SEMESTER

Course Name	RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS (IPR)	L	T	P	C	IM	EM	TM
Course Code	22BIT 204	3	0	1	3	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description:**

Research Methodology & IPR (PHYC204) course is aimed to develop research bent of mind (spirit of inquiry) and impart research skills to all the +

Post graduate students. It also encompasses the series of research methodology contents: from problem formulation, to design, to data collection, analysis, reporting and dissemination. This course also covers intellectual property rights (IPR) and intended to equip students with conceptual understandings of current scenario of IPR, and the practical issues encountered in filing patents, trademarks, and copyrights.

❖ **Course Learning Objectives:**

The objective of research is to find answers to the questions by applying scientific procedures. In other words, the main aim of research is to find out the truth which is hidden and has not yet been discovered.

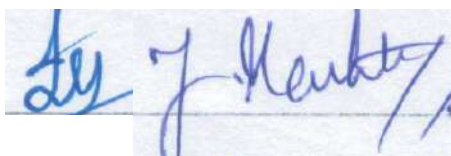
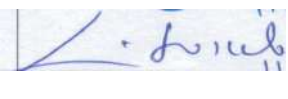
Specific objectives include:

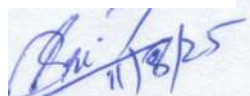
- ✓ To understand some basic concepts of research and its methodologies
- ✓ To develop an understanding of the basic frame work of research process.
- ✓ To develop an understanding of various research designs and techniques.
- ✓ To identify various sources of information for literature review and data collection.
- ✓ Ability to write a research Proposal, report and thesis
- ✓ To demonstrate knowledge and understanding of IPR Filing and Rights

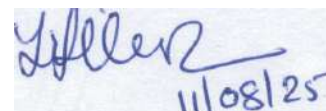
❖ **Course Learning Outcomes:**

At the end of this course the students should be able to :

- Understand some basic concepts of research and its methodologies
- Identify appropriate research topics
- Select and define appropriate research problem and parameters
- Demonstrate the ability to choose methods appropriate to research aims and objectives
- Have adequate knowledge on measurement & scaling techniques
- Have basic awareness of data analysis-and hypothesis testing procedures
- Prepare a project proposal (to undertake a project)
- Write a research report and thesis
- File Patents, Trademarks and Copy Rights




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➤ **Course Content:**

UNIT-I: Foundations of Research & Research Design

Meaning of Research– Definitions of Research– Motivation in Research– General Characteristics of Research– Criteria of Good Research– Types of Research–Research Process–Research Methods vs. Methodology– Defining and Formulating the Research Problem – Review of Literature – Approaches to Critical Literature Review – Importance of Literature Review in Identifying Research Gaps and Defining a Problem – Development of Working Hypothesis.

UNIT-II: Research Design, Sampling Concepts, and Data Collection Methods

Meaning, Significance and Characteristics of Good Research Design– Types of Research Design: Exploratory, Conclusive Research and Experimental – Sampling Theory: Types of Sampling and Errors in Sampling – Data Collection: Types of Data – Data Collection Methods and Techniques for Primary and Secondary Data.

UNIT-III: Measurement & Scaling Techniques, Hypothesis Formulation and Testing, Overview of Data Analysis and Report Writing

Basic measurement scales –Reliability & Validity – Definition and Types of Hypothesis–Hypothesis Formulation and Testing Procedure – Overview of Data Analysis: Methods, Process and Types–Report Writing: Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report Precautions for Writing Research Reports –How to Write a Research Proposal– Research Ethics, Conflict of Interest and Plagiarism.

UNIT-IV: Intellectual Property Rights (IPR)

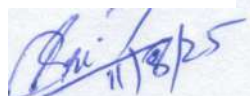
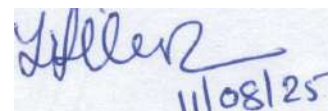
Definition and Nature and Features of Intellectual Property Rights (IPR)–Types of Intellectual Property Rights –Procedure for Grants of Patents– Rights of a Patent– Scope of a Patent Rights- Licensing and Transfer of Technology– Why protection of intellectual property is important? Enforcement of IPR– Infringement of IPR

UNIT -V: Indian and International Scenario and New Developments in IPR

IPR Developments in India for the past Five Years – Development of IPR Laws in India –International Cooperation on IPR– New Developments in IPR– Administration of Patent System– International Patent protection – Case Studies in Indian and Global Contexts.

PRACTICAL COMPONENTS:

1. Students should identify different research problems with examples and describe the characteristics of researchable problems in their academic area/society/community/organization concerned.
2. Students are to form In groups (a group consists of 4-6 students) and conduct critical literature survey with regard to the identified research problems and prepare a brief literature review coupled with research gaps and working hypothesis.

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3. Students are required to identify and develop good research design to address the defined research problems.
 4. Students are expected to write the research design on Exploratory and Descriptive Research.
 5. Students are required to develop practical experience in writing a research proposal by conducting a thorough critical review of any three research proposals (examples).
 6. Students are expected to develop templates for technical report writing.
 7. Students should conduct a team based mini research project, which is a unified and practical case on a topic of their choice, with approximately 4-6 students per group.
 8. Students are expected to identify types of plagiarism in academic research, and how to avoid plagiarism in research.
 9. Students are asked to identify and submit a brief report on Indian patents of international repute.
 10. Students are asked to write on Patent registration procedure, and visit Official website of Intellectual Property India <https://ipindia.gov.in> to know how to get IPR in India.
 11. Students are asked to identify and summarize remedies available against the infringement of intellectual property rights in Indian and global contexts.
- Students are asked to submit any five examples of ethical issues in copyright and patents.

Text and Reference Books:

1.

- Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002, An introduction to Research Methodology, RBSA Publishers.
2. Cohen, L., Lawrence, M., & Morrison, K. (2005), Research Methods in Education (5th edition). Oxford: Oxford University Press.
3. Kothari, C.R., 1990, Research Methodology: Methods and Techniques, New Age International.
4. Dornyei, Z. (2007). Research Methods in Applied Linguistics. Oxford: Oxford University Press.
5. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009, Research Methods: A Process of Inquiry, Ally and Bacon.
6. Fink, A., 2009, Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications.
7. Day, R.A., 1992, How to Write and Publish a Scientific Paper, Cambridge University Press.
8. Wadehra, B.L. 2000, Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.
9. Coley, S.M. and Scheinberg, C.A., 1990, Proposal Writing, Sage Publications.
10. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options, Zed Books, New York.
11. Leedy, P.D. and Ormrod, J.E., 2004, Practical Research: Planning and Design, Prentice Hall.
12. Satarkar, S.V., 2000. Intellectual property rights and Copyright. Ess Ess Publications.

Important Websites:

> www.ipindia.nic.in- Intellectual Property Office, India

- > www.patentoffice.nic.in–Patent office, India
- > <http://copyright.gov.in>–Copy right Office, India
- > ipr.icegate.gov.in–Automated Recordation & Targeting for IPR Protection
- > <http://www.icegate.gov.in>–E-Commerceportal of Central Board of Excise and Customs
- > www.ipab.tn.nic.in–Intellectual Property Appellate Board, India
- > www.mit.gov.in–Department of Information Technology, India
- > <http://www.mit.gov.in/content/office-semiconductorintegrated-circuits-layout-designregistry>
- > Semiconductor Integrated Circuits Layout-Design Registry (SICLDR)
- > www.plantauthority.gov.in–PlantVarietiesandFarmers'RightsAuthority, India
- > <http://nbaindia.org/> -National Biodiversity Authority
- > www.nipo.in–The Indian IPR Foundation
- > www.wipo.int–World Intellectual Property Organization
- > <http://www.wto.org>–World Trade Organization

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc.– BIOTECHNOLOGY, II SEMESTER

Course Name	MOLECULAR BIOLOGY	L	T	P	C	IM	EM	TM
Course Code	25BITDSE201	4	0	0	4	30	70	100

L-Lecture, **T**-Tutorial, **P**-Practical, **C**-Credits, **IM**-InternalMarks, **EM**-ExternalMarks, **TM**- Total Marks

❖ **Course description and Purpose:**

Molecular biology is the study of biological systems at the molecular level. Molecular biology deals with nucleic acids and proteins and how these molecules interact within the cell to promote proper growth, division, and development. It is a large and ever-changing discipline. The topics covered include; the structure and replication of DNA, chromosome organization, the molecular mechanisms underlying the recombination of DNA, the molecular basis of gene regulation and how gene expression is tied to intracellular and extracellular factors by signal transduction pathways. To provide students with an appreciation of the experimental approaches used to do research in molecular biology several important experiments including the methodologies used to perform them will be covered. This will introduce students to recombinant DNA methodologies such as gene cloning, DNA sequencing and in vitro mutagenesis. Emphasis will be placed on understanding basic concepts and on the

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integration of these concepts for problem solving. To reflect this pedagogical approach, the mid-term and final exams are open book.

❖ **Course learning objectives:**

This course is designed to provide students with a back ground in molecular genetics. The two main learning objectives of this course are;

- The development of an understanding of gene expression and gene regulation.
- The familiarization of students with the experimental approaches used in molecular biology.

❖ **Course Learning outcomes:**

After completing the course the student should be able to:

- Explain the structure and function of cells and cell organelles for eukaryote and prokaryote cells
- Explain the structure and function of DNA, RNA, protein, fat substance and carbohydrates in a cell biological relation
- Explain central cell biological processes and how they are regulated and quality assured (for instance: replication and cell division, gene expression and signal transduction)
- Explain how different cell types get and transform energy
- Explain genetic variation and inheritance
- Understand how molecular cell biology forms the foundation of biotechnology in different social structures.

❖ **Course Content:**

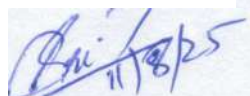
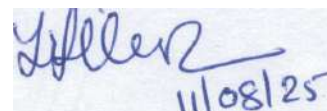
UNIT-I: DNA Replication: Models of DNA replication, –Enzymes involved in DNA replication. Structure of oriC. Mechanism of oriC open complex formation. Replication initiation. Elongation – Okazaki fragments synthesis and processing. Direction of replication for k movement and termination. Replication of single stranded DNA in ØX174. Replication of bacteriophage lambda DNA (rolling circle). Replication of closed covalent circular DNA (θ model).

Problems associated with replication of linear DNA molecules. DNA replication in Eukaryotes–Histone dissociation, DNA replication and reassociation. Fidelity of DNA replication and inhibitors of DNA replication.

UNIT-II: RNA Biosynthesis: Transcription Initiation- Prokaryotic RNA polymerase–Core enzyme and σ factors ($\sigma 70$, $\sigma 32$). Promoter elements. Promotor–RNA polymerase interaction – DNase protection method and Foot-printing assays. Mapping of transcription start point (TSP). Transcription elongation. Transcription termination– Rho- independent and Rho-dependent. Monocistronic and polycistronic RNA, Upstream activating sequences and their role in regulation of transcription.

Eukaryotic transcription, Eukaryotic RNA polymerases (RNA pol I, II and III) and Transcription factors. Enhancer sequences. Processing of RNA (capping, tailing and splicing). Inhibitors of transcription.

Unit – III: Protein Biosynthesis: Central dogma theory and flow of genetic information. Genetic code

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and its elucidation. Wobble hypothesis. Prokaryotic and eukaryotic ribosomes. Structures of mRNA and tRNA.

Events of protein synthesis (amino acid activation, initiation, elongation and termination) in prokaryotes and eukaryotes, Post-translational modification of proteins, Inhibitors of translation. Protein trafficking—Concept of signal peptide transport. Membrane targeting of proteins –Sec pathway.

Unit–IV: Regulation of Gene Expression in Prokaryotes : Regulation of gene expression in prokaryotes- levels of control. Operon concept. Inducible and repressible expression systems.

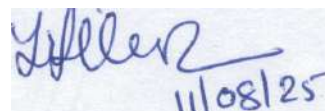
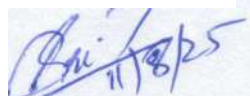
Regulation of gene expression - lactose, arabinose and tryptophan operon in E. coli. Regulation of nif (nitrogen fixation) gene expression in Klebsiella pneumonia. Mechanism of switch from lytic to lysogenic cycle in bacteriophage lambda.

Unit –V: Regulation of Gene Expression in Eukaryotes: Regulation of gene expression In Eukaryotes- Transcription factor domains and their role in regulation of gene expression: helix-turn-helix motif, zinc-finger motif, leucine-zipper and helix-loop-helix motif. Yeast gal genes.

Steroid hormone induced gene expression by anti-sense RNA. Gene expression as influenced by environmental factors. Regulation of gene expression by termination technology.

