Master of Science
in
Biotechnology

Course Structure and Syllabus

For students admitted from academic year 2022-23 onwards

UNDER CHOICE BASED CREDIT SYSTEM (CBCS) & OUTCOME BASED EDUCATION (OBE)

(Regulations:R22)

Department of Biosciences & Biotechnology

Krishna University

Machilipatnam – 521 004

Andhra Pradesh

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, interdisciplinary 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 Roadmap 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 sstrengthen 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 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	Post Graduate.
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/MOOCS	Internal Marks	External Marks	No. of Credits
		Lecture	Practical	Tutorial				
22BIT101	Cell Biology	4	0	0	Core	30	70	4
22BIT102	Genetics	4	0	0	Core	30	70	4
22BIT103	Biomolecules	4	0	0	Core	30	70	4
22BIT104	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
22BITL101	Cell Biology & Genetics	0	6	0	Core	30	70	3
22BITL102	Biomolecules and Microbiology	0	6	0	Core	30	70	3
TOTAL FOR FIRST SEMESTER						**210**	**490**	**25**

II SEMESTER

Course Code	Course Name	Teaching Hours/ week			CORE / IDC/DSE/ SEC/OEC/MOOCS	Internal Marks	External Marks	No. of Credits
		Lecture	Practical	Tutorial				
22BIT201	Bioanalytical Techniques	4	0	0	Core	30	70	4
22BIT202	Introduction to Enzymes & Hormones	4	0	0	Core	30	70	4
22BIT203	Intermediary Metabolism	4	0	0	Core	30	70	4
22BIT204 COMPULSORY	Research Methodology &IPR	3	1	0	SEC	30	70	3
DOMAIN SPECIFIC ELECTIVE COURSES (CHOOSE ANY ONE)								
22BITDSE201	Molecular Biology	4	0	0	DSE	30	70	4
22BITDSE202	Environmental Biotechnology	4	0	0	DSE	30	70	4
22BITDSE203	Ecology & Evolution	4	0	0	DSE	30	70	4
LAB PRACTICALS								
22BITL201	Bioanalytical Techniques & and Enzymology Lab	0	6	0	Core	30	70	3
22BITL202	Intermediary Metabolism and Molecular Biology Lab	0	6	0	Core	30	70	3
TOTAL FOR SECOND SEMESTER						**210**	**490**	**25**

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.

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				
22BIT301	Genetic Engineering	4	0	0	Core	30	70	4
DOMAIN SPECIFIC ELECTIVE COURSES (CHOOSE ANY THREE)								
22BITDSE301	Bioprocess Engineering	4	0	0	DSE	30	70	4
22BITDSE302	Immunology and Immune Technology	4	0	0	DSE	30	70	4
22BITDSE303	Cell and Tissue culture	4	0	0	DSE	30	70	4
22BITDSE304	Quality Analysis, Control & Assurance	4	0	0	DSE	30	70	4
22BITDSE305	Biosafety, Bioethics & IPR	4	0	0	DSE	30	70	4
22BITDSE306	Thermodynamics & Bioenergetics	4	0	0	DSE	30	70	4
LAB PRACTICALS								
22BITLAB301	Genetic Engineering and Bioprocess Engineering Lab	0	6	0	Core	30	70	3
22BITLAB302	Immunology and Cell and Tissue culture Lab	0	6	0	Core	30	70	3
OPEN ELECTIVE (INTERDISCIPLINARY/MULTIDISCIPLINARY) COURSES (CHOOSE ANY ONE)								
22BITOEC301		3	0	0	OEC	30	70	3
22BITOEC302		3	0	0	OEC	30	70	3
22BITOEC303		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	0	0	Core	30	70	4
DOMAIN SPECIFIC ELECTIVE COURSES (CHOOSE ANY THREE)								
22BITDSE401	Molecular Virology	4	0	0	DSE	30	70	4
22BITDSE402	Cancer Biology	4	0	0	DSE	30	70	4
22BITDSE403	Molecular Therapeutics	4	0	0	DSE	30	70	4
22BITDSE404	Nutritional Disorders	4	0	0	DSE	30	70	4
22BITDSE405	Bioengineering	4	0	0	DSE	30	70	4
22BITDSE406	Developmental Biology	4	0	0	DSE	30	70	4
LAB PRACTICALS								
22BITL401	Biostatistics and Bioinformatics lab	0	6	0	Core	30	70	3
ENTREPRENURAL & INNOVATION/IT SKILL RELATED TO DOMAIN SPECIFIC ELECTIVE COURSES (CHOOSE ANY ONE)								
22BITSEC401	Agrofarming	3	0	0	SEC	30	70	3
22BITSEC402	Fermented Foods and Dairy technology	3	0	0	SEC	30	70	3
22BITSEC403	Fundamentals of 1Medical Coding	3	0	0	SEC	30	70	3
* 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

