KRISHNA UNIVERSITY, MACHILIPATNAM – 521003
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY

Course structure and syllabus for **M.Sc. Biotechnology**

w.e.f 2020-21 admitted batch (Regulation: R2020)

1.	Title of the Course	M.Sc. Biotechnology
2.	Duration of the course	2 years (Four Semesters)
3.	Eligibility criteria for admission	The candidate seeking admission in to M.Sc. Biotechnology course should have passed a Bachelor's Degree examination not less than three years duration in any discipline with Biotechnology and biology at 10+2 level or should have passed Bachelor's Degree Examination not less than three years duration in any discipline with Biotechnology as one of the subjects or Biological sciences.
4.	Level of the Course	Post graduate
5.	Mode of Admission	The mode of admission is through KRUCET conducted by Krishna University
6.	Objectives of the course	The Objective of M.Sc. Biotechnology course is to impart knowledge and practical training in the recent advancements and recent trends and technologies in the field of Biotechnology with an aim to develop research in commercial and scientific applications.
7.	Course Requirement	The course shall include Theory papers, Labs, Assignments, Tests, Seminars and Project Work.
8.	Number of working days	In each semester ninety working days must be dedicated for theory classes, practical classes and seminars.

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003

DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY

M.Sc: **Biotechnology (BIT)**

Semester - I

Paper Code	Name of the Course	Hours			Credits	
		L	T	P		
					Theory	Practicals
20 BIT 101	Cell Biology & Genetics	4	-	-	4	-
20 BIT 102	Biochemistry of Biomolecules	4	-	-	4	-
20 BIT 103	General Microbiology	4	-	-	4	-
20 BIT 104	Enzymology	4	-	-	4	-
20 BIT 105	Cell Biology, Genetics & Enzymology lab	-	-	8	-	4
20 BIT 106	Biochemistry of Biomolecules & Microbiology lab	-	-	8	-	4
	Sub-Total	**16**	**-**	**16**	**16**	**8**
	Total	**32 hours per week**			**24 Credits per semester**	

L - Lecture, T- Tutorial & P - Practicals

Semester –II

Paper Code	Name of the Course	Hours			Credits	
		L	T	P		
					Theory	Practicals
20 BIT 201	Bioanalytical Techniques	4	-	-	4	-
20 BIT 202	Molecular Biology	4	-	-	4	-
20 BIT 203	Intermediary metabolism	4	-	-	4	-
20 BIT 204	Intellectual Property Rights (IPR), Biosafety & Bioethics	4	-	-	4	-
20 BIT 205	Bioanalytical Techniques & Intermediary metabolism lab	-	-	8	-	4
20 BIT 206	Molecular Biology & IPR & Biosafety lab	-	-	8	-	4
20 OEBIT 207	Open Elective - 1	4	-	-	4	-
	Sub-Total	**20**	**-**	**16**	**20**	**8**
	Total	**36 hours per week**			**28 Credits per semester**	

Semester –III

Paper Code	Name of the Course	Hours			Credits	
		L	T	P		
					Theory	Practicals
20 BIT 301	Immunology & Immunotechniques	4	-	-	4	-
20 BIT 302	Bio-informatics & Bio-statistics	4	-	-	4	-
20 BIT 303	Cell & Tissue Culture Techniques & Applications	4	-	-	4	-
20 BIT 304	Genetic Engineering	4	-	-	4	-
20 BIT 305	Immunology & Bio-informatics & Bio- statistics lab	-	-	8	-	4
20 BIT 306	Cell & Tissue Culture Techniques & Genetic Engineering lab	-	-	8	-	4
20 OEBIT 307	Open Elective - 2	4	-	-	4	-
	Sub-Total	**20**	**-**	**16**	**20**	**8**
	Total	**36 hours per week**			**28 Credits per semester**	

Semester – IV

Paper Code	Name of the Course	Hours			Credits	
		L	T	P		
					Theory	Practicals
MOOCS 20 BIT 401	**MOOCS**	4	-	-	4	-
20 BIT 402.1 OR 20 BIT 402.2	Elective-I Development Biology Or Environmental Biotechnology	4	-	-	4	-
20 BIT 403.1 OR 20 BIT 403.2	Elective-II Bio-Process Engineering& Technology Or Molecular Therapeutics	4	-	-	4	-
20 BIT 404	Molecular Virology	4	-	-	4	-
20 BIT 405	Molecular Virology Lab	-	-	4	-	2
20 BIT 406 Project work	Project midterm review				2 (50 M)	
	Project evaluation				6 (150 M)	
	Sub-Total	**16**	**-**	**4**	**16**	**10**
	Total	**20 hours per week**			**26 Credits per semester**	

- **Open Electives*:**

Paper Code	Name of the course	Semester	Credits
20 OE BIT 207	Open Elective -1	II	4
20 OE BIT 307	Open Elective -2	III	4

- **Total number of credits at the end of course:**

S.No	Semester	Credits
1	I Semester	24
2	II Semester	28
3	III Semester	28
4	IV Semester	26
	TOTAL	**106**

Note: Open Elective/Non-core 8 Credits will not be considered for division / percentage.