➤ **Text Books:**

- 1.Molecular Biology of the Gene (4thEdn) JD Watson, NH Hopkins, JW Roberts,
- 2.JA Steitzand AM Weiner, The Benjamin/ Cummings Publ, Co. Inc, California.
- 3.Molecular Cell Biology(2nd Edn)J. Darnell, H. Lodishand D .Baltimore,
- 4.Scientific American Books, Inc.USA1994
- 5.Molecular Cloning: A Laboratory manual, J. Sambrook, E.F frischand T. Maniatis, Old Spring Harbor Laboratory Press NewYork,2000
- 6.Introduction to Practical Molecular Biology, P. D. Dabre, John Wiley & Sons Ltd,
- 7.Molecular Biology, TA Brown (Ed) Bios Scientific Publishers Ltd., Oxford,1991.



KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc.– BIOTECHNOLOGY, II SEMESTER

Course Name	ENVIRONMENTAL BIOTECHNOLOGY	L	T	P	C	IM	EM	TM
Course Code	25BITDSE202	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course description and Purpose:**

The Environmental Biotechnology course aims to introduce and elaborate the fundamental concepts and applications of biotechnology in all aspects of environment including its protection, restoration and sustainability. Considering the rising challenges of climate change, energy and environmental crisis. The course is structured to provide the students with fundamental concepts of environmental biotechnology, highlighting the importance of Biofertilizers, GMOs and scopes for implementation.

❖ **Course learning objectives:**

- To make understand the great biodiversity existing in the microbial world and relate the eco physiological aspects of microorganisms to the functioning of the bio geochemical cycles that govern the terrestrial ecosphere.
- Know the possibilities of environmental application presented by the biotechnology of higher organisms.

❖ **Course learning outcomes:**

- The intended subject specific learning outcomes. On successfully completing the module students will be able to:
Demonstrate comprehensive knowledge and understanding of the Bioremediation and biodegradation principles, processes and applications will be discussed along with advanced applications in wastewater, oil recovery, biohydrometallurgy, biofuel .
- Demonstrate critical understanding of microbes and microbial communities in pollution abatement to mitigation of climate change, bioenergy, biomaterial to enzyme discovery.
- Demonstrate thorough knowledge and understanding of the experimental approaches used in Hazardous Waste Management.
- Demonstrate the ability to work individually to solve environmental biological problems.
Analyze and evaluate complex experimental data confidently.

❖ **Course content**

UNIT -I: Structure of model ecosystem: terrestrial, aquatic ecosystems - Energy flow - Degradation of ecosystem. Consequences - Ecosystem managements - Energy conservation - Alternative energy sources - Biofuels: Production of bioethanol, biobutanol from agriculture waste - Problems and perspectives -

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Biodiesels: mass cultivation and use of *Jatropha*, microalgae for production of biohydrogen.

UNIT-II: Types and sources of pollution; Environmental impact of pollution and measurement methods, Composting of organic wastes, microbial bioremediation of oil spills, Wastewater treatment - sewage treatment and common industrial effluent treatment, Concepts of bioremediation (*in-situ* and *ex-situ*), Bioremediation of toxic metal ions—biosorption and bioaccumulation. Concepts of phytoremediation, Microbial biotransformation of pesticides and xenobiotics, Microbial leaching of ores – direct and indirect mechanisms.

UNIT- III: Biofertilizers and their importance In crop productivity, Algal and fungal (mycorrhizae) biofertilizers, Bacterial biofertilizers, phosphate solubilizing bacteria, their significance, Biopesticides: Bacterial (Bt pesticides), fungal (*Trichoderma*), Viral biopesticides – Baculovirus insecticides. Production of biofertilizers and biopesticides for large scale application

UNIT- IV: Genetically engineered microorganisms (GMOs) in environmental health, genetically engineered plants and microorganisms in agriculture and productivity, genetically engineered bacteria in bioremediation of organic pesticides, insecticides oil spills, Hazards of genetically engineered microorganisms, plants and animals, Policies of genetic engineering research in India.

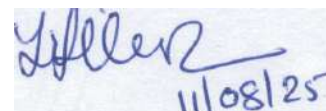
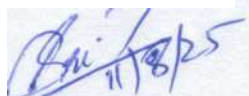
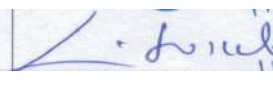
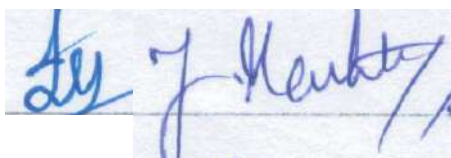
UNIT-V: Hazardous Waste Management: Introduction - Xenobiotic compounds, recalcitrance. Hazardous wastes - biodegradation of Xenobiotics. Biological detoxification - market for hazardous waste management. Biotechnology application to hazardous waste management - examples – cyanide detoxification - detoxification of oxalate, urea - toxic organics – phenols, e-waste and nuclear waste.

PRACTICALS:

1. Biomass estimation by different methods
2. Isolation of Biofertilizer microbes by biological enrichment method
3. Efficacy testing for biofertilizers (nodulation test for rhizobia) and biopesticides
4. Estimation of BOD
5. Testing for microbiological quality of potable water (Coli form test)
6. Microbial degradation of organic matter
7. Testing for effect of chemical pesticides on soil microbial respiration
8. Testing for microbial biodegradation of pesticides

➤ Text Books:

1. Comprehensive Biotechnology (All volumes) Ed. Young, M.Y. Pub: Pergmon Press
2. Environmental Microbiology. Grant, WD and Long PE. Publ: Blakie, Glasgow
3. Biotreatment systems Vol. 22. Ed. Wise, DL.
4. Microbial Ecology: Principles, Methods and Applications by Lavin, Seidler, Rogul,
5. Laboratory Experiments in Microbiology by Gopal Reddy et al



6. Environmental Biotechnology, Principles and Applications by Bruce E Rittman and Perry L McCarty, Mc Graw hill Higher education.
7. Environmental Biotechnology Edited by Hans-Joachim Jördening and J Winter, WILEY-VCH Verlag GmbH & Co.
8. Bioremediation and Natural Attenuation by Pedro J JAlvarage and Walter A Illman, Wiley Inter science.
9. Environmental Biotechnology, Vol 10 Handbook of Environmental Engineering, Edited by L K Wang et al, Humana Press.

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc.– BIOTECHNOLOGY, II SEMESTER

Course name	ECOLOGY AND EVOLUTION	L	T	P	C	IM	EM	TM
Course code	25BITDSE203	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course description and purpose:**

To provide theoretical ecological concepts to understand the evolution of different species and their interaction.

❖ **Course learning objectives:**

Students will be equipped to understand the evolutionary background and its importance.

-To understand and convey the ecological, social, and economic impacts of diversity loss, and

- To apply management principles and tools that are used to conserve diversity at levels from genes to landscapes

-To provide theoretical ecological concepts to understand the evolution of different species and their interaction.

-Students will be equipped to understand the evolutionary background and its importance.

❖ **Course learning Outcomes:**

- Students will demonstrate broad-based knowledge of the fundamentals of Ecology, Behavior, Evolution and Physiology and the relationships among these disciplines.

- Know fundamental patterns and processes in biodiversity, ecology and evolution.

- Be well acquainted with, and understand, evolutionary and ecological theory for interspecific variations in adaptations.

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- Explains the manner in which specific ecological processes, including migration, birth and death rates, age of reproduction affects the outcome of evolution and how evolution may, in turn, alter those processes.

❖ Course content

UNIT 1: Ecology: Fundamental concepts: Abiotic and biotic components; scales (population, species, community, ecosystems, biomes); niches and habitats.

Population ecology: Population growth rates (density dependent/independent); metapopulation ecology (colonization, persistence, extinction, patches, sources, sinks); age-structured populations.

UNIT II- Interactions: Types (mutualism, symbiosis, commensalism, competition, parasitism, predation, etc); ecophysiology (physiological adaptations to abiotic environment); prey-predator interactions Community ecology: Community assembly, organization and succession.

Species richness, evenness and diversity indices, species-area relationships; theory of island biogeography Ecosystems structure and function: trophic levels and their interactions; nutrient cycles; primary and secondary productivity.

UNIT III: Evolution: History of Evolutionary thought: Lamarckism; Darwinism; Fundamentals: Variation; heritability; natural selection; fitness and adaptation; types of selection (stabilizing, directional, disruptive)

Diversity of life: Origin and history of life on earth; diversity and classification of life; systems of classification (cladistics and phenetics)

UNIT-IV: Population and Quantitative genetic: Allocation of resources, Interactions: Co-evolution, prey predator interactions (mimicry, crypsis, etc)

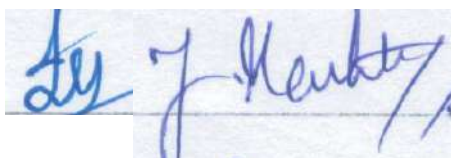
Population and Quantitative genetics: Origins of genetic variation; Mendelian genetics; Hardy-Weinberg equilibrium; population genetic structure (panmixia, gene flow, F_{ST}); polygenic traits; gene-environment interactions (phenotypic plasticity); heritability

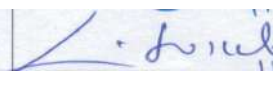
UNIT-V: Molecular evolution and phylogenetics: Neutral theory; molecular clocks; rates of evolution; phylogenetic reconstruction; molecular systematics

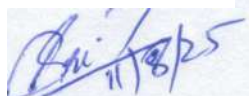
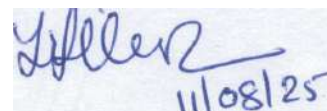
Macroevolution: Species concepts and speciation; adaptive radiation; convergence; biogeography

➤ Text Books:

1. Cockburn, A, 2001. An Introduction to Evolutionary Ecology, 2nd Edition, Wiley Blackwell.
2. Mayhew, PJ 2006, Discovering Evolutionary Ecology, Oxford University Press. Reference
3. Krishnamurthy, K. V. 2004. An advanced textbook on Biodiversity: Principles and practice. Oxford and IBH. Publ. Co. New Delhi.260Pp.





4. Mabberley, D.J.2005. The Plant Book. A portable of dictionary of the vascular plants. 2nd ed. Cambridge University Press.
5. Behavioral ecology. E.S. Morton and B. Stutchbury.2001. Academic Press.

➤ **Reference Books:**

Fox, CW, Roff, DA Fairbairn 2001 Evolutionary Ecology: Concepts and Case studies, Oxford University press.

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc.– BIOTECHNOLOGY, II SEMESTER

Course name	BIOANALYTICAL TECHNIQUES & ENZYMOLGY LAB	L	T	P	C	IM	EM	TM
Course code	25BITL201	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM- Total Marks

➤ **List of Experiments**

➤ **Bioanalytical Techniques:**

1. Separation of amino acids by paper chromatography.



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2. Separation of amino acids/ sugars/ lipids by Thin Layer Chromatography.
3. Ultraviolet absorption spectra of nucleic acids and proteins.
4. Gel filtration of proteins.
5. Ion exchange chromatography of amino acids.
6. Purification of enzyme by affinity chromatography.
7. Polyacrylamide gel electrophoresis of proteins.
8. Estimation of reducing sugars by Benedict's titrimetric method.
9. Estimation of total carbohydrates by anthrone method.
10. Estimation of proteins by Lowry and Bradford methods.
11. Estimation of ascorbic acid

➤ **Enzymology:**

1. Isolation and partial purification of enzymes: amylases and cellulases.
2. Localization of enzymes – mitochondrial (SDH) and cytosolic (GSH)
3. Effect of temperature and pH on the rate of enzyme- catalyzed reaction.
4. Effect of inhibitors/activators on enzyme-catalyzed reactions.

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DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc.– BIOTECHNOLOGY, II SEMESTER

Course name	INTERMEDIARY METABOLISM AND MOLECULAR BIOLOGY LAB	L	T	P	C	IM	EM	TM
Course code	25BITL202	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM- Total Marks

➤ **List of Experiments:**

➤ **Intermediary Metabolism:**

1. Isolation and estimation of glycogen from liver
2. Isolation and estimation of Cholesterol from brain
3. Preparation of lecithin
4. Estimation of proteins by Biuret, modified Lowry and Bradford method.
5. Estimation of amino acids by ninhydrin method.
6. Estimation of glucose by glucose oxidase method
7. Titration curve of an amino acid and calculation of pK and pI values
8. Quantitative analysis of carbohydrates
9. Quantitative analysis of DNA, RNA.