22BITOEC301	Entrepreneurship in Biotechnology
22BITOEC302	Gender based Health & Education
22BITOEC303	Food & Nutrition

L – Lecture, T- Tutorial & P – Practicals

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 sameon grade cards and PCs and ODs as per the regulations of the University.

22 BOT P401: 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 100 marks, 20 marks for Pre- Project Review, 50 marks shall be for Project report/dissertation/record and 30 marks for the End Semester Examination (Viva-voce). The Viva- Voce 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	CELL BIOLOGY	L	T	P	C	IM	EM	TM
Course Code	22BIT101	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), andcancer 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 workplace oras 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. Chemotaxis and Quorum sensing. Cytoskeleton: microtubules, actin filaments and intermediatefilaments.

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 brushchromosomes. Organization of nucleolus.

UNIT – IV: Cell cycle, apoptosis and cancer

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

Apoptosis- Neurotrophic factors, caspases, Pathways of apoptosis.

Cancer- Types and stages of cancer, characteristics of cancer cell, carcinogenesis, carcinogens, oncogenes, Tumor suppressor genes and protooncogenes, Molecular basis of cancer, cell senescence.

UNIT – V: Cell –Cell Interactions and Signaling

Cell to cell interaction – Microvilli, tight junctions, gap junctions, desmosomes. Cell adhesion andcell signaling (autocrine, paracrine, synaptic and endocrine). Second messengers – Types and mechanism of action.

Text books:

1. Verma P.S and Agarwal V.K. 2006. Cell Biology, Genetics, Molecular Biology, Evolution andEcology. 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 and 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.) TheBenjamin/Cummings Publishing Company, Inc.
6. Albert's 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.) Jonesdand Barlett 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. Freemanand Company, New York.
12. Becker MW, Kleinsmith LJ and Hardin J. 2007. The world of the Cell (6th Ed.) Tata McGrawHill Publications.
13. Raven PH, Johnson GB, Losos JB and Singer SR.2006. Biology (7th Ed.) Tata McGraw HillPublications.
14. Smith & Wood, Cell Biology, 2nd Edition, Chapman & Hall, London, 1996.

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

Course Name	GENETICS	L	T	P	C	IM	EM	TM
Course Code	22BIT102	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 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 packaged.
- 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 – Pseudogenes, 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, triparental 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.

- **Text books:**

1. Cell Biology : DeRobertis and DeRobertis
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.

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

Course Name	BIOMOLECULES	L	T	P	C	IM	EM	TM
Course Code	22BIT 103	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 & 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.

- **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, oligo saccharides, mucopolysaccharides, bacterial cell polysaccharides, starch, cellulose, lectins, glycoproteins.

UNIT – II: Amino acids
Classification, structure and physico-chemical properties of amino acids, stereoisomerism, 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 triacyl glycerol, 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, Tm, kinetics of reassociation, cot values.

- **Text books:**

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. Tymcozko 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. Garret, Charles M. Grisham. 1995. National Academy ofSciences, USA. 2nd Edn.
12. Organic Chemistry, DJ. Cram and GS 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 & PHYSIOLOGY**	**L**	**T**	**P**	**C**	**IM**	**EM**	**TM**
Course Code	**22BIT 104**	**4**	**0**	**0**	**4**	**30**	**70**	**100**

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

❖ **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 ecophysiological 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 metabolicdiversity of microorganisms.
- Demonstrate critical understanding of genetic biochemical and physiological regulation inmicroorganisms.
- Demonstrate thorough knowledge and understanding of the experimental approaches used toinvestigate physiological and genetic control in microorganisms.
- Demonstrate the ability to work individually to solve biological problems.Analyze and evaluate complex experimental data confidently.
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❖ **Course Content**

UNIT-I: Over view of prokaryotic cell: structure & functions Cell wall synthesis, flagella structure and 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 Nutrition, Microbial Growth kinetics, Microbial Photosynthesis.