- **Evaluation**

I Semester **Marks**
1. Four theory papers 4X100 = 400
2. Title of the paper(s) Practical-1=100 Total = 600 M
3. Title of the paper(s) Practical-2 =100

II Semester **Marks**
1. Four theory papers 4X100 = 400
2. Title of the paper(s) Practical-1 = 100 Total = 600 M
3. Title of the paper(s) Practical-2 = 100

III Semester **Marks**
1. Four theory papers 4X100 = 400
2. Title of the paper(s) Practical-1 = 100 Total = 600 M
3. Title of the paper(s) Practical-2 = 100

IV Semester **Marks**
1. Four theory papers 4X100 = 400
2. Title of the paper(s) Practical = 100 Total = 700 M
3. Project work = 200

Grand total Marks = 600+600+600+700= **2500**

1. Open Elective / Non-core I of student choice from other departments 100M Total = 200M
2. Open Elective / Non-core II of student choice from other departments 100M

Note: Open Elective/Non-core 200 marks will not be considered for division / percentage. The total marks will be 2500 only.

- **Procedure to evaluate midterm examinations:**

- **Theory:**

Midterm Examinations – I & II	30 marks

Note: Final midterm semester marks shall be arrived at by considering the marks secured by the student i.e., average of the two mid examinations.

For Example:

If the student attended both the mid-term examinations:

Marks obtained in first mid: 30
Marks obtained in second mid: 30
Final mid semester Marks: (30+30) = 60/2= 30

If the student attended only one mid-term examination:

- If the student is absent for any one midterm examination, the final mid semester marks shall be is as follow for Example:

Marks obtained in first mid: 30
Marks obtained in second mid: Absent
Final mid semester Marks: (30+0) = 30/2= 15

- **Practical:**

*Continuous assessment/ Day to day work evaluation	Semester End Exam	Total
30 marks	70 marks	100M

*Continuous assessment sheet given below.

Note: For practical courses, there shall be a continuous assessment/day to day work evaluation during the semester for 30 sessional marks and end examination shall be for 70 marks. Day-to-day work in the laboratory shall be evaluated for 30 marks by the concerned laboratory teacher based on the regularity/record/viva. The end examination shall be conducted by the concerned laboratory teacher and external examiner in the subject nominated by the university. Both internal and external examiners have to sign on the marks sheet.

- Internal marks will be awarded by internal examiner only.

Template

Krishna University, Machilipatnam - 521003

Department of Biosciences & Biotechnology

Day to day evaluation sheet / Continuous Evaluation of Practicals

Course: **PG** Program: M.Sc .Biotechnology

Subject Title with Code: Academic Year:

Student Roll. No	Student Name	Experiment & Marks										Total Marks (100)	Final Marks (30M)
		1 (10M)	2 (10M)	3 (10M)	4 (10M)	5 (10M)	6 (10M)	7 (10M)	8 (10M)	9 (10M)	10 (10M)		

*Number of experiments varies from subject to subject. Each experiment carries 10M.

***Note: If the final marks are in fraction, it shall be rounded off to the next number.**

Faculty/Lab In charge Signature with date

- **PROJECT:**

Project midterm review	50 marks
Project evaluation	150 marks

- **Procedure for Conduct and Evaluation of Project Midterm review:**

After selecting the specific project topic, the student shall collect the information and prepare an abstract, showing his/her understanding of the proposed project topic as a summary and submit the same to the department before implementation of the project in the beginning of the IV Semester. The status of the project work will be reviewed and the presentation shall be evaluated by the departmental committee consisting of Head of the Department, Project supervisor and a senior faculty member after two months of the project. It shall be evaluated for 50 marks. A student shall acquire 2 credits assigned to the Project midterm review, when he/she secures 40% or more marks for the total of 50 marks. There shall be no external evaluation for Project midterm review.

In case, if a student fails in Project midterm review, a re-review shall be conducted within a month. In case if he/she fails in the re-review also, he/she shall not be permitted for Project Evaluation. Further, such students shall reappear as and when IV semester regular examinations are conducted.

Procedure for Conduct and Evaluation of Project Evaluation:

Out of a total of 200 marks, 50 marks for **Project Review** and for the **Project Evaluation**, 100 marks shall be for Project report/thesis/record and 50 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.

M.Sc-Biotechnology
Summary of Course Structure
Semester – I

S.No	Paper No.	Title of the paper	Paper Code	Internal Marks	External Marks	Total Marks
1.	Paper-I	Cell biology & Genetics	20 BIT 101	30	70	100
2.	Paper-II	Biochemistry of Biomolecules	20 BIT 102	30	70	100
3.	Paper-III	General Microbiology	20 BIT 103	30	70	100
4.	Paper-IV	Enzymology	20 BIT 104	30	70	100
5.	Pract-I	Cell Biology, Genetics & Enzymology lab	20 BIT 105	30	70	100
6.	Pract-II	Biochemistry of Biomolecules & Microbiology lab	20 BIT 106	30	70	100

Semester – II

S.No	Paper No.	Title of the paper	Paper Code	Internal Marks	External Marks	Total Marks
1.	Paper-I	Bioanalytical Techniques	20 BIT201	30	70	100
2.	Paper-II	Molecular Biology	20 BIT202	30	70	100
3.	Paper-III	Intermediary metabolism	20 BIT204	30	70	100
4.	Paper-IV	Intellectual Property Rights(IPR),Biosafety & Bioethics	20 BIT201	30	70	100
5.	Pract-I	Bioanalytical Techniques & Intermediary metabolism lab	20 BIT205	30	70	100
6.	Pract-II	Molecular Biology & IPR & Biosafety lab	20 BIT206	30	70	100
7	Paper V	**(Open elective-1)**	20 OEBIT 207	30	70	100