➤ **Molecular Biology:**

1. Isolation of genomic DNA from bacteria
2. Determination of purity of the isolated DNA by UV spectrophotometry
3. Colorimetric method (Di phenyl amine reagent)
4. Thermal denaturation of DNA and demonstration of hyper chromic effect.
5. Isolation of RNA by Trizol methods.
6. Estimation of RNA.
7. Determination of melting temperature (T_m) and estimation of GC content.
8. Isolation of plasmids from *E.coli* and separation of CCC, Open circular and linear forms of plasmids
10. Agarose gel electrophoresis– Separation and molecular size determination of DNA
11. Isolation and separation of proteins by SDS-PAGE
12. Western blot.
13. Purification of DNA fragment from agarose gels.

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KRISHNA UNIVERSITY, MACHILIPATNAM – 521003
DEPARTMENT OF BIOSCIENCES & BIOTECHNOLOGY
M.Sc Bio-Technology, II-SEMESTER

Course Name [Add on]	Foundations of Quantum Science for Life Sciences	L	T	P	C	IM	EM	TM
Course code	25BITOM201	0	4	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks,
TM-Total Marks

➤**Objective:** This course introduces the fundamental principles of quantum science and their relevance to atoms, molecules, and biomolecules. It aims to help life science students understand how quantum concepts explain biological processes such as photosynthesis, vision, and enzyme action. The course also explores emerging applications of quantum technologies in medicine, nano biotechnology, and healthcare innovation.

Out comes:

Students will gain a clear understanding of the basic principles of quantum science relevant to life sciences.

Students will be able to describe how quantum phenomena influence biological systems and processes.

Students will learn to apply quantum concepts in interpreting spectroscopic and molecular techniques.

Students will recognize the scope of quantum technologies in advancing biotechnology, medicine, and healthcare.

Course Outline:

Unit - I:

Introduction to Quantum Science: Origin and development of quantum theory, Key concepts: wave-particle duality, quantization of energy, Basic postulates of quantum mechanics, Applications of quantum principles in biology and chemistry

Unit - II:

Quantum Physics of Atoms and Molecules: Structure of atoms: quantum numbers and orbitals, Chemical bonding from quantum perspective, Molecular orbitals and energy levels, Quantum basis of

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spectroscopy (UV, IR, fluorescence, NMR basics)

Unit - III:

Quantum Chemistry in Biological Systems: Quantum description of biomolecules (proteins, nucleic acids, pigments), Hydrogen bonding and electron transfer mechanisms, Quantum tunneling in enzymes, Photosynthesis and light absorption at quantum level

Unit - IV:

Quantum Dynamics in Life Processes: Quantum coherence and entanglement in biology, Quantum effects in vision (rhodopsin and photon absorption), Magnetoreception in birds (radical pair mechanism), Role of quantum mechanics in drug-receptor interactions

Unit -V:

Emerging Applications of Quantum Science in Life Sciences: Quantum dots and nano biotechnology, Quantum sensors in medical diagnostics, Quantum computing in biological data analysis, Future perspectives: quantum biology and healthcare innovation

Recommended Books:

1. Al-Khalili, J. & McFadden, J. (2014). Life on the Edge: The Coming of Age of Quantum Biology. Bantam Press, UK.
2. Mohseni, M., Omar, Y., Engel, G.S., & Plenio, M.B. (2014). Quantum Effects in Biology. Cambridge University Press, UK.
3. Abbott, D., Davies, P.C.W., & Pati, A.K. (2008). Quantum Aspects of Life. Imperial College Press, London.
4. Chandra, A.K. (2006). Quantum Chemistry. 4th Edition, Tata McGraw-Hill Education, New Delhi.
5. Prasad, R.K. (2014). Quantum Chemistry. 4th Edition, New Age International Publishers, New Delhi
6. Chattopadhyay, Arpita (2018). Molecular Biophysics. Universities Press (India) Pvt. Ltd., Hyderabad.
7. Bawa, R.K. & Mishra, M. (2015). Nanoscience and Nanotechnology. Narosa Publishing House, New Delhi.
8. Banwell, C.N. & Mc Cash, E.M. (2017, Indian Reprint). Fundamentals of Molecular Spectroscopy. McGraw-Hill Education India, New Delhi.

Dr. J. K. Kaur

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KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, III SEMESTER

Course Name	GENETIC ENGINEERING	L	T	P	C	IM	EM	TM
Course Code	25BIT301	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description and Purpose:**

❖ **Course Learning Objectives:**

- To acquire knowledge on tools and techniques in genetic engineering.
- To gain knowledge in choice of host for cloning, methods of gene transfer and screening procedure.
- To understand the principles and application of PCR techniques, DNA sequencing methods.
- To learn about genetically modified organisms and their benefits.
- To realize ethical issues on genetic engineering.

❖ **Course Learning Outcomes:**

- Technical know-how on versatile techniques in recombinant DNA technology.
- An understanding on application of genetic engineering techniques in basic and applied experimental biology.
- Proficiency in designing and conducting experiments involving genetic manipulation.
- Manipulating DNA sequences with versatile DNA modifying enzymes.
- Designing cloning experiments using routine and specialized vectors for such applications as plant transformation, protein expression and genomic DNA library construction etc.
- Editing genomic sequences using site-directed mutagenesis.
- Employing PCR, nucleic acid hybridization and sequencing technologies for detection and diagnostics.

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❖ Course Content

UNIT – I:

Genetic Engineering Basic concepts - Overview of recombinant DNA technology. Isolation and purification of genomic RNA and Plasmid DNA. Detection and quantification methods of nucleic acids.

UNIT-II

Enzymes used in genetic engineering. Restriction endonucleases - Classification, nomenclature and properties. Restriction mapping. DNA polymerase-I. Polynucleotide kinase. Terminal nucleotide transferase. Reverse transcriptase - structure, mechanism and functions. Alkaline phosphatase. S1 nuclease. DNA Ligases and ligation of foreign DNA to vectors - cohesive and blunt end methods.

UNIT – III

Vectors - Salient features of cloning vectors. Types of cloning vectors - plasmids, cosmids, phages (lambda and M13 phage vectors), animal (SV40, Baculo) and plant (CMV) viral vectors. Yeast Artificial chromosomes (YACs). Techniques of gene transfer - transformation, transfection, micro-injection, electroporation, silicon carbide fiber method. Liposome mediated Gene transfer (lipofection). Biolistic Transformation (Gene gun method).

UNIT – IV

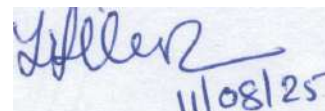
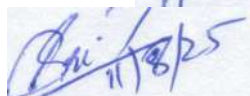
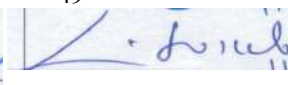
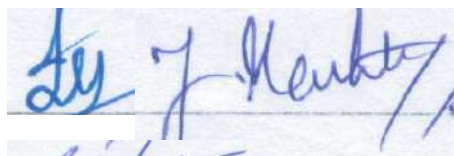
Selection of Recombinant cells after Gene transfer - Selection of r-DNA clones and their expression. Marker genes and reporter genes. Nucleic Acid Probes. Colony hybridization. Fluorescent in-situ hybridization. Polymerase Chain Reaction and its applications. Real-Time PCR. Reverse Transcription PCR. DNA microarray technology.

UNIT – V

Genome editing technology – CRISPR / Cas9. Applications of genetic engineering in agriculture, animal husbandry, medicine and industry. Protein Engineering - Overview of Protein Engineering. Alterations in protein sequence. Modification Methods of natural enzymes and proteins.

Text books:

1. Recombinant DNA technology by Watson et. al.(Scientific American Books).
2. Genes-VIII by Benjamin Lewin (Oxford).
3. Principles of Gene Manipulation by Old and Primrose (Blackwell).
4. DNA Science by David Micklos (Carolina Publishing Company).
5. From genes to clones by Winneker.
6. From genes to genomes concepts and applications of DNA technology by Jeremy W dale



- and Malcolm von Scrantz, Wiley Black well
7. Molecular Biotechnology by Glick.
 8. Genetic Engineering by Sandhya Mitra.
 9. Genomes by T.A. Brown.
 10. Protein Engineering by Bornscheuer (Springer)

e-Reference links

1. <https://www.pdfdrive.com/molecular-biotechnology-principles-andapplications-of-recombinant-dna-4th-edition-e162050162.html>
2. <https://www.pdfdrive.com/molecular-biotechnology-principles-andapplications-of-recombinant-dna-e156918014.html>
3. <https://www.pdfdrive.com/recombinant-dna-technology-molecular-biologyand-paradigms-e11385991.html>
4. <https://www.pdfdrive.com/recombinant-dna-principles-and-methodologie-e185941491.html>

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, III SEMESTER

Course Name	BIOPROCESS ENGINEERING	L	T	P	C	IM	EM	TM
Course Code	25BITDSE301	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ Course Description and Purpose:

COURSE OBJECTIVES

The field of biotechnology is developing very rapidly and needs skilled engineers with bioprocess engineering background to design, build, control, and operate bioreactors and fermenters. This course provides students with basic concepts and prepares them to meet the challenges of the new and emerging biotechnology industry. After successful completion of this course, the student will be able to:

1. Design bioreactors for the production of various products.
2. Analyze and formulate mechanisms for enzymatic reactions.
3. Understand soluble and immobilized enzyme technologies for the production of industrial and medical products.
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Specify required technologies to effectively utilize genetically engineered microorganisms for bioprocessing.

COURSE OUTCOME

This course will cover material related to the application of biological, biochemical, and engineering fundamentals in the area of bioprocess engineering. Students will review aspects related to cell biology, genetic engineering, biochemistry and microbiology as they pertain to bioprocess engineering concepts. Advanced topics will include bioprocessing kinetics (enzymes, cell growth, substrate utilization, and product formation); bioenergetics; quantification of metabolism; bioreactor design and selection; bioprocess scale-up; product recovery; biosafety and good manufacturing practices; and the role of bioprocess engineering in medicine.

UNIT -1

Isolation, screening and maintenance of industrially important microbes; microbial growth and death kinetics (an example from each group, particularly with reference to industrially useful microorganisms); Strain improvement for increased yield and other desirable characteristics.

UNIT - II

Bioreactor designs; types of fermentation and fermenters; Concepts of basic modes of fermentation – batch, fed batch and continuous. Solid substrate, surface and submerged fermentation; Fermentation economics; Fermentation media; Fermenter design – Types of fermenters. Large scale animal cell cultivation: Upstream processing; media formulation; sterilization; aeration and agitation in bioprocess; Measurement and control of bioprocess parameters.

UNIT - III

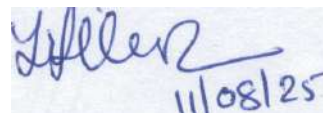
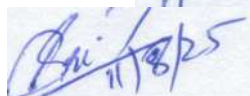
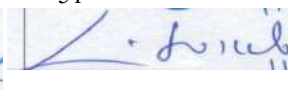
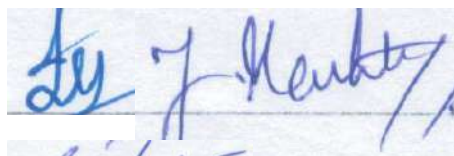
Preparation and application of Immobilized enzymes: Kinetics of Enzyme catalyzed reactions -Kinetics of immobilized enzyme catalyzed reactions - Kinetics of balanced growth - Transient growth kinetics. Gas-liquid mass transfer in cellular systems - Aeration – Agitation - Estimation of oxygen transfer rates.

UNIT - IV

Bioseparation - filtration, centrifugation, sedimentation, flocculation; cell disruption; Liquid-liquid extraction; Purification by chromatographic techniques; reverse osmosis and ultra filtration; drying; crystallization; Storage and packaging; Treatment of effluent and its disposal.

UNIT-V

Industrial production of recombinant proteins (riboflavin, streptomycin, tPA). Large scale production and purification of recombinant therapeutics (streptokinase, epidermal growth factor, insulin). Scenario



of Indian biotech industries (local, state and national wide).

TEXT BOOKS/ REFERENCES

1. Douglas S. Clark and Harvey W. Blanch. Biochemical Engineering, Second Edition, CRC Press 1997
2. Bjorn K. Lydersen, Nancy A. D'Elia, and Kim L. Nelson, Bioprocess Engineering: Systems, Equipment and Facilities. 1st Edition, Wiley-Interscience, 1994
3. S. Liu, Bioprocess Engineering: Kinetics, Biosystems, Sustainability, and Reactor Design, Elsevier, 2016
4. Pauline Doran, Bioprocess Engineering Principles, 2nd Edition, Academic Press 2012
5. James M. Lee, Biochemical Engineering, Prentice Hall, 1992
6. James E. Bailey and David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill 1986
7. Octave Levenspiel, Chemical Reaction Engineering, Wiley 2016.