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

UNIT – III: Two component signal transduction in prokaryotes: Chemotaxis, Quorum sensing &Biofilms, Sporulation inducing signals & events in sporulation.

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

UNIT-IV: Physiological Adaptations and Intercellular signaling: Regulation of gene expression & responses to changing environments Introduction to two component system,

Regulatory systems sporulation in Bacillus subtilis, control of competence in Bacillus subtilis. Heat-Shock responses.

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

Transposons, and mechanism of transposition. Biology of plasmids. Extra chromosomal inheritance.

- **Text Books :**

1. Text book of Microbiology by Pleczar and Reid (Mc Graw Hill).
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 (Mac Millan).
7. Cell and Molecular Biology by E,D.P.DeRoberties (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* (3rd Ed.) (2003). McGraw 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 Text book 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, M J, Chan E C S., Krieg N R, Microbiology, (5th Ed.), (2001). McGraw Hill Book Company, NY.

KRISHNA UNIVERSITY:: MACHILIPATNAM
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 theresult of where we are born, the circle we interact with and our personal temperament. Every person is different. There are some characteristics 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 emotionalintelligence
4) Learn to develop coping mechanism to manage stress through Yoga and meditationtechniques
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.

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 Negation 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: Neetisatakam-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-Verses 17, Chapter 3-Verses 36,37,42 – Chapter 4-Verses 18, 38,39 Chapter18 –
Verses 37,38,63

UNIT -V: **Yoga & Stress Management**

Meaning and definition of Yoga - Historical Perspective of Yoga-Principles of Astanga Yoga by 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 - Nadanusandhana Pranayama-Meditation techniques: Om Meditation - Cyclic meditation: Instant Relaxation technique (QRT), Quick
Relaxation Technique (QRT), Deep Relaxation Technique (DRT) (Theory & Practical).

PRACTICAL COMPONENTS:

- 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 examplesof each.
- Students are expected to check their attitudes and develop ways to improve their attitudesat work place and home.
- Students are required to identify keys to self-motivation to achieve their goals.

Students are expected to identify at least seven types of body language and conductactivities 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 Skillsand Empathy

Exercise: Card Pieces

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

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 havefour triangular pieces for each card.
2. Mix all the pieces together and put equal numbers of cards into as many envelopes asyou have teams.
3. Divide people up into teams of three or four. You need at least three teams. If you'reshort 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 tomake 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 themost cards wins the round.

Advice for the Teacher/Facilitator

After the activity, ask your team members to think about the strategies they used. Discussthese 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 1 meter/100 cm. and scissors.Start with the following questions:

1. If the life span of an individual is say, 100 years. Consider that each cm representsone year. The response will be that few live that long. Assuming a life of 75 to 90years, 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 cannot 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 7.14 years. Reduce the ribbon by another 7.14 cm.
5. We also usually have Saturdays off, so reduce another 7. cms.
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 X 50 = almost 17 years). Cut off another 17 cm.
9. You spend time eating lunch, breakfast, snacks, and dinner total 2 hours daily (i.e.30 days a year X 50 years= 4 years or so). Cut off another 4 cm.
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 ofoptions. If ideas run dry, introduce an alternative brainstorming 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 Neetisatakam-Holistic development of personality.
- Students are asked to identify personality of role Mmodels from Shrimad Bhagwadgeetaand 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 McGraw Hill,2006.
2. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari"s ThreeSatakam, Niti-sringar-vairagya, New Delhi, 2010
3. Swami Swarupananda, 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. Goodwill Publishing House.2005.
7. Smith, B . Body Language. Delhi: Rohan Book Company. 2004
8. Yogic Asanas for Group Training - Part-I: Janardhan Swami Yogabhyasi Mandal,Nagpur.
9. Rajayoga or Conquering the Internal Nature by Swami Vivekananda,Advaita Ashrama(Publication Department), Kolkata.
10. Nagendra H.R nad 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://freevideolectures.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

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 Pka
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 ad 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

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	22BIT 201	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 bio analytical 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 andbasic 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 & non-aqueous solvents. Classification of colloids and their properties. 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 (denaturing Agarose Gel Electrophoresis, recovery of DNA from gel). 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 radioisotopes.