Semester –III

S.No	Paper No.	Title of the paper	Paper Code	Internal Marks	External Marks	Total Marks
1.	Paper-I	Immunology & Immunotechniques	20 BIT301	30	70	100
2.	Paper-II	Bio-informatics & Bio-statistics	20 BIT302	30	70	100
3.	Paper-III	Cell & Tissue Culture Techniques & Applications	20 BIT303	30	70	100
4.	Paper-IV	Genetic Engineering	20 BIT304	30	70	100
5.	Pract-I	Immunology & Bio-informatics & Bio-statistics lab	20 BIT305	30	70	100
6.	Pract-II	Cell & Tissue Culture Techniques & Genetic Engineering lab	20 BIT306	30	70	100
7	Paper V	**(Open elective-2)**	20 OEBIT 307	30	70	100

Semester –IV

S.No	Paper No.	Title of the paper	Paper Code	Internal Marks	External Marks	Total Marks
1.	Paper-I	MOOCS	20 BIT401	30	70	100
2.	Paper-II	Elective-I Development Biology Or Environmental Biotechnology	20 BIT402	30	70	100
3.	Paper-III	Elective-II Bio-Process Engineering & Technology Or Molecular Therapeutics	20 BIT403	30	70	100
4.	Paper-IV	Molecular Virology	20 BIT404	30	70	100
5.	Pract-I	Molecular Virology lab	20 BIT405	30	70	100
6.	Paper- VI	Project Work	20 BIT406	50	150	200

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc – BIOTECHNOLOGY, I SEMESTER

Paper Code &Title: 20 BIT101 : Cell Biology & Genetics

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

- **Course Learning Objective(s):**

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

UNIT -I

Cell

Cell classification, Cell theories and Cell variability (size, shape, complexity, and function). Structural organization: prokaryotic and eukaryotic cells. Differences between procytes and eucytes. Physicochemical Properties, Molecular Organization asymmetrical organization of lipids, proteins and carbohydrates and functions. Transport across membranes: Types of transport (simple diffusion, passive-facilitated diffusion). Active transport - primary and secondary group translocation.

UNIT -II

Cell organelles

The ultrastructure of nucleus, mitochondria, endoplasmic reticulum (rough and smooth), Golgi apparatus, Ribosomes, Chloroplast, lysosomes and their function. The cytoskeleton: microtubules and microfilaments. The extra cellular matrix: collagen.

UNIT – III

Cell-cycle

Phases of cell cycle cell cycle check points. CdK, cyclins, MPF, P^{53}, wait signal Apoptosis. Cell division by mitosis and meiosis.
Biochemistry of cancer characteristics of cancer cell carcinogenesis, carcinogens, oncogenes and tumor suppressor genes.

UNIT-IV

Cell signaling

Forms of intracellular signaling, hormone and their receptors (steroid and plant hormones) Pathways of intracellular signal transduction: c-AMP pathway, c-GMP pathway, phospholipids (IP3 and DAG) and Ca++. Ras, Raf and MAP kinase pathway. JAK/STAT pathway

UNIT-V

Genetics of Eukaryotes

Gene & Environment. Genotype and phenotype, Mendel's experiments. Dominance relationships. Multiple alleles Gene Interaction, Gene mutations, Sex determination, Sex linkage, Linkage and recombination in diploids and Elements of gene mapping.

❖ **Course Learning Outcome(s):**

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

➢ **Text books :**

1. The Cell-a molecular approach. Cooper Geoffrey, M. 2000. 2nd Edn. ASM Press Washington
2. Molecular biology of the cell. Alberts A et al. 1994. Garland Publ. New York
3. Cell and Molecular Biology. De Robertis EDP & EMF De Robertis. 2001. Lippincott Williams & Wilkins. Bombay.
4. Becker MW, Kleinsmith and Hardin J. 2007. The world of the Cell (6th Ed.) Tata M Publications
5. Molecular Cell Biology. Harvey Lodish, Amold Berk, Chris A. Kaiser, Mathew P.Scott. 2007. Ploegh and Paul Matsudaria. 6th Edn.
6. Chromosome techniques: Theory and Practice. Sharma AK and A Sharma. 1980. Butterworth.
7 Molecular Biology Freifelder D. 1990, Narosa publication house, New Delhi
8. Principles of Genetics. Eldon John Gardner, Michael J. Simmons, D. Peter Snustad. 2004. 8th Edn. Wiley. New York.
9. Genetics. Sambamurthy, AVSS. 1999. Narosa publ. New Delhi.
10. Principles of Genetics. Sinnot EW., LC Dunn & T Dobzhansky 1958. McGraw Hill, New York
11. Theory & Problems in Genetics. Stansfield WD 1991. McGraw Hill, New York.
12. Genetics. Strickberger MW 1996. 3rd Edn. McMillan, New York.
13. Genetics. Winchester AM. 1967. Oxford & IBH. New Delhi.
14. Microbial Genetics. Stanley R. Maloy, John E. Cronan and David Freifelder, 1994. Jones & Bartlett Publishers, UK.
15. Genetics A Conceptual Approach Benjamin A Pierce 2006. 2nd Fdn Freeman
16. Verma P.S and Agarwal V.K. 2006. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd
17. Lewin B. 2008, Genes IX. Jones and Bartlett publishers
18. Satyanarayana U. 2007. Biotechnology. Books and allied (P) Lad
19. Watson ID. Hopkins NHL Roberts Wet al. 1987. Molecular Biology of the Gene (4th ed) The Benjamin Cummings Publishing Company, Inc.