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, III SEMESTER

Course Name	IMMUNOLOGY	AND	L	T	P	C	IM	EM	TM
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	IMMUNE TECHNOLOGY							
Course Code	25BITDSE302	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ Course Description and Purpose:

❖ Course Learning Objectives:

- To understand the basic concepts of the various immune systems of human body.
- To gain knowledge on antigen antibody reactions, humoral and cell mediated immunity.
- To know the role of Immune system in Health and Disease – Complement system and its pathways, Autoimmune disorders.
- To obtain knowledge on the various immune techniques in diagnosis and Immunotherapy and various other applications.

❖ Course Learning Outcomes:

- Thoroughly understand the basic concepts of immunology, cells and organs of immune system and types of immunity.
- Acquire knowledge on various immunological phenomena like activation, regulation and processing of various immune components in humoral and cell mediated immunity.
- Interpret the role of Immune function in Health, vaccine and Disease.
- Analyze the immunological problems, understand various immuno diagnosis testing principles.
- Explain the transplantation and its classification, tumors of the immune system - tumor antigens

❖ Course Content

UNIT-I

Types of immunity – innate, acquired, passive and active. Organization and structure of lymphoid organs – bone marrow, thymus, spleen and lymph nodes. Cells of the immune system – B-Lymphocytes, T-Lymphocytes, Monocytes, Macrophages, Neutrophils, Eosinophils, Basophils, NK cells and their effector functions.

UNIT-II

T-cell receptor – structure and function. T cell maturation, activation, and differentiation. Types of cells mediated immunity, effector functions of TH and TC cells and lymphokine activated killer cells. Clonal nature of immune response. Immunological memory. Immunoregulation. Adjuvants and immunological tolerance.

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UNIT-III

Components of Immune system - Nature of antigens and antibodies. Structure and function of antibodies. Isotypes, Allotypes and Idiotypes. Antigen – antibody interactions. B-cell development, activation, and generation of antibody diversity. Antigen receptors on B & T lymphocytes. Effector mechanisms of B-cells. Major Histocompatibility Complex (MHC). Human leukocyte antigens (HLA), MHC restriction and typing. Lymphokines, effector cell mechanisms. Complement system.

UNIT-IV

Immunological techniques - ELISA, RIA, Western Blot, Immunoblot and Immunofluorescence techniques. FACS. Hybridoma technology - production and applications of monoclonal antibodies. Antibody engineering, chimeric antibodies.

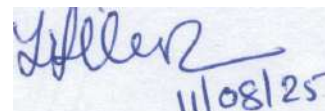
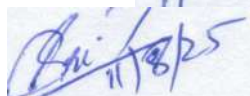
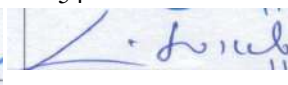
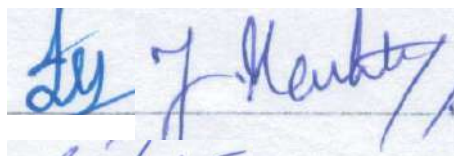
UNIT-V

Hypersensitivity - Types of hypersensitivity - immediate and delayed hypersensitivity. Autoimmune diseases, transplantation and immunity, immunity to infectious agents. Vaccines and Vaccination, types of vaccines including new generation vaccines. Tumor immunology.

Text books:

1. Sunil Kumar Mohanty, K Sai Leela, Textbook of Immunology, Publisher Jaypee Brothers Medical Publishers, 2014.
2. Basir F, Textbook Of Immunology, Publisher Prentice Hall India Learning Private Limited, 2012.
3. Latha P. Madhavee, Textbook of Immunology, Publisher S Chand & Company 2012.
4. Kubly J. Immunology, 6th Edition. W.H. Freeman and Company, New York. 2006.
5. Roitt I. 2017, Essential Immunology Blackwell Scientific Publications, Oxford 13th Edition
6. Geoffrey Sunshine, Immunology: A Short Course Richard Coico, Wiley Blackwell 7th Edition, 2015.
7. Abul K. Abbas and Andrew H. Lichtman, Cellular and Molecular Immunology, 2014,
8. David K. Male, Jonathan Brostoff, David E. Roth, and Ivan M. Roitt, Immunology, 8th revised edition, Elsevier, 2012.
9. Thao Doan, Roger Melvold, Susan Viselli, Carl Waltenbaugh, Immunology, Lippincott Illustrated Reviews Series, 2012.

e-Reference links



1. <https://www.pdfdrive.com/microbiology-and-immunology-textbook-of2nd-edition-e33405391.html>
2. <https://www.pdfdrive.com/cellular-molecular-immunology-7th-edition-e157242744.html>
3. <https://www.pdfdrive.com/basic-immunology-e21670961.html>
4. <https://www.pdfdrive.com/medical-microbiology-virology-immunology-e43491517.html>

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, III SEMESTER

Course Name	CELL & TISSUE CULTURE	L	T	P	C	IM	EM	TM
Course Code	25BITDSE303	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

Course Outcomes:

- CO1.Gain knowledge on plant tissue culture media and techniques.
CO2.Familiarize with animal cell culture techniques.
CO3.Obtain knowledge about artificial tissues and organs.
CO4.Familiarize with different types of stem cells, their differentiation and propagation.
CO5.Understanding of applications of stem cells.
CO6.Attain knowledge on neuromorphology, neurophysiology and neurodegenerative diseases.

Learning Outcomes:

- LO1.Understand the different types of plant cell culture techniques and their importance. LO2.Able to distinguish the different mechanisms of mammalian cell culture techniques. LO3.Understand production of various artificial tissues and organs and their role in transplantation studies. LO4.Comprehend the importance of stem cells in bone marrow transplantation. LO5.Apprehend the significance of morphology and physiology of nerve fibers. LO6.Understand the different kinds of neurodegenerative diseases.

UNIT-I

Plant tissue culture technology. Culture media - composition and preparation. Factors governing *in vitro* behavior. Somatic embryogenesis, organogenesis and plant regeneration. Culture types. Micro propagation. Haploids. Somaclonal variations. Metabolite production in cultures. Isolation of protoplasts, protoplast fusion and culture. Somatic hybridization.

UNIT-II

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Animal cell and tissue culture - Primary culture, balanced salt solutions and simple growth medium. Serum and protein free defined media. Cell lines, primary and established cell line cultures. Basic techniques of mammalian cell culture in vitro. Tissue and organ culture. Production and use of artificial tissues and organs – Skin, liver and pancreas. Apoptosis - mechanism and significance.

UNIT-III

The biology of stem cells – Different types of stem cells. Embryonic stem cells, fetal tissue stem cells, adult stem cells. Stem cell differentiation. Stem cell plasticity – differentiation versus stem cell renewal. Isolation and propagation of embryonic stem cells. Chimeras. Generation of knockout mice and knock-in technology. Applications of AI and Machine Learning in stem cell identification, classification, and differentiation prediction.

UNIT-IV

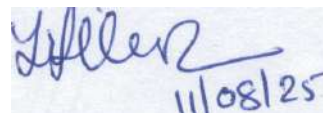
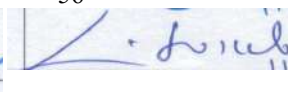
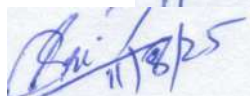
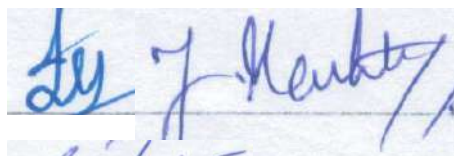
Hematopoietic stem cells and bone marrow transplantation - Cells for hematopoietic reconstitution. Cord blood stem cells. Cells for adoptive cellular immunotherapy. Bone marrow transplantation - advantages and disadvantages. Allogenic, autologous, syngenic and congenic transplantation. Clinical applications of stem cell therapy. Future perspectives of AI in precision regenerative medicine.

UNIT-V

Neuromorphology – Organisation of neuron, dendrites and axons. Glial cells – astrocytes, oligodendrocytes, ependymal cells, schwann cells. Nerve fiber types and functions. Neurophysiology – Excitation and conduction, generation and conduction of action potential, saltatory conduction, ion channels and transport of ions. AI-assisted neuroimaging and diagnosis of neurological disorders. Synaptic transmission. Neurotransmitters and Neurohormones – chemistry, synthesis, storage and release. Blood Brain CSF barrier – Characteristics and transport systems. Biochemistry of vision. Neurodegenerative diseases – Parkinson's disease, Alzheimers, spinal cord injury and other brain syndromes. Ethical considerations and future prospects of AI in neuroscience.

Books suggested:

1. Plant tissue culture – theory and practice by Bhojwani S.S.
2. Plant cell culture – A practical approach by Dixon R.A.
3. Culture of Animal cells by R.I. Freshney. Wiley – Liss.
4. Animal Cell Culture – A Practical approach Ed. by John R.W. Masters (IRL Press).
5. Animal cell culture techniques, Ed. Martin Clynes, Springer.
6. Plant Cell, Tissue and Organ Culture, By Reinert, J. and YPS Bajaj (Springer – Verlag).
7. Plant tissue and cell culture, by Street, HE (Blackwell).



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- 8.Stem cells in regenerative medicine by Audet (Springer).
- 9.Cell and tissue reaction engineering by Eibl (Springer).
- 10.A text book of Medical Physiology by Guyton. A.C., H. (Saunders Philadelphia).
- 11.Introduction to Physiology by Davidson H and Segal M. B. (Academic Press).
- 12.Review of Medical Physiology-William F.Ganong.
- 13.Siegel et al., Basic Neurochemistry, 6th Edition, (Lippincott -Williams-Wilkins).
- 14.Kandel et al., Principles of Neural science, 4th Edition, (McGraw-Hill Medical).
- 15.Zegmond, Fundamentals of Neuroscience, 1st Edition, (Academic Press).

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, III SEMESTER

Course Name	QUALITY CONTROL & QUALITY ASSURANCE	L	T	P	C	IM	EM	TM
Course Code	25BITDSE304	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

Scope

This course deals with the various aspects of quality control and quality assurance aspects of pharmaceutical industries. It covers the important aspects like cGMP, QC tests, documentation, quality certifications, GLP and regulatory affairs.

Objectives

Upon completion of this course the student should be able to

- Understand the cGMP aspects in a pharmaceutical industry.
- To appreciate the importance of documentation.
- To understand the scope of quality certifications applicable to.Pharmaceutical industries.
- To understand the responsibilities of QA & QC departments.

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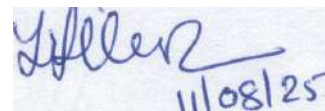
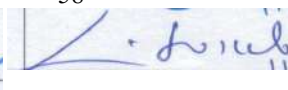
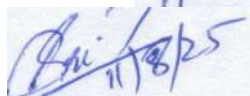
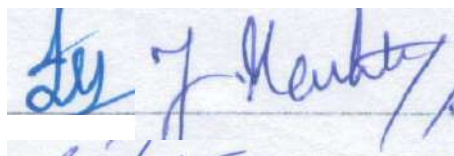
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THEORY

1. **Introduction:** Concept and evolution and scopes of quality control and quality assurance, good laboratory practice, GMP, overview of ICH Guidelines - QSEM, with special emphasis on Q-series guidelines.
Good Laboratory Practices: Scope of GLP, definitions, quality assurance unit, protocol for conduct of non clinical testing, control on animal house, report preparation and documentation. CPCSEA guidelines.
2. cGMP Guidelines according to schedule M, USFDA (inclusive of CDER and CBER), pharmaceutical inspection convention(PIC),WHO and EMEA covering: Organization and personnel responsibilities, training, hygiene and personal records, drug industry location, design, construction and plant lay out, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination and Good warehousing practice.
3. Analysis of raw materials, finished products, packaging materials, in process quality control (IPQC), developing specification (ICHQ6 and Q3), purchase specifications and maintenance of stores for raw materials. In process quality control and finished products quality control for following dosage forms in pharma industry according to Indian, US and British pharmacopoeias: tablets, capsules, ointments, suppositories, creams, parenterals, ophthalmic and surgical products (How to refer pharmacopoeias).
4. **Documentation in Pharmaceutical Industry:** Three tier documentation, policy, procedures and work instructions, and records (Formats). Basic principles- How to maintain, retention and retrieval etc. Standard operating procedures (How to write),master batch record, batch manufacturing record, quality audit plan and reports. Specification and test procedures, protocols and reports, distribution records, electronic data handling, concepts of controlled and uncontrolled documents. Submission documents for regulators DMFs as common technical document and electronic common technical documentation (CTD, eCTD). Concept of regulated and non regulated markets
5. **Manufacturing Operations and Controls:** Sanitation of manufacturing premises, mix-ups and cross contamination processing of intermediates and bulk products, packaging operations, IPQC, release of finished product, process deviations, charge-in of components, time limitations on production, drug product inspection, expiry date calculation, calculation of yields, production record review, change control, sterile products, aseptic process control, packaging, reprocessing, salvaging, handling of waste and scrap disposal. Introduction, scope and importance of intellectual property rights. Concept of trade mark, copyright and patents.