- **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: Willson 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	22BIT 202	4	0	0	4	30	70	100

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

❖ **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 effectsof 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.T his 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 usedin 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 EADescribe 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 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., allchemical communicators (hormones, neurocrines, cytocrines, etc.) work in essentially the same manner.

❖ **Course Content:**

Unit-I: Introduction to Enzymes: Holoenzyme, apoenzyme, coenzyme and cofactor, prostheticgroups, 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 Km andVmax 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, Harmone action, Signal transduction. Receptors-Types, structure- insulin, Thyroid, steroidal receptors, Concept of Second messengers cAMP, IP3, Calcium and NO, Protein phosphosphorylatin 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 thyroidismm, parathyroid hormones: parathtormone 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, 2001,2nd Edn. Woodhead Publishing Limited.
2. Fundamentals of Enzymology, Nicholas C. Price and Lewis Stevens 1999, 3rd Edn. OxfordUniversity Press.
3. Principles of Enzymology for Food Science, J.R. Whitaker, 1994, MarcelDekkar Publishers.
4. Structure and Mechanism in Protein Science, Alan Fersht, 1999, 2nd Edn. W.H. Freeman andCo., NY
5. Enzyme Structure and Function, S. Blackburn, MarcelDekkar, 1976, Inc. NY
6. Enzymatic Reaction Mechanism, Christopher Walsh, 1979. W. H. Freeman Pub, SanFrancisco.
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-HillEducation.
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	22BIT 203	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 organisation 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 pathwayanalysis.
- Acquire knowledge and understanding of how enzymes and metabolites in living system workto produce energy and synthesizing different biomolecules.
- Extend comprehensive knowledge about biochemical pathways involved in intermediarymetabolism 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 regulation. Electron transport chain – Energy yield during aerobic and anaerobic conditions. Glyoxylate cycle, Gluconeogenesis and its regulation. HMP shunt and its significance. Uronic acid pathway. Glycogen metabolism and its regulation with special reference to phosphorylase and glycogen synthase. Cori cycle.

UNIT – II: Metabolism of Amino acids: Biosynthesis of nonessential amino acids. Catabolism of tyrosine, phenylalanine, tryptophan and branched chain amino acids. Ketogenic and glycogenic 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. Metabolism of arachidonic acid – formation of prostaglandins, thromboxanes, leucotrienes. Biosynthesis of triglycerides. Metabolism of phospholipids, sphingolipids. Biosynthesis of cholesterol and its regulation. Formation of bile acids. Role of liver and adipose tissue in lipid metabolism.

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 and polynucleotides. Inhibitors of nucleic acid biosynthesis. Biosynthesis and degradation of heme.

UNIT – V: Metabolic Disorders: Metabolic disorders: Inborn errors of carbohydrate metabolism – Lactose intolerance, Diabetis mellitus, Cori's disease Inborn errors of amino acid metabolism – Alkaptonuria, Tyrosinemia. Inborn errors of lipid metabolism – Gaucher disease, hyper and hypo cholesterelomia. Inborn errors of nucleic acid metabolism – Gout, Hyper uricemia, Lesch- Nyhan syndrome.

- **Text Books:**
    1. Principles of Biochemistry - White. A, Handler, P and Smith.
    2. Biochemistry - Lehninger A.L.
    3. Biochemistry - David E. Metzler.
    4. Biochemistry - LubertStryer.
    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 PROPERTYRIGHTS (IPR)	L	T	P	C	IM	EM	TM
Course Code	22 BIT 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 the all 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 framework 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