➢ **Reference books:**

➢ **E- content / E-books (optional)**

➢ **Websites**

1. www.journals.elsevier.com/journal-of-molecular-biology/
2. www.springer.com › Home › Life Sciences › Cell Biology

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc – BIOTECHNOLOGY, I SEMESTER

Paper Code &Title : 20 BIT102 : Biochemistry of Biomolecules

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

❖ **Course Learning Objective(s):**

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

UNIT – I

Carbohydrates:

Definition and Classification of carbohydrates, reactions of monosaccharides, acid Derivatives of monosaccharides, Amino sugars, disaccharides, oligo saccharides, mucopolysaccharides, bacterial cell polysaccharides, 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: Hemoglobin, Myoglobin). 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

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.

Course Learning Outcome(s):

1. Students will be able to demonstrate an understanding of fundamental biochemical principles, such as the structure and functions of Biomolecules, s t r u c t u r e s , and the fucntions of biological/biochemical processes.
2. 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.

- **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. Organic Chemistry, DJ. Cram and GS Hammon
12. Biochemistry. Reginald A. Garret, Charles M. Grisham. 1995. National Academy of Sciences, USA. 2nd Edn.
13. Biochemistry. Mathews
14. Biochemistry. B.D. Hames, N.M. Hooper
15. Practical Biochemistry. Wilson and Walker

- **Reference books:**

- **E- content / E-books (optional)**

Websites

1. http://www.una.edu/faculty/aecrews/Biochemistry/LectureNotes.htm

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc – BIOTECHNOLOGY, I SEMESTER

Paper Code &Title : 20 BIT103 : General Microbiology

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

- **Course Learning Objective(s):**

UNIT-I

Over view of Prokaryotic Cell

Prokaryotic cell - structure and functions, Cell wall synthesis, flagella structure and synthesis. Exopolysaccharide synthesis. Membrane transport 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 and Microbial Photosynthesis. Stress Adaptations in thermophiles, halophiles alkaliphiles, acidophiles, extremophiles - adaptations & significance in biotechnology.

UNIT-III:

Viruses

Classification, Nomenclature of RNA and DNA Viruses, General Characteristics of TMV, Lambda Phage and HIV, general steps in replication of viruses, General Methods of Cultivation, Purification, detection and quantification of bacterial, animals and plant virus, Prions and Virusoids, Viroids, satellite and defective virus practices.

UNIT-IV:

Methods and Techniques

Sterilization and disinfection - Physical and Chemical methods. Isolation of pure Cultures, Cultivation aerobic and anaerobic microbes. Media for growth of microorganisms (bacteria, Fungi, algae). Preservation and maintenance of cultures. Principle and applications of microscopy in microbiology- Bright field, Dark field Microscopy. Methods of identification of bacteria.

UNIT-V:

Bacterial Growth and Microbial Genetics

Nutritional groups of Bacteria (autotrophs and heterotrophs) Nutritional mutants and their use in metabolic studies. Growth cycle of bacteria, Estimation of bacterial growth factors influencing growth (physical and Chemical), synchronous culture and continuous growth of microbes.

Recombination in prokaryotes, Transformation, conjugation & transduction, Mapping of prokaryotic genes. Transposons, and mechanism of transposition. Biology of plasmids. Extra chromosomal inheritance.

❖ **Course Learning Outcome(s):**

➢ **Text books :**

1. Stainer R.Y. Adelberg, E.A., Ingram J.L. General Microbiology. 4th ed. Macmillan, 1976.
2. Davis, B.D., Dulbecco, Reisen, H.N., Ginsberg H.S Microbiology Harper & Row publishers 1980
3. Pelczar, M.L.Chan, E.C.S. Krieg. N.R. Microbiology, Mc Graw-Hill Book Company, 1986.
4. Freeman B.A. Burrows Text book of Microbiology Saunders HB Company, 1985.
5. Joklik, W.K., Willet H.P., Amos, D.B. and Wilfert C.M. Zinssers Microbiology, 19th ed. Prentice- Hall International Inc. 1988.
6. Paul J. Vandemark, Barry L. Batzing th microbes. The Benjamin cummings publishing company, Inc. 1987.
7. Lansing M. Prescott, John P. Harley, Donald. A.Klein, Microbiology, 3rd edition brown publishers, 1996
8. Text book of Microbiology by Pleczar and Reid (Mc Graw Hill).
9. Microbiology by Tortora. Funk & Case.
10. Principles of Heridity by Robert Tumarin.
11. Genetics by M. W.Strickberger (Mac Millan)
12. Cell and Molecular Biology by E.D.P.De Roberties (International edition)

➢ **Reference books:**

➢ **E- content / E-books (optional)**

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc – BIOTECHNOLOGY, I SEMESTER

Paper Code &Title: 20 BIT104 : Enzymology

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

❖ **Course Learning Objective(s):**

1. Demonstrate a basic knowledge of enzyme kinetics, the parameters of the enzymatic reaction, mechanisms of action of enzymes and inhibitors, dependence on the temperature and pH of the enzymatic activity, knowledge of the structure of enzymes and amino acids that build active sites of enzymes.
2. To give hands on training to students so that they understand the enzyme kinetics.