REFERENCES

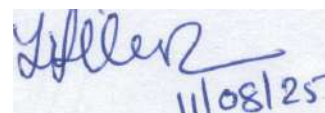
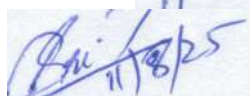
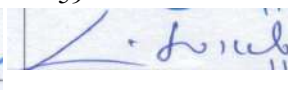
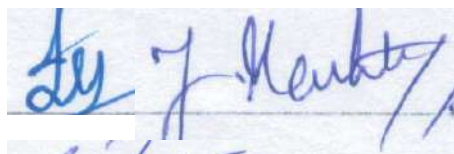
1. Quality Assurance Guide by Organization of Pharmaceutical Procedures of India, 3rd revised edition, Volume I & II, Mumbai, 1996.
2. Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol. 69, Marcel Dekker Series, 1995.
3. Quality Assurance of Pharmaceuticals- A compedium of Guide lines and Related materials Vol I & II, 2nd edition, WHO Publications, 1999.
4. How to Practice GMP's – P P Sharma, Vandana Publications, Agra, 1991.
5. The International Pharmacopoeia – vol I, II, III, IV & V - General Methods of Analysis And Quality Specification for Pharmaceutical Substances, Excipients and Dosage forms, 3rd edition, WHO, Geneva, 2005.
6. Good laboratory Practice Regulations – Allen F. Hirsch, Volume 38, Marcel Dekker Series, 1989.
7. ISO 9000 and Total Quality Management
8. The drugs and cosmetics act 1940 – Deshpande, Nilesh Gandhi, 4th edition, Susmit Publishers, 2006.
9. QA Manual- D.H. Shah, 1st edition, Business Horizons, 2000.
10. Good Manufacturing Practices for Pharmaceuticals a plan for total quality control – Sidney H. Willig, Vol. 52, 3rd edition, Marcel Dekker Series.
11. Steinborn L. GMP/ISO Quality Audit Manual for Healthcare Manufacturers and Their Suppliers, Sixth Edition, (Volume 1 - With Checklists and Software Package). Taylor & Francis; 2003.
12. Sarker DK. Quality Systems and Controls for Pharmaceuticals. John Wiley & Sons; 2008.
13. Schedule M and Schedule N.

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, III SEMESTER

Course Name	BIOSAFETY, BIOETHICS & IPR	L	T	P	C	IM	EM	TM
Course Code	25BITDSE305	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

COURSE OBJECTIVES



- To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
- To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
- To disseminate knowledge on copyrights and its related rights and registration aspects • To disseminate knowledge on trademarks and registration aspects
- To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects
- To aware about current trends in IPR and Govt. steps in fostering IPR

COURSE OUTCOME

- The students once they complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works
- During their research career, information in patent documents provide useful insight on novelty of their idea from state-of-the art search. This provide further way for developing their idea or innovations
- Pave the way for the students to catch up Intellectual Property(IP) as an career option a. R&D IP Counsel b. Government Jobs – Patent Examiner c. Private Jobs d. Patent agent and Trademark agent e. Entrepreneur

Unit I

Biosafety levels

Introduction; Historical Background; Introduction to Bioethics, Ethical dilemma and Ethical decision making, Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals;

Unit II

Biosafety Guidelines

Government of India; Definition of GMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Assessment.

Unit III

Introduction to Intellectual Property

Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Farmers rights, Breeders rights, Traditional Knowledge,

International framework for the protection of Intellectual Property (IP), IPs of relevance to Biotechnology Research & Development.

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Unit IV

Agreements and Treaties

History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; Patent Cooperation Treaty (PCT); Indian Patent Act 1970 & recent amendments, CBD Convention on Biodiversity (NBA, SBB, BMC, ABS)

Unit V

Basics of Patents and Concept of Prior Art

Introduction to Patents; Types of patent applications: Specifications: Provisional and complete; Forms and fees, Invention in context of “prior art”; Patent databases; Searching International Databases, Licensing and Transfer of technology, Patent infringement and litigation.

PRACTICALS

1. List of patents
2. The Geographical Indications
3. Procedure for obtaining Patents
4. Searching Patent databases
5. Levels of Biosafety in virology laboratories
6. Biosafety guidelines in virology laboratories
7. Biosafety committees by Govt of India

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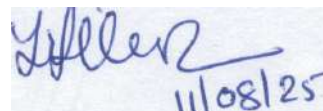
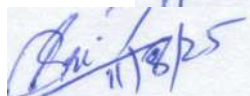
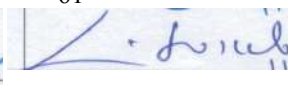
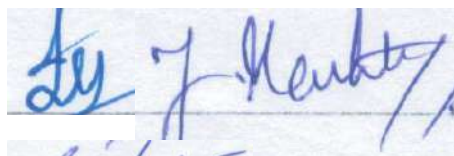
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2. Sasson A. Biotechnologies in developing countries present and future, UNESCO publishers, 1993.
3. Singh K. Intellectual Property Rights on Biotechnology, BCI, New Delhi.

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1. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd, 2007.
2. Mayall, “Industrial Design”, McGraw Hill, 1992.
3. Niebel, “Product Design”, McGraw Hill, 1974.
4. Asimov, “Introduction to Design”, Prentice Hall, 1962.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
6. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008
7. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
8. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007

USEFUL WEBSITES:

1. Cell for IPR Promotion and Management (<http://cipam.gov.in/>)



2. World Intellectual Property Organization (<https://www.wipo.int/about-ip/en/>)
3. Office of the Controller General of Patents, Designs & Trademarks (<http://www.ipindia.nic.in/>)

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, III SEMESTER

Course Name	THERMODYNAMICS & BIOENERGETICS	L	T	P	C	IM	EM	TM
Course Code	25BITDSE306	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Learning Objectives:**

1. Explains the sources of energy supply of the processes running in the living organisms and molecular mechanisms of the energy transformation in the cells;
2. Describes the thermodynamics of the biological (living) systems: exergonic and endergonic reactions, Gibbs (free) energy, spontaneous and non-spontaneous reactions, free energy changes of coupled reactions;
3. Describes the molecular principles of composition and structure of biological membranes. Will acquire detailed knowledge about the transport of the substances across membranes and the crucial role of biological membranes for the energy storage;
4. Describes the different electron transport chains, to deepen knowledge on mitochondrial respiratory chain, its components and complexes; inhibitors of electron transport systems and the mechanisms of action of uncouplers of oxidative phosphorylation;

Course Learning Outcomes:

ability to explain molecular mechanisms of energy accumulation in cells and on energy transformation in living organisms.

- knowledge about general principles of regulation and control of the energy conversion processes in living organisms.
- knowledge about the main problems of bioenergetics and special techniques for studies of bioenergetics;
- skills to analyze, compare, and critically evaluate the bioenergetics-related information;
- ability to apply theoretical knowledge in solving quantitative and qualitative problems of both familiar and unfamiliar nature.

❖ **Course Content**

UNIT – I: Bioenergetics

Bioenergetics-basic principles; enthalpy, entropy, spontaneous and non-spontaneous thermodynamic reactions, equilibrium constant and concept of free energy, standard reduction potential and its calculations, relation of Gibbs free energy and standard reduction potential, Nernst equation, principles of metabolic regulation, thermodynamic consideration of committed

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steps in metabolic reactions. High-energy compounds.

UNIT – II: Energy transducing membrane

Energy transducing membrane, Oxidation and reduction reaction, Ubiquinone, Iron-sulphur center, co-enzyme and proteins as universal electron carrier, electron transport system in mitochondria, structure of different electron carrier, chemiosmotic theory of Peter Mitchell, oxidative phosphorylation, Proton Motive force, P/O ratio, uncouplers, thermodynamics of electron transport system in mitochondria.

UNIT – III: Thermodynamics of protein folding

Thermodynamics of protein folding, Biogenetics of amyloidogenesis, Stability of extreme proteins (thermophile and cryophile), stability of intrinsically disordered proteins, thermodynamic based regulation of metabolic pathways, bacterial photosynthesis, thermodynamic consideration of light harvesting complex in plants and ATP synthesis in thylakoid membrane.

UNIT – IV: Thermodynamics of bonding

Thermodynamics of bonding, types of bonding, hydrogen bonding, van der Waals interaction, electrostatic interaction and hydrophobic interaction, role of non-covalent interaction in the stability of biomolecules, thermodynamics of antigen-antibody interaction, thermodynamics of receptor-ligand interaction.

UNIT – V: Thermodynamic parameters

Methods used to calculate thermodynamic parameters, Principle and application of Differential Scanning Calorimetry (DSC), Isothermal Titration Calorimetry (ITC) and Surface Plasmon Resonance (SPR), Spectroscopic methods used for calculating of enthalpy, entropy and Gibbs free energy.

Text books:

1. Voet D., Voet J.G, Biochemistry 4th Edition., John Wiley and Sons, 2011.
2. Nelson, D. C. and Cox, M.M., Lehninger Principles of Biochemistry, 5th Edition, W. H. Freeman, 2010.
3. Berg J.M., Tymoczko J.L. and Stryer L., Biochemistry. 7th edition, W.H. Freeman and Co. • New York, 2011.

Dr. J. K. Kaur

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KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, III SEMESTER

Course Name	GENETIC ENGINEERING AND BIOPROCESS ENGINEERING LAB	L	T	P	C	IM	EM	TM
Course Code	25BITLAB301	0	0	6	3	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

➤ **List of experiments**

➤ **Genetic Engineering Experiments**

1. Isolation of DNA from Bacteria
2. DNA amplification by PCR
3. Restriction digestion of genomic or lambda DNA
4. Ligation
5. Preparation of competent cells, transformation of E.coli and screening of transformants

➤ **Bioprocess engineering experiments**

1. Production of protease/amylase by batch fermentation.
2. Immobilization of an enzyme (invertase/lipase/amylase) by gel entrapment.
3. Immobilization of whole cells for enzyme/antibiotic production by gel entrapment.
4. Screening of soil samples for isolation of bacteria, and fungi.
5. Selective isolation of actinomycetes from soil samples.
6. Microbiological assay of an antibiotic including the construction of standard curve.

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7. UV survival curve.
8. Production of alcohol by *S.cerevisiae* and its estimation.
9. Production of streptomycin by fermentation.
10. Production of citric acid by *A.niger*.
11. Production of red wine from grapes.
12. Production of Glutamic acid by *M. glutamicus*.

References

1. M.R.Green and J. Sambrook (2012) Molecular cloning, A Laboratory Manual Vol. III. Fourth edition, Cold Spring Harbor Laboratory Press.
2. Abbas et al. Cellular and Molecular Immunology. Elsevier. 9th ed. 2018.
3. Fred M. Ausubel et al. editors Current Protocols in Molecular Biology. John Wiley and Sons, Inc, 2017.
4. M.R.Green and J. Sambrook. Molecular cloning, A Laboratory Manual Vol. III. 4th Edition, Cold Spring Harbor Laboratory Press, 2012.
5. Fred M. Ausubel. Current Protocols in Molecular Biology. John Wiley and Sons, Inc, 2017.

KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, III SEMESTER

Course Name	IMMUNOLOGY AND CELL AND TISSUE CULTURE LAB	L	T	P	C	IM	EM	TM
Course Code	25BITLAB302	0	0	6	3	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

➤ List of experiments

➤ Immunology

1. Preparation of plasma and serum, Blood cell analysis – total count, differential count.
2. ELISA
3. FACS
4. Blotting techniques (Southern Blotting, Northern Blotting, Western Blotting)
5. Immune diffusion methods (Radial immunodiffusion, single immunodiffusion double
6. immunodiffusion), Rocket electrophoresis, Immuno electrophoresis

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Cell and tissue culture experiments

1. General out lay of plant tissue culture laboratory.
2. Preparation of media.
3. Callus induction – carrot.
4. Clonal propagation through meristem cultures.
5. Embryo culture – groundnut.
6. Anther culture – Datura/tobacco.
7. Establishment of cell cultures and determination of growth pattern.
8. Determination of plating efficiency of cell cultures.
9. Protoplast isolation and culture.
10. Protoplast fusion.
11. Observation of different developmental stages of somatic embryo in embryogenic callus.
12. Preparation of artificial seeds
13. Preparation of animal cell culture media and membrane filtration.
14. Preparation of single cell suspension from spleen and thymus.
15. MTT assay for cell viability.
16. Demonstration of sections of human ovary, testis and aborted human embryos.
17. Estimation of dissolved oxygen and salinity in water samples.
18. Estimation of Chemical Oxygen Demand (COD).
19. Estimation of Biochemical Oxygen Demand (BOD).
20. Determination of suspended solids in industrial effluents.
21. Removal of color of the industrial effluents by biological methods.
22. Reduction of pollution load in effluents by biological methods (laboratory models).

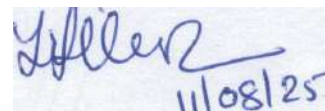
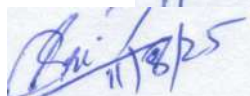
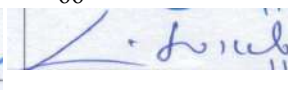
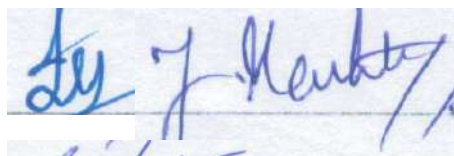
KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, III SEMESTER

Course Name	Biotech Entrepreneurship	L	T	P	C	IM	EM	TM
Course Code	25BITOE301	0	0	6	3	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

COURSE OBJECTIVES

1. To make student good communicator and negotiator for being good entrepreneur
2. To impart basic knowledge how biotechnology can boost up entrepreneurship development
3. To use research and development for developing entrepreneurial enterprise



4. To tell students different avenues of entrepreneurship in biotechnology discipline
5. To increase confidence levels so that the students will be good entrepreneur

COURSE OUTCOMES

On successful completion of the course students will be able to:

1. Become good communicator with proficient skills
2. Have full knowledge of entrepreneurship development through biotechnology
3. Start new business
4. Helpful in employment generation
5. Become real stake holder of national GDP

UNIT-I (8 Hours)

Basics of Entrepreneurship, Entrepreneurial traits, Need to commercialize biotechnology for entrepreneurship. Development process, success rates and costs etc., Creating and marketing the image of the biotechnology company.

UNIT-II (8 Hours)

Entrepreneurial Motivation, Role of venture capitalism, business plan, selection of CEO and personnel, real estate for a biotech start-up., Government assistance for developing new start- ups, Role of a biotechnology manager, technology decision-making and resource decision-making etc., Product marketing decision.

UNIT-III (8 Hours)

Role of research & development, university-industry technology transfer arrangements, benefits of a biotech company. Research extension and successful developed organization

UNIT-IV (8 Hours)

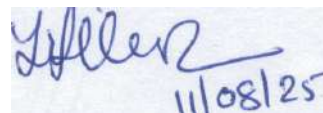
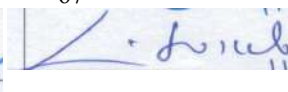
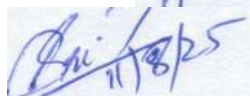
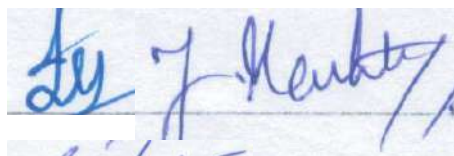
Positioning, power and importance of a company name, product, workable marketing and the strength of distribution. Effective advertising and marketing, marketing research and consumer behaviour, Case studies of successful launching of bioproduct

UNIT-V (8 Hours)

Opportunities international marketing and lessons to be learned, Indian and foreign prospective of biotechnology and current challenges for the biotechnology-based products. Case studies of international marketing of life science based products

TEXT /REFERENCE BOOKS:

1. Positioning by All Rise and Jack Trout (1986), Warner Books.
2. Biotechnology: The science & the business by V. Moser & R.E. Cape (1999) Harwood.
3. Entrepreneurship Development.2014.S.S.Khanka.S Chand & Co.
4. <http://www.startupindia.gov.in>
5. Latest review articles and papers on the subject.



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DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, III SEMESTER

Course Name	FOOD PROCESSING AND PRESERVATION	L	T	P	C	IM	EM	TM
Course Code	25BITLOE302	0	0	6	3	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

Objectives: To enable students

1. To enable students to learn different methods of processing of plant and animal derived foods.
2. To understand the principles of food preservation and acquire skills in methods of food preservation

UNIT I

Principles of food processing and preservation- Preservation by Low and high temperatures, Canning, osmotic pressure, dehydration & drying, Irradiation. & use of Preservatives, Food additives, Definition, types, importance and industrial uses of Food additives.

UNIT II

Methods of Plant food processing- different methods of processing of cereals, legumes, nuts and oilseeds.

UNIT III

Methods of Processing of milk & milk products

UNIT IV

Methods of Fruits and Vegetables processing.

UNIT V

Methods of Processing of Animal Foods.

Food fortification and enrichment -current trends & applications. fermented food products.

BOOKS AND JOURNALS

1. Sri Lakshmi B (2004) Food Science. New Age Int.
2. Pecham GG, Foundation of food preparation.1972. Mac millan Pbs.
3. Subbulakshmi G and Udipi A. 2004. Food Processing and Preservation techniques. New Age Int. 55
4. Swaminathan M (1992) Handbook of Food Science and Experimental foods. 2nd Ed. Bangalore.
5. Potter NH and Hotchkiss JH (1996) Food Science. 5th ed.. New Delhi, CBS pbs.
6. Sethi M and Rao SE (2001) Food science experiments and application. CBS pbs. New Delhi.
7. Journal of Food chemistry
8. Indian food Industry Journals- AFST Pbs
9. J of Food Sc. And Technology- AFST Pbs

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DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, III SEMESTER

Course Name	HEALTH & FITNESS	L	T	P	C	IM	EM	TM
Course Code	25BITLOE303	0	0	6	3	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

UNIT I

Health – Definition, meaning of health and factors affecting health. Health hazards – environment, population explosion, explosives, adulteration, dampness and measures to prevent health hazard.

UNIT II

Food for health promotion:-Definition of food, Nutrition, Nutrients and Nutritional status. Functions of food – Physiological, psychological and socio - cultural functions, constituents of food and their functions.

UNIT III

Health improvement Balanced diet – Definition & objectives, food selection. Health education – Definition, importance of health education, personal hygiene. Physical education – Meaning & scope, role of gymnastic exercises and yoga in improving health. Difference between yoga & other gymnastic exercises.

UNIT IV

Sports nutrition –Introduction to kinanthropometry, Requirements during training and performance for athletes and endurance games, aerobic and anaerobic exercise, fuel for exercise, glycogen load. Exercise to maintain fitness. Health club equipments & activities – Tread mill, hammer strength, steppers, cycles, body sculpting, kick boxing, Reebok ridge rocker, hanging, hand grips, swing, climbing and lifting weight.

UNIT V

Health insurance scheme (government & non government) – Mediclaim policy,

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Employee state insurance scheme, ICICI health scheme, Specialised insurance scheme and others.

Reference Books and websites:

- 1.Sizer F, Eleanor Whitney - Nutrition concepts and controversies, Eighth Edition (2000).
2. Narayan dash B – Health & physical education, 1st edition, 2003, Neelkamal publications, Hyderabad.
3. Krause"s– Food ,Nutrition and Diet therapy 6th Edition WB Saunders company, London.
6. <http://adfdell.pstc.brown.edu/classes/readings>

25BIT401- BIOSTATISTICS & BIOINFORMATICS
KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY

Course Name	BIOSTATISTICS & BIOINFORMATION S	L	T	P	C	IM	EM	Total
Course Code	25BIT401	0	0	3	3	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM Total Marks

Course Learning Objective(s):

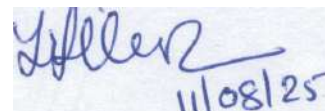
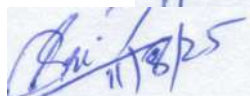
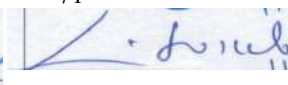
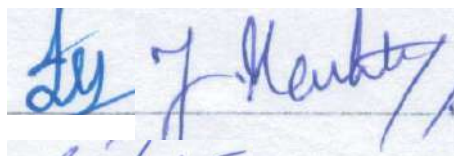
1. To help students understand the use statistics in sorting the data
2. To give the students a thorough understanding of the sources and organization of data.
3. To make them understand the usage of tools and resources that aid in the analysis of data.
4. To introduce them to mapping, alignment and searching methods in bioinformatics.
5. To show them the different fields that bioinformatics is used in.

Course Learning Outcome(s):

1. Students get a thorough understanding of Biostatistics and apply them in their research work
2. Getting precision on the available resources in bioinformatics and on how to use different tools, search and analysis methods in bioinformatics

UNIT – I Biostatistics

Meaning of data and their representation in biostatistics.Measures of central tendency Measures of dispersion.Normal distribution curve, characteristics and uses Standard errors. Hypothesis testing (null



& alternative hypothesis). Correlation and Regression. Probability types of events & rules. T-test, chi-square test and ANOVA. AI-in Biostatistics.

UNIT – II Bioinformatics – tools & databases

Introduction to Bioinformatics. Online & offline tools. Biological databases types (bibliographic databases- PubMed, Nucleic acid sequence databank – NCBI and EMBL, Protein sequence databank- NBRF- PIR, SWISSPROT, Structural databases - protein data Bank (PDB). Metabolic pathway : data bank (Pub gene), Microbial genomic database (MBGD), Cell line database (ATCC), Virus data bank (UICTVdb). AI empowered retrieval of genomic and proteomic data.

UNIT – III Alignment, Mapping & Searching

Sequence alignment - Global and Local alignment, scoring matrices. Restriction mapping - NEB CUTTER, Similarity searching (FASTA and BLAST), Pair wise comparison of sequences. Multiple Sequence alignment of sequences. AI based sequence analysis.

UNIT – IV Identification & Analysis

Identification of genes in genomes. Identification of ORFs and motifs. 61 Regulatory sequence analysis. Genome maps, markers and variation. Artificial Intelligence for Genome Analysis.

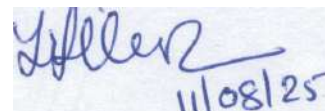
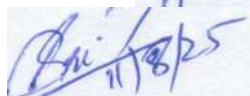
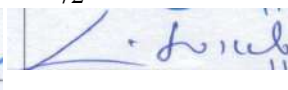
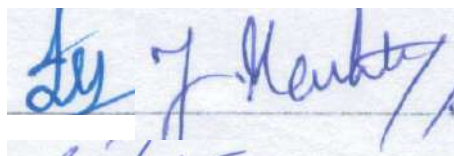
UNIT – V Applications

Medical Applications of Bioinformatics. Bioinformatics for Homology modeling Bioinformatics for microarray designing transcriptional profiling. Metabolic reconstruction. Phylogenetic analysis (Mega). Artificial Intelligence in Precision Medicine

Text Books

1. Bioinformatics basics: Applications in biological science & medicine by Hooman Rashidi, Lukas K. Buehler
2. Introduction to bioinformatics by : Stephen A. Krawetz, David D. Womble
3. Bioinformatics-D. Mount.
4. Programming in C by Balaguru Swamy.
5. Introduction to Bioinformatics by Arthur M. Lesk, Oxford.
6. Biostatistics-Daniel. (Wiley).
7. Statistics by S.C Gupta.
8. Statistical methods by G.W. Sneedecor & W.G. Cochran.
9. Fundamentals of Biostatistics-Khan & Khanum.
10. Let us C-Kanetkar
11. Fundamentals of Biostatistics by U.B. Rastogi (Ame Books Ltd).

Reference books: E- content / E-books (optional)



KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, IV SEMESTER

25BITDSE401- MOLECULAR VIROLOGY

Unit I

History and principles of virology, virus taxonomy, Virus structure and morphology. infrastructure Principles of bio-safety, contaminant facilities, maintenance and handling of laboratory animals and requirements of virological laboratory

Unit II

Structure of animal viruses and plant viruses; Classification of animal and plant viruses; Satellite viruses, Viroids; Virusoids Prions, etc.; Diseases caused by animal viruses and plant viruses; Economic loss due to important viruses

Unit III

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Genome organization of DNA and RNA plant viruses; Introduction to replication strategies Replication of DNA and RNA animal and plant viruses.