❖ **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 IntellectualProperty 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.
3. Students are required to identify and develop good research design to address the definedresearch problems.
4. Students are expected to write the research design on Exploratory and DescriptiveResearch.
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 andpractical 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 toavoid plagiarism in research.
9. Students are asked to identify and submit a brief report on Indian patents of internationalrepute.
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 identity 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 (5thedition).
3. Oxford: Oxford University Press.
4. Kothari, C.R., 1990, Research Methodology: Methods and Techniques, New AgeInternational.
5. Dornyei, Z. (2007). Research Methods in Applied Linguistics. Oxford: Oxford UniversityPress.
6. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009, Research Methods: A Process of Inquiry, Ally and Bacon.
7. Fink, A., 2009, Conducting Research Literature Reviews: From the Internet to Paper. SagePublications.
8. Day, R.A., 1992, How to Write and Publish a Scientific Paper, Cambridge University Press.
9. Wadehra, B.L. 2000, Law relating to patents, trade marks, copyright designs and geographical
10. indications. Universal Law Publishing.
11. Coley, S.M. and Scheinberg, C. A., 1990, Proposal Writing, Sage Publications.
12. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: theTRIPS agreement and policy options, Zed Books, New York.
13. Leedy, P.D. and Ormrod, J.E., 2004, Practical Research: Planning and Design, Prentice Hall.
14. Satarkar, S.V., 2000. Intellectual property rights and Copy right. Ess Ess Publications.

Important Websites:

- www.ipindia.nic.in - Intellectual Property Office, India
- www.patentoffice.nic.in – Patent office, India
- http://copyright.gov.in/ - Copyright Office, India
- ipr.icegate.gov.in – Automated Recordation & Targeting for IPR Protection
- http://www.icegate.gov.in- E- Commerce portal 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 – Plant Varieties and Farmers' Rights Authority, India
- http://nbaindia.org/ - National Biodiversity Authority
- www.nipo.in – The Indian IPR Foundation
- www.wipo.int – World Intellectual Property Organisation
- http://www.wto.org – World Trade Organisation

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	22BITDSE 201	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:**

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 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 background 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 – Meselson and Stahl, Cairn's experiments. 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 fork 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: Prokaryotic RNA polymerase – Core enzyme and σ factors (σ70, σ32).Promoter elements. Promotor–RNApolymerase interaction – DNAse protection method and Foot-printing assays. Mapping of transcription start point (TSP). Upstream activating sequences and their role in regulation of transcription. Transcription elongation. Transcription termination – Rho-independent and Rho-dependent. Monosystronic and polycistronic mRNA.

Eukaryotic RNA polymerases – Transcription factors. Structure and functions of RNA pol I, II and III dependent promoters. 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 and its elucidation. Wobble hypothesis. Structure and composition of 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. Alternative protein transport mechanisms.

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 in lactose, arabinose and trptophan operon in Escherechia 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. Regulation of homeotic genes in insects. Gene expression as influenced by environmental factors. Regulation of gene expression by termination technology.

- **Text Books:**

1.Molecular Biology of the Gene (4th Edn) JD Watson, NH Hopkins, JW Roberts,
2.JA Steitz and AM Weiner, The Bjnjamin/Cummings Publ, Co. Inc, California.
3.Molecular Cell Biology (2nd Edn) J. Darnell, H.Lodish and D. Baltimore,
4.Scientific American Books, Inc. USA 1994
5.Molecular Cloning: A Laboratory manual, J. Sambrook, E.Ffrisch and T.Maniatis, Old Spring Harbor Laboratory Press New York, 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	**22BITDSE202**	**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 ecophysiological 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 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 - Biodiesels: mass cultivation and use of Jatropa, 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, Waste water 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 solubulizing 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. Biomas 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, McGrawhill 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 J Alvarage and Walter A Illman, Wiley Interscience.
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	22BITDSE203	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.

- Explains the manner in which specific ecological processes, including migration, birth and death rates, age of reproduction affect 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, FST); 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, WileyBlackwell.
2. 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. Behavioural 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 & AND ENZYMOLOGY LAB**	**L**	**T**	**P**	**C**	**IM**	**EM**	**TM**
Course code	**22BITL201**	**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.
2. Separation of amino acids/ sugars/ lipids by Thin Layer Chromatography.
3. Ultra violet 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.

KRISHNA UNIVERSITY:: MACHILIPATNAM
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	**22BITL202**	**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 spectrophometry
3. Colorimetric method (Diplhenylamine reagent)
4. Thermal denaturation of DNA and demonstration of hyperchromic effect.
5. Isolation of RNA by Trizol methods.
6. Estimation of RNA.
7. Determination of melting temperature (Tm) and estimation of GC content.
8. Isolation of plasmids from *E.coli* and separation of CCC, Open circular and linear forms of
9. 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.