UNIT- I

Introduction

Introduction to Enzymes, Enzyme nomenclature & classification, Catalytic power and specificity. Active site-Fischer and Koshland models. The law of mass action and order reaction.

UNIT – II

Kinetics

Kinetics of single substrate enzyme catalyzed reaction - Michaelis-Menten equation and its significance, Line weaver Burk plot, Kinetics of multi substrate enzyme catalyzed reaction – Ping-pong mechanism, random order mechanism and compulsory order mechanism. Determination of Vmax , Km, Kcat and their significance

UNIT – III

Enzyme Activity

Effect of pH, temperature, enzyme and substrate concentration on enzyme activity. Units of enzyme activity (IU) and Turnover number. Purification of enzymes. Criteria of purity. Assay of enzymes: Coupled kinetic assay.

UNIT – IV

Enzyme inhibition and catalysis

Reversible inhibition-competitive, uncompetitive and non competitive inhibition, Allosteric inhibitions, Irreversible inhibitions, Proximity and orientation, Covalent catalysis and acid-base catalysis. Metal ion catalysis.

UNIT – V

Enzyme catalysis and Applications.

Mechanisms of enzymes action-lysozyme, chymotrypsin and ribonuclease, Isoenzymes (LDH), Ribozymes (catalytic RNA), Immobilized enzymes and applications. Industrial and clinical applications of Enzymes.

❖ **Course Learning Outcome(s):**

1. The student can make a qualitative and quantitative description of the basic enzymatic phenomena and processes.
2. Knows and understands the importance of mathematical and statistical methods required for thedescription, interpretation of enzymatic phenomena and processes.
3. Learns the basic concepts, terms and techniques used in Enzymology.
4. Acquires knowledge of the basic techniques and research tools used in enzymology is able to link theoretical knowledge of enzymology with its practical application in industry, health care and environmental protection.

➢ **Text books :**

1. Principles of Biochemistry general aspects 1983-Smith et al McGraw Hill.
2. Principles of Biochemistry, 2001, nelson & Cox, CBS India.
3. Biochemistry, Lehninger, A.H.
4. Text book of biochemistry, West, E.S., Todd, Manson & Vanbruggen,. Macmillion.
5. Organic Chemistry, I.L.Finar, ELBS, 1985.
6. Biochemistry, Zubay, C.Addison, Wesley 1986.
7. Biochemistry of Nucleic acids, Adams et al., Chapmann and Hall, 1986.

➢ **Reference books:**

➢ **E- content / E-books (optional)**

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003
Department of Biosciences & Biotechnology
M.Sc –BIOTECHNOLOGY, I SEMESTER

Paper Code &Title: 20 BIT105 : Cell Biology, Genetics & Enzymology lab

No. of hours per week: 8 Total credits: 4

Total marks: 100 (Continuous evaluation: 30 M & External: 70 M)

- **List of experiments**

Cell Biology & 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
6. Preparation of cytological studies for identification of stages of mitosis using root tips
7. Examination of cells isolated from chick epithelium
8. Demonstration of chromosomal (structural and numerical) aberrations
9. Study of polytene chromosomes
10. Karyotypic study

Enzymology

1. Assay of trypsin
2. Assay of salivary amylase
3. Effect of temperature on enzyme activity
4. Effect of pH and determination of optimum pH of α- Amylase
5. Effect of different metal ions on enzyme activity
6. Determination of characteristics of enzyme catalyzed reactions(Vmax and km)
7. Immobilization of enzymes

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003
Department of Biosciences & Biotechnology
M.Sc –BIOTECHNOLOGY, I SEMESTER

Paper Code &Title: 20 BIT106: Biochemistry of Biomolecules & Microbiology lab

No. of hours per week: 8 Total credits: 4

Total marks: 100 (Continuous evaluation: 30 M & External: 70 M)

- **List of experiments**

Biochemistry of 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

Microbiology

1. Sterilization techniques- Autoclaving, Heat sterilization, filtration, UV-irradiation chemical.
2. Preparation of media
3. Staining techniques in bacteria- Simple, and Capsule, Flagella
4. Isolation and Cultivation of pure cultures.
5. Techniques of maintenance of stock cultures.
6. Anaerobic culture of bacteria.
7. Testing the efficiency disinfectant action, Dettol Phenol (Reidel-Walker test).
8. Growth curve and generation time of bacteria.
9. Detection of extracellular enzymes.

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc – Biotechnology, II SEMESTER

Paper Code &Title: 20 BIT201 : Bioanalytical Techniques

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

- **Course Learning Objective(s):**

1. To understand about the canonical structure of bio-instrumentation systems.
2. To learn the qualitative functions of the primary system components.
3. To learn the technical information's associated with instrumentation and design and basic signal analysis.
4. To learn about the review, the static and dynamic performance characteristics for instrumentation systems.
5. It focuses on the common principles and theories that are associated while making measurements in living organisms.

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 andIon- 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.

❖ **Course Learning Outcome(s):**

1. Describes and explains the principles of various bio-instrumental devices and sensors.
2. Demonstrate an ability to use appropriately and safely the techniques, sensors, and selected modern engineering tools necessary for bio-instrumentation practice.

➢ **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.