Unit IV

Methods to diagnose animal virus infections: Tissue culture growth of viruses, Virus quantitation assays, Viral serology: ELISA, neutralization assays; Molecular methods: hybridization, PCR, RT PCR, Real time PCR, sequencing, microarray, antiviral assays

Unit V

Methods to study plant viruses; Infectivity assays – Sap transmission, insect vector transmission, agroinfection (using Agrobacterium); Ultracentrifugation, Microscopy: Fluorescence, Electron and confocal microscopy,

PRACTICALS

1. Sample Collection & Processing a. Stool b. Throat & Nasal Swabs c. Urine
2. Preparation, Maintenance of Cell Cultures & Viral Inoculation
3. Freezing & Revival of Cell Lines
4. Estimation of TCID₅₀
5. Routes of Inoculations in Embryonated Eggs
6. Identification of PCR Amplified Products of Viral Antigens
7. SDS PAGE
8. PCR & RT-PCR

TEXT BOOKS:

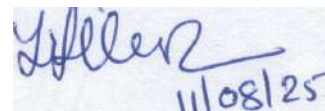
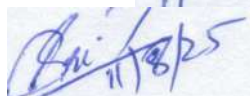
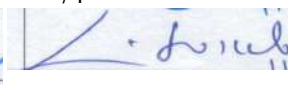
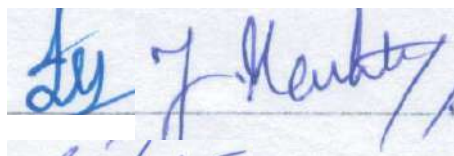
Recommended Books:

1. Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses. S. J. Flint, V. R. Racaniello, L. W. Enquist, V. R. Rancaniello, A. M. Skalka Latest edition / Pub. Date: December 2003 Publisher: American Society Microbiology.
2. DNA Virus Replication. Alan J. Cann. Latest edition / Pub. Date: March 2000. Publisher: Oxford University Press.
3. Principles of Molecular Virology. Alan Cann J. Cann. Latest edition / Pub. Date: June 2005. Publisher: Elsevier Science & Technology Books.
4. Fields virology, 4thEd, Vol 2 Ed by David M Knipe, and Peter M Howley Chapters: 24, 28, 34,54,55,67 and 68.

Course Objectives

1. To enable the students to have the understanding on the basics of the learning of Virology.
2. To impart the knowledge regarding the diagnostics clinical aspects and related implications of human viral disease and newer emerging viral infections including the viral mutant forms for emerging infections.
3. The identification is very essential for all the three line managements – primary, secondary and tertiary managements and hence the systematic training course for the graduates at the university level is found to be very essential and urgent need

Course Outcomes



By the end of this course, students should be able to:

1. Describe virus taxonomy, virus structure and virus entry, trafficking
2. Describe the basics of the viral gene expression, including viral replication, transcription, post transcriptional regulation, translation and post translational regulation of virus genes.
3. Apply techniques used in modern virology and design experiments to test novel hypotheses in virology.

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KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, IV SEMESTER

Course Name	CANCER BIOLOGY	L	T	P	C	IM	EM	TM
Course Code	25BITDSE402	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description and Purpose:**

❖ **Course Learning Objectives:**

- To learn the principles of cancer biology and identify the main cellular and molecular mechanisms underlying the initiation and progression of neoplastic growth.
- The main focus of this course is on the comparative overview of proliferation control and signal transduction in malignant cells and normal cells.
- We will explore the molecular pathways responsible for genome instability in cancer cells and the multi-step process of tumor progression leading to invasive metastatic growth.
- The course will also examine the role of stem cells and their potential for differentiation in different types of malignancies.
- Class discussions will include recent advances in molecular diagnostics and therapy of cancer and the modern methods in cancer research using molecular probes, genomics and high resolution cell imaging.

❖ **Course Learning Outcomes:**

- Upon successful completion of this course students should be able to:
- Identify the main cellular mechanisms leading to initiation and progression of cancer growth. Describe the characteristics of cancer cells that explain high mortality rate.
- Define the role of oncogenes and mutations in cancer and explain why several types of cancer have heritable traits and family history.
- Discuss the cellular signaling pathways that are deregulated in tumor cells compared to normal cells.
- Define the main factors contributing to metastatic growth. Identify the role of stem-like cells, their properties and contribution to tumor progression. List and describe the main factors controlling the evolution of cancer cell populations.
- Develop a solid understanding of the main methods used in the modern studies of cellular and molecular mechanisms of cancer.
- Demonstrate core knowledge of the cellular targets and molecular mechanisms of traditional and novel cancer therapies.

❖ Course Content

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Unit 1: Fundamentals of Cancer Biology

Historical perspectives and definitions of cancer, Characteristics of cancer cells, Types and classification of cancers, Cancer epidemiology and risk factors (genetic, epigenetic, environmental, viral, lifestyle)

Unit 2: Molecular Basis of Cancer

Cell cycle regulation and checkpoints, Oncogenes: activation, examples (Ras, Myc, HER2, BCR-ABL), Tumor suppressor genes: p53, Rb, BRCA1/2, Apoptosis and evasion mechanisms, Epigenetic changes in cancer (DNA methylation, histone modifications, miRNA regulation)

Unit 3: Cellular & Genetic Mechanisms

DNA damage and repair defects in cancer, Signal transduction pathways in tumorigenesis (MAPK, PI3K/AKT, Wnt, Hedgehog, Notch), Genomic instability and chromosomal aberrations, Telomeres and telomerase in cancer, Tumor microenvironment: stromal cells, extracellular matrix, angiogenesis

Unit 4: Metastasis & Tumor Progression

Invasion and metastasis mechanisms, EMT (epithelial to mesenchymal transition), Role of adhesion molecules and proteases, Circulating tumor cells (CTCs), Organ-specific metastasis

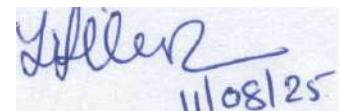
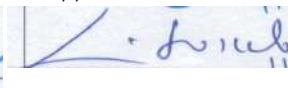
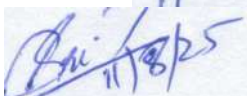
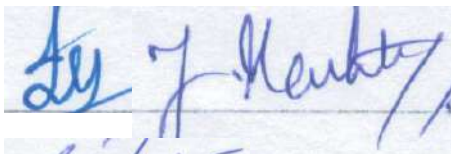
Unit 5: Cancer Detection, Diagnostics & Therapeutic strategies

Biomarkers of cancer (genetic, proteomic, metabolomic), Liquid biopsy and circulating tumor DNA (ctDNA), Molecular imaging techniques (PET, MRI, fluorescence imaging), Next-Generation Sequencing (NGS) in cancer diagnostics, Personalized medicine and companion diagnostics

Conventional therapies: surgery, radiation, chemotherapy; Targeted therapy (tyrosine kinase inhibitors, monoclonal antibodies); Epigenetic therapies; Nanotechnology in cancer therapy (nanoparticles, liposomes, drug delivery systems); Gene therapy approaches (CRISPR, siRNA, antisense oligos)

Text books:

1. The Biology of Cancer, 2nd Edition, Robert A Weingberg, ISBN-10: 0815342209, ISBN-13: 978-0815342205
2. Cancer Biology, 4th Edition, Raymond W Ruddon, ISBN-10: 0195175441 | ISBN13: 978-0195175448



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KRISHNA UNIVERSITY:: MACHILIPATNAM
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, IV SEMESTER

Course Name	MOLECULAR THERAPEUTICS	L	T	P	C	IM	EM	TM
Course Code	25BITDSE403	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description and Purpose:**

❖ **Course Learning Objectives:**

- After finishing this module the students will be able to get an idea about what is a stem cell, various adult stem cells in the human body.
- Student will get clarity on what are embryonic stem cells (ESCs), Induced pluripotent stem cells (iPSCs), regulatory and ethical issues associated with the use of these cells for research in India
- Student will also get a clarity on the SC therapies for various diseases

❖ **Course Content**

UNIT – I: Gene therapy

Gene therapy - concept, vectors, gene targeting and tissue-specific expression, Ethics and human genetics, Introduction to pharmacogenomics and toxicogenomics.

UNIT – II: Antibodies and antibody based therapy

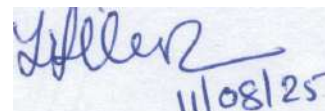
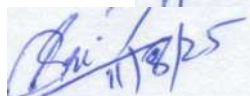
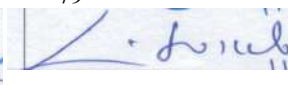
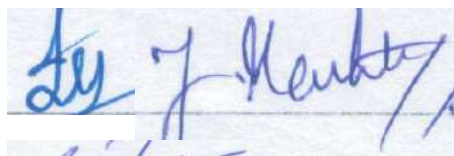
Antibodies and antibody based therapy - Characteristics of animal cells and their implication on process design, Nutritional requirements and serum free culture of mammalian cells, Kinetics of growth and product formation. Reactor systems for large -scale production using animal cells.

UNIT – III: Polyclonal antibody

Production of Polyclonal antibodies with different types of antigens : antigen preparation and modification, adjuvant, dose and route of antigen administration, collection of sera, purification of antibodies, Inhibitors of tumor necrosis factor, targeting the IL2 receptor with antibodies or chimeric toxins, monoclonal antibodies to CD3.

UNIT – IV: Hybridoma technology

Hybridoma technology – production and applications of monoclonal antibodies for diagnosis and therapy. Immunotherapy for allergic diseases - Specific and nonspecific immunotherapy for Asthma and allergic diseases, insect stings etc. Vaccine & peptide therapy in Transplantation - Renal, pancreas, cardiac, lung, liver transplantation, xenotransplantation. Cellular & Drug therapy in HIV -



Tumor Immunology, AIDS and other Immunodeficiencies.

UNIT – V: Stem cells and Gene Therapy

Stem cells and Gene Therapy: Signaling pathway involved in self-renewal and differentiation of stem cells. Identifying and isolating stem cells. Cancer stem cells: Historical perspective, isolation and characterization of cancer stem cells. Solid cancer stem cells (Breast, Lung, prostate, liver, stomach, Glioma). Targeting cancer stem cells. Hematological malignancies and stem cells. Side population cells in flow cytometry, Induced pluripotent stem cells, its derivation and applications. Regulatory and ethical issues of stem cell research in India. Stem cell therapy for various diseases (neurodegenerative, retinal, leukemia, heart).

Text books:

1. Robert Lanza, “Essentials of Stem cell Biology”, Elsevier, 2006
2. Daniel R. Marshak, Richard L. Gardner and David Gottlieb, “Stem cell Biology”, Cold spring Harbour Laboratory Press, 2001

Dr. J. K. Kaur

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DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, IV SEMESTER

Course Name	NUTRITIONAL DISORDERS	L	T	P	C	IM	EM	TM
Course Code	25BITDSE404	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description and Purpose:**

❖ **Course Learning Objectives:**

❖ **Course Content**

UNIT – I: Dietary Management

Obesity and Underweight, Dietary management in Obesity a) Etiology, Classification and Energy balance b) Physiology of the obese state & Clinical manifestations c) Risk factors, Complications and Lifestyle modifications d) Nutraceuticals and Dietary management Dietary management in Underweight a) Etiology and dietary management Dietary management in Eating disorders a) Definition, Signs and symptoms and Complications/health risks, Diagnostic criteria and nutrition management in Anorexia Nervosa and Bulimia Nervosa.

UNIT – II: Diet in Gastrointestinal diseases:

Diet in Gastrointestinal diseases: Planning and preparation of diets for the following conditions- Gastro Intestinal Disorders Peptic Ulcer, Constipation, Diarrhoea, Lactose intolerance, Celiac Disease, IBS and IBD: menu planning, preparation, standardization, sensory analysis, nutrient calculation and cost calculation.

UNIT – III: Diabetes Mellitus

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a) Prevalence, Types, Aetiology and Signs and Symptoms b) Factors affecting normal blood glucose levels c) Impaired glucose homeostasis d) Diagnostic test for diabetes e) Complications of diabetes - macro-vascular and micro-vascular

UNIT – IV: Dietary management of Diabetes mellitus

Management of Diabetes a) Food exchange list, b) Glycaemic index of foods, Carbohydrate counting and Resistant starch c) Sweeteners and sugar substitutes d) Meal planning approaches - With and without Insulin and during sickness. e) Medications - Oral hypoglycaemic drugs and Insulin. f) Lifestyle modification and exercise to manage diabetes mellitus

UNIT – V: Diet in Cardiovascular Diseases

Diet in Cardiovascular Diseases: Diet in Cardiovascular Diseases a) Prevalence, Clinical effects b) Risk factors, Role of fat in the development of atherosclerosis c) Dietary management d) Hypertension e) Physical activity and Heart diseases f) Fat substitute . Hypertension – etiology, symptoms, medical nutrition therapy

Text books:

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Course Name	NUTRITIONAL DISORDERS	L	T	P	C	IM	EM	TM
Course Code	22BITDSE405	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

Course Outcomes:

CO1.Gain knowledge on environmental pollution sources, adverse effects and biotechnological control.

CO2.Obtain knowledge on renewable sources of energy and bioleaching of ores.

CO3.Attain insight in to biotechnological remedies for environmental problems.

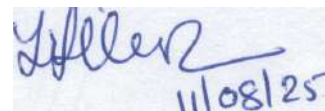
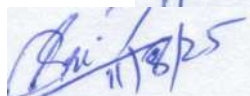
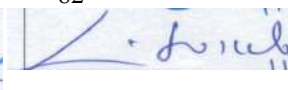
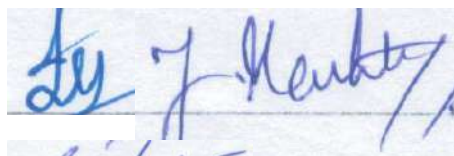
Course Specific Outcomes:

CSO1. Have a thorough knowledge of global environmental problems and alternate strategies in producing biofuels.

CSO2.Awareness regarding the impact of environmental pollutants on human health.

UNIT - I

Air pollution- natural and anthropogenic sources of pollution, primary and secondary pollutants, transport and diffusion of pollutants, gas laws governing the behaviour of pollutants in the atmosphere, Methods of monitoring and control of air pollution, SO₂, NO_x, CO, SPM.



Water pollution - types sources and consequences of water pollution, physico-chemical and bacteriological sampling, Analysis of water quality, standards, sewage and wastewater treatment and recycling, water quality and standards.

Soil pollution chemical and bacteriological sampling as analysis of soil quality, soil pollution control, industrial waste effluents and heavy metals and their interactions with soil components.

Noise pollution - sources of noise pollution, measurement and indices. Marine pollution, sources of marine pollution and its control. Effects of pollutants on human beings, plants, animals and climate. Air quality standards and air pollution.

Solid Waste Management Plan, Waste minimization technologies, Hazardous Waste Management, Sources & Classification, physicochemical properties, Hazardous Waste Control & Treatment. Hospital Waste Management, Hazardous Waste Management & Handling rules, 1989 & 2000 (amendments)

1. Biotechnology by B.D.Singh (Kalyani).
2. Ecology and Environment by PD Sharma.
3. Fundamentals of Ecology, by Odum, EP (McGraw Hill)
4. Environmental Biotechnology by Forster, C.F. and Wase D.A.J. (Ellis Horwood).
5. Biotechnological innovations in environmental management by Leach, CK and Van Dam Mieras, MCE (Butterworth Heinemann, Oxford (Biotol Series).
6. Molecular Biology and Biotechnology by Meyers, RA, A comprehensive Desk reference (VCH Publishers).
7. Biotechnology by U. Satyanarayana (Books & Allied (P) Ltd).
8. The Environment and Human Health. M Mccally (MIT Press)

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M.Sc. – BIOTECHNOLOGY, IV SEMESTER

Course Name	NUTRITIONAL DISORDERS	L	T	P	C	IM	EM	TM
Course Code	25BITDSE406	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

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Course Objectives:

- CO 1. To impart knowledge on basic concepts of development
- CO 2. To learn about gametogenesis, fertilization & early development
- CO 3. To have knowledge on morphogenesis and organogenesis
- CO 4. To know about the advanced technologies
- CO 5. To gain knowledge on assisted reproduction technologies & contraceptive measures

Course Outcomes:

- LO 1: Will master the foundational knowledge that defines the field of developmental biology
- LO 2: Will gain the knowledge of main anatomical changes that occur during development
- LO3: Will acquire knowledge on advanced technologies in reproductive biology

UNIT – I

- 1.1 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.
- 1.2 Heterogamy in eukaryotes.
- 1.3 Comparative account of differentiation of gonads in a mammal and an invertebrate (Snail).

UNIT - II

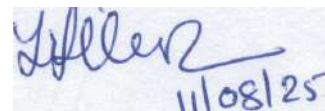
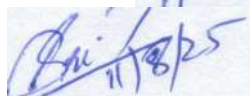
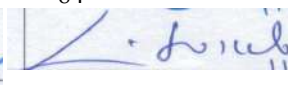
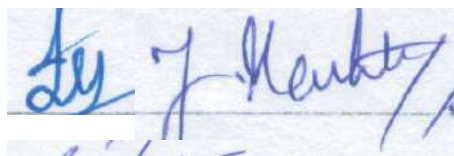
- 2.1 Production of gametes – Spermatogenesis, Spermiogenesis (Sperm structure, Semen composition and formation; assessment of sperm functions), Oogenesis and Vitellogenesis (Ovarian follicular growth and differentiation) cell surface molecules in sperm - egg recognition in mammals (Rodents), Acrosomal reaction, zygote formation.
- 2.2 Fertilization - Pre-fertilization, Biochemistry of fertilization, Post-fertilization
- 2.3 Cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals, embryogenesis.

UNIT – III

- 3.1 Cell aggregation and differentiation in Dictyostelium, Axes and pattern formation in Drosophila, amphibia and chick.
- 3.2 Organogenesis – vulva formation in Caenorhabditis elegans, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons,
- 3.3 Post embryonic development - larval formation, metamorphosis; environmental regulation of normal development; sex determination.

UNIT – IV

- 4.1 Collection and cryopreservation of gametes and embryos.
- 4.2 Multiple ovulation and embryo transfer technology (MOET) (Super ovulation, In vitro oocyte maturation, In vitro fertilization, embryo transfer).
- 4.3 Transgenic animals and knockouts: Production & Applications.
- 4.4 Embryonic stem cells.



UNIT – V

- 5.1 Assisted reproduction technologies –Ovulation induction- In vitro fertilization- Pre-implantation genetic diagnosis- Mitochondrial replacement therapy- gamete intrafallopian transfer- Reproductive surgery, treating cryopreservation.
- 5.2 Embryo sexing and cloning, Screening for genetic disorders, ICSI, Cloning of animals by nuclear transfer
- 5.3 Teratological effects of Xenobiotics.
- 5.4 contraception: Barrier methods- hormonal birth control- intrauterine devices (IUDs) - Surgical sterilization - behavioral methods - Immunocontraception.

Suggested Books

1. Gilbert, S.F. Developmental Biology. 10th Edition, Sinauer Associated Inc., Massachusetts
2. Balinsky, B.I. Introduction to Embryology. Saunders, Philadelphia
3. Berril, N.J. and Karp, G. Development Biology. McGraw Hill, New York
4. Hamburger V & Hamilton HL. Handbook of chick developmental stages. Saunders Publications. 1965.
5. Berril, N.J. and Karp, G. Development Biology. McGraw Hill, New York
6. Stanley Shostak, Embryology - An Introduction to Developmental Biology
7. Muthukaruppan and Pitchappan. Animal development – A laboratory guide. Co-SIP – ULP Publications, India. First Edition, 1979.
8. Austen, C.R. and Short, R.V. Reproduction in animals
9. Schatten and Schatten. Molecular biology of fertilization
10. F.T. Longo. Fertilization, Chapman & Hall
11. R.G. Edwards. Human Reproduction

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DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, IV SEMESTER

Course Name	Agrofarming	L	T	P	C	IM	EM	TM
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Course Code	25BITSEC401	4	0	0	4	30	70	100
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L-Lecture, **T**-Tutorial, **P**-Practical, **C**-Credits, **IM**-Internal Marks, **EM**-External Marks, **TM**-Total Marks

❖ Course Description and Purpose:

Unit-I

Commercial Dairy Farming- Comparison of dairy farming in India with advanced countries. Dairying under mixed farming and as specialized farming, economic dairy farming. Starting of a dairy farm, Capital and land requirement, organization of the dairy farm. Opportunities in dairy farming, factors determining the efficiency of dairy animal. Herd recording, budgeting, cost of milk production, pricing policy; Personnel Management. Developing Practical and Economic rations for dairy cattle; supply of greens throughout the year, feed and fodder requirements of Dairy Farm. Feeding regimes for young stock and bulls, heifers and breeding animals; new trends in feeding young and adult stock; Feeding records.

Unit-2

Commercial meat, egg and wool production- Development of practical and economic rations for sheep, goats, pigs, rabbits and poultry. Supply of greens, fodder, feeding regimes for young and mature stock. New trends in enhancing production and management. Capital and land requirements and socio- economic concept.

Unit-3

Veterinary Jurisprudence- Rules and Regulations for improvement of animal quality and prevention of animal diseases - State and central rules for prevention of animal and animal product borne diseases- S P C A- Veterolegal cases- Certificates -Materials and Methods of collection of samples for veterolegal investigation. Feeding and management of animals under drought, flood and other natural calamities.

Unit-4

Poultry Products Technology- Chemical composition and nutritive value of poultry meat, pre - slaughter care and management. Slaughtering techniques, inspection, preservation of poultry meat and products. Legal and BIS standards.

Structure, composition and nutritive value of eggs. Microbial spoilage. Preservation and maintenance. Marketing of poultry meat, eggs and products. Value added meat products.

Unit-5

Dr. J. K. Kaur

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Rabbit/Fur Animal farming - Rabbit meat production. Disposal and utilization of fur and wool and recycling of waste by products. Grading of wool.

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M.Sc. – BIOTECHNOLOGY, IV SEMESTER

Course Name	FERMENTED FOODS AND DAIRY TECHNOLOGY	L	T	P	C	IM	EM	TM
Course Code	25BITSEC402	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ **Course Description and Purpose:**

❖ **Course Learning Objectives:**

- Acquaint the students with the importance and classification of health beneficial dairy starters.
- Impart basic knowledge on activity and different preservation techniques of the starter cultures for future use.
- Aware them with the use of dairy starters for the production of different types of milk based fermented foods with improved nutritional and therapeutic value.

❖ **Course Learning Outcomes:**

- Characterize different types of beneficial microorganisms that can be incorporated in the development of fermented dairy foods.
- Implement improvement strategies to develop better starters for dairy industry.
- Prepare different types of fermented milk products possessing nutritional and therapeutic benefits

❖ **Course Content**

Unit-1

Course Introduction, Fermented Food: Past, Present and Future. Microorganisms involved in Food Fermentations. Detection and Identification of Microorganisms in Fermented Foods

Unit-II

Starter Cultures, Biochemical Reactions and Metabolisms of Fermented Foods. Fermentation of Alcoholic Beverages, Meat Products, vegetables, & fruits, cereal based products, vinegar

Unit-III

Indigenous fermented foods in Asia. Bioconversion of agricultural by-products and food processing by-products to value added products. Prebiotics, Probiotics and synbiotics

Unit-IV

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Fermented dairy products Preparation of cultured milks, cultures and their management, yoghurt, Dahi, Lassi and Srikhand. Preparation of flavoured and sterilized milks. Legal standards. Sanitation requirement for clean and safe milk and for the milk plant equipment.

Unit-V

Milk Products marketing Technology.- Selection of raw materials, processing, storing , distributing and marketing milk products such as Cream, Butter, Ghee, Khoa, Channa, Cheese, condensed, evaporated, dried milk and baby food, Ice cream and Kulfi; by-products, whey products, butter milk, lactose and casein. Testing, grading, judging milk products- BIS and Agmark specifications, legal standards, quality control and nutritive properties. Packaging, processing and operational control. Costing of dairy products.

Text books:

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DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc. – BIOTECHNOLOGY, IV SEMESTER

Course Name	Medical Coding	L	T	P	C	IM	EM	TM
Course Code	25BITSEC402	4	0	0	4	30	70	100

L-Lecture, T-Tutorial, P-Practical, C-Credits, IM-Internal Marks, EM-External Marks, TM-Total Marks

❖ Course Description and Purpose:

Unit-1

Introduction to Medical Terminology, Anatomy Structure, Medical Terminology

Unit-2

Medical Ethics, ICD-9-CM Coding Manual

Unit-3

Infections using ICD-9-CM, Digestive System using ICD-9-CM

Unit-4

Coding for Pregnancy using ICD-9-CM, CPT Coding for Reproductive Systems

Unit-5

Coding for Mental Disorders using ICD-9-CM

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