➢ **Reference books:**

➢ **E- content / E-books (optional)**

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003

DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY

M.Sc – Biotechnology, II SEMESTER

Paper Code &Title: 20 BIT202 : Molecular Biology

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

- **Course Learning Objective(s):**
  1. To give an in-depth knowledge on how the nucleus is organized, methods of replication, transcription and translation
  2. Also to explain the control mechanisms involved
  3. To make them understand the damages caused to DNA and the methods used to overcome it

UNIT – I

Nuclear Organization & Replication

Central dogma of the cell.Nuclear organization – Prokaryotes and eukaryotes
Prokaryotic replication – enzymes & mechanism.Eukaryotic replication – enzymes & mechanism.
Replication in Telomeres.Replication in mitochondria. Inhibitors of replication.

UNIT – II

Transcription & Transcriptional control

Structure of bacterial RNA polymerase and sigma factor types – 70,32.Initiation, elongation and termination in prokaryotes.Eukaryotic RNA polymerase, Promoter sequences, TATA box, CAAT box, UAS.Initiation, elongation and termination in eukaryotes
RNA processing in Prokaryotes Vs Eukaryotes.

UNIT – III

Translation & its control

Ribosome assembly, mechanism of activation of amino acids. Mechanism of translation in prokaryotes. Mechanism of translation in eukaryotes. Genetic code, Wobble hypothesis.
Regulation of translation. Protein targeting.

UNIT – IV

Gene expression control

Regulation of gene expression and types.Operon model- lac, trp and ara operon
Transcription factors and their role in regulation of gene expression - motifs
Role of environmental factors on Gene Yeast gal genes.
Steroid hormone induced gene expression. Lytic cascades and lysogenic repression.

UNIT – V

DNA damage & repair

DNA damage.DNA mutation- alkylation, deamination, oxidation, UV radiation.
Molecular basis of mutation.
Repair mechanisms- photo reactivation, excision repair, mismatch repair and SOS repair.

❖ **Course Learning Outcome(s):**

1. Students will be able to exhibit a knowledge base on molecular biology.
2. They will be exposed to and trained in advanced molecular biology techniques.

➢ **Text books :**

1. Molecular Biology of the gene (4th Edn) JD Watson, NH Hopkins, JW Roberts, JA Steitz and AM Weiner, The Benjamin/Cummings Publ, Co.Inc, California.
2. Molecular Cell biology (2nd Edn) J. Darnell, H. Lodish and D. Baltimore, Scientific American Books, Inc, USA 1994.
3. Molecular Cloning: A Laboratory manual, J. Sambrook, E.Ffrisch and T. Maniatis, Old Spring Harbor Laboratory Press New York, 2000.
4. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd.
5. Molecular Biology, TA Brown (Ed) Bios Scientific Publishers ltd., oxford, 1991.

➢ **Reference books:**

➢ **E- content / E-books (optional)**

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003

DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY

M.Sc – Biotechnology, II SEMESTER

Paper Code &Title: 20 BIT203 : Intermediary metabolism

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

- **Course Learning Objective(s):**

UNIT – I

Carbohydrates metabolism

Glycolysis, citric acid cycle and pentose phosphate pathway.Bioenergetics: Energy transformation, Laws of Thermodynamics, Biological oxidations, Gibb's energy, Free energy changes. Mitochondrial respiratory chain- ETC, Chemiosmotic theory, Respiratory controls and inhibitors of oxidative phosphorylation.

Gluconeogenesis.Glycogen Metabolism- Glycogenesis & Glycogenolysis, Regulation of Glycogen metabolism with reference to Glycogen phosphorylase and Glycogen synthase. Regulation of blood glucose homeostasis by hormones. Glyoxylate cycle.Cori' s cycle

UNIT – II

Amino Acid Metabolism

Biosynthesis of nonessential amino acids. Catabolism of tyrosine, phenylalanine, tryptophan, branched chain amino acids.Ketogenic and Glycogenic aminoacids. Formation of Creatinine, Ammonia, Urea cycle and its regulation. Protein turnover- Role of Ubiquitin

UNIT – III

Lipids Metabolism

Fatty acid oxidation: β oxidation.Biosynthesis- Triacyglycerols, phospholipids, sphingolipids, cholesterol, fatty acids, Arachidonic acid metabolim and ketone bodies.

Formation of Bileacids. Role of liver and adipose tissue in lipid metabolism.

UNIT – IV

Nucleic Acid and Porphyrin metabolism

Biosynthesis of Purines and Pyrimidines nucleotides. Regulation of Purine and Pyrimidine biosynthesis. Degradation of Purines and Pyrimidines nucleotides.

Heme biosynthesis and degradation

UNIT – V

Inborn Errors of Metabolism

Carbohydrate Metabolism (Diabetis Mellitus, Glycogen storage diseases). Aminoacid metabolism (phenylketonuria (PKU) and maple syrup urine disease). Nucleicacid Metabolism (Gout, Lesch Nyhan syndrome). Lipid metabolism (**Gaucher disease** and **Tay**-Sachs disease).

- **Course Learning Outcome(s):**

- **Text books :**

- **Reference books:**

1. Harper's Biochemistry – Murray, Granner, Mayes, and Rodwell – Prentice Hall International Inc.
2. Biochemistry – Lehninger – CBS Publishers.
3. Biochemistry – Stryer – W. H. Freeman & Co. – New York.
4. Text Book of Biochemistry – West, Todd, Mason, Bruggen – Amerind Publishing Co. Pvt., Ltd. M.Sc.

- **E- content / E-books (optional)**

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003

DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY

M.Sc – Biotechnology, II SEMESTER

Paper Code &Title: 20 BIT204 : Intellectual Property Rights, Biosafety & Bioethics

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

- **Course Learning Objective(s):**
  - To provide the knowledge about intellectual property rights for protection of biological invention.

Unit- I

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.

Unit- II

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.

Unit- III

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.

Unit-IV

Biosafety

Introduction; Historical Background; 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-V

Bioethics

Introduction to bioethics, Social and ethical issues in Biotechnology GMP (Good Manufacturing Practices) GLP (Good Labaratory Practices), Definition of GMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Assessment.

- **Course Learning Outcome(s):**
  - Student will be acquainted with intellectual property rights and protection of biological inventions.

- **Text books :**

1. Sasson A, Biotechnologies and Development, UNESCO Publications, 1988.
2. Sasson A. Biotechnologies in developing countries present and future, UNESCO publishers, 1993.
3. Singh K. Intellectual Property Rights on Biotechnology, BCll, New Delhi.

- **Reference Books:**

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/)

- **E- content / E-books (optional)**

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003

DEPARTMENT OF BIOSCIENCES & BIOTECHNOLOGY
M.SC – BIOTECHNOLOGY, II SEMESTER

Paper Code &Title: 20 BIT 205: Bioanalytical techniques & Intermediary metabolism lab

No. of hours per week: 8 Total credits: 4

Total marks: 100 (Continuous evaluation: 30 M & External: 70 M)

- **List of experiments**

Bioanalytical techniques

1. Preparation of buffers
2. Separation of amino acids by paper chromatography
3. Separation of amino acids by thin layer chromatography
4. Affinity chromatography
5. Protein estimation by Lowry's method using U.V Spectrophotometer
6. Absorption spectra of proteins.
7. High Performance Liquid Chromatography - HPLC (demonstration)
8. Separation of DNA by agarose gel electrophoresis

Intermediary metabolism

1. Reactions of Amino acids and sugars.
2. Isolation and Estimation of Glycogen from Liver.
3. Isolation and Estimation of Cholesterol from brain.
4. Estimation of Glucose by Glucose oxidize method.
5.Titration curve of an amino acid and calculation of pK and pI values.

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003

DEPARTMENT OF BIOSCIENCES & BIOTECHNOLOGY
M.SC – BIOTECHNOLOGY, II SEMESTER

Paper Code &Title: 20 BJT 206 : Molecular Biology & IPR & Biosafety lab

No. of hours per week: 8 Total credits: 4

Total marks: 100 (Continuous evaluation: 30 M & External: 70 M)

- **List of experiments (Font: Times New Roman – 11)**

Molecular Biology

1. Isolation of genomic DNA from bacteria
2. Isolation of genomic DNA from leaves
3. Isolation of genomic DNA from sheep liver
4. Isolation of RNA by trizol methods
5. Estimation of DNA by diphenyl amine method
6. Estimation of RNA by orcinol method
7. Determination of purity of the isolated DNA by UV spectrophotometry
8. Agarose gel electrophoresis
9. Isolation and separation of protein by SDS-PAGE
10. Western blotting demonstration

IPR & Biosafety

1. List of patents
2. The geographical indications
3. Procedure of obtaining patents
4. Searching patent database
5. Level of biosafety in virology laboratory
6. Biosafety committees by Govt. of India

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc – BIOTECHNOLOGY, III SEMESTER

Paper Code &Title: 20 BJT301 : Immunology & Immunotechniques

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

- **Course Learning Objective(s):**

1. To introduce the students to an overview of the immune system – its types & components
2. To give an in-depth knowledge on how our immune system defends against invading pathogens in a logical fashion
3. To make the students understand our innate ability to defend against microorganisms (innate immunity) and if this first line of defense fails, how we can fight infections (acquired immunity); if we react excessively, what price we pay (hypersensitivity); if we misdirect our defense, what the consequences are (autoimmunity) and very importantly, can we prevent pathogens from infecting us (vaccination).

UNIT – I

Immune system

History of immune system. Types of Immunity- Innate and acquired.
Organs- Primary, secondary and tertiary lymphoid organs. Cells of the immune system- B cells, T cells, phagocytes, inflammatory cells, antigen presenting cells.
Antigens- Nature, types, factor influencing antigenicity, haptens, adjuvants and superantigens.
Antibodies-structure, types, classes and functions. Antibody diversity- mechanism.

UNIT – II

Antigen-antibody interactions

Precipitation reaction – Radial immunodiffusion, Ouchyterlony technique, Immunoelectrophoresis, Rocket electrophoresis. Agglutination reactions – Heme agglutination, Inhibitions assay.
RIA, ELISA and ELISPOT– principle, methodology and applications.
Immunofluorescence, FAACS, immunoblotting.
Hybridoma technology – Production of monoclonal antibodies and application.

UNIT – III

Activation & Maturation

T cell receptor – structure and diversity.MHC – types, structure, distribution, self- restriction.
T and B cell activation. Treg cells. Maturation of lymphocytes – positive and negative selection, process of maturation. Antigen processing and presentation – cytosolic and endosomal pathways.T cell and NK cell – mediated lysis of cells, ADCC.
Complement system – components, cascades.Cytokines – classification, properties and role as immunomodulators.

UNIT – IV

Immune Reactions

Hypersensitivity – classification, mediators, mechanism, consequences of hypersensitivity.
Autoimmunity – concept of tolerance of autoimmune disorders, basis and therapy for autoimmune disorders. Transplantation – transplantation antigens, mechanism of graft rejection, graft versus host reaction, immunosuppressors.
Tumour immunity - tumors of immune system, immune responses against tumors.
Immunodeficiency - primary and secondary immunodeficiency, combined immunodeficiency, SCID.

UNIT – V

Vaccines

Vaccines – concepts of immunization, routes of vaccination. Types of vaccines – whole organism (attenuated and inactivated) and component vaccines (synthetic peptides, DNA vaccines, recombinant vaccines, subunit vaccines, idiotypic – based vaccines, deletion vaccines, glycoconjugate vaccines).
Vaccine delivery systems.Large scale manufacturing of vaccines (Cell factories)

- **Course Learning Outcome(s):**

1. Students will be able to exhibit immunology concepts.
2. They will be exposed to and trained in immunotechnology techniques

- **Text books :**

1. Essentials of Immunology, Ivan and Riott, Peter. J. Delves, 2001 Black Well Scientific Publications.
2. Fundamentals of Immunology, William. C. Boyed (Wiley Toppan)
3. Introduction of Immunology, John. W. Kinball.
4. Fundamentals of Immunology, Otto. S. View and others.
5. Immunology, D.M. Wier.
6. Immunology, Jains Kuby (2001) 2nd Ed, W.K. Frecman and com, New York
7. Cellular and Molecular immunology 5th Ed Abdul. K. Abbas, K. Lichtman, S. Pober, 2003
8. Immunology Eli Benjamini.
9. Roitts Essential Immunology. Ivan. M. Riott Peter.
10. Immunology. Richard Coico
11. Kuby Immunology Kindt Osborne

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

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003

DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY

M.Sc – BIOTECHNOLOGY, III SEMESTER

Paper Code &Title : 20 BIT302 : Biostatistics & Bioinformatics

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

- **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.

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.

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).

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.

.

UNIT – IV

Identification & Analysis

Identification of genes in genomes. Identification of ORFs and motifs.
Regulatory sequence analysis. Genome maps, markers and variation

UNIT – V

Applications

Medical Applications of Bioinformatics. Bioinformatics for Homology modeling
Bioinformatics for microarray designing transcriptional profiling.
Metabolic reconstruction. Phylogenetic analysis (Mega).

- **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

- **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 – 521003
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc – BIOTECHNOLOGY, III SEMESTER

Paper Code &Title: 20 BIT303 : Cell & Tissue Culture Techniques & Applications

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

- **Course Learning Objective(s):**

1. To enable candidates to acquire an overview of plant tissue culture and micropropagation. To develop the ability of students to appreciate how biotechnology is applied in plant productivity and safety.

2. To understand the basic mechanisms followed in Animal Biotechnology. To explore the numerous possibilities of using animal cell and tissue culture in various fields.

UNIT – I

Plant Biotechnology: Introduction to plant tissue culture

Introduction to plant tissue culture: Preparatory techniques- cleaning, sterilization, sterile handling tissue culture lab requirements. Media – Composition, Preparation and sterilization. Concept of differentiation and dedifferentiation.Callus culture
plant regeneration—Organogenesis. Somatic embryogenesis
Anther, pollen culture and its importance Production of virus free plants by meristem tip culture.

UNIT – II

Micro propagation & cell culture products

Cell culture techniques for production of useful compounds: Hairy root culture – transformed root using Agrobacterium rhizogenesis. Production of secondary metabolites. Plants as bioreactors. Germplasm preservation by tissue culture
Artificial seeds.
Protoplast - isolation of protoplasts, culture and fusion methods.Somatic hybrids and cybrids. Production of Transgenic plants - Bt cotton, Bt brinjal, golden rice. Production of Therapeutic proteins, Edible vaccines and enzymes in plants.

UNIT – III

Transgenic plants for insect/pest resistance and herbicide resistance.Transgenic plants for bacterial, fungal and viral resistance.Transgenic plants for drought, salt and heavy metal and stress tolerance. Transgenic plants for production of biopharmaceuticals (edible vaccines & α-interferon).Transgenic plants for improvement of nutritional quality (oil, amino acids, vitamins & micronutrient

UNIT – IV

Animal Biotechnology

History and development of animal tissue culture. Modes of Contamination and sterilization techniques. Cell culture – characters, Requirements – work area & instruments, source & types of tissue, components of media, antibiotics, serum, growth factors and applications.Characterization (using markers) & differentiation of cell lines - its inducers and control

Types of cell cultures – primary & secondary, finite & continuous; 3D cell culture

Methods to measure growth. Cell viability and cytotoxicity assays.

.

UNIT – V

Techniques and applications of Animal Biotechnology

- Nuclear transfer technology: transfer of nuclei into eggs; somatic cell nuclear transfer technology; development potential of transplanted nuclei.Animal cloning and application in wild life and life stock; Pronuclear early embryonic development. Transgenic technology, Transgenic animals– Production and applicationsGeneration of chimeric, transgenic and knockout mice and other animals.

.

Application of Biotechnology for animal health – Production of vaccines, diagnostic, hormones,Poultry and fish culture.

❖ **Course Learning Outcome(s):**

- To explore the numerous possibilities of using plant tissue culture and micropropagation to get high yield.
- The course is designed to educate the students on the techniques used in Animal Biotechnology.

➢ **Text books :**

1. Introduction to Plant Biotechnology – H.S.Chawla, 2000
2. Plant Biotechnology – Adrian Slater, 2003
3. Plant Biotechnology: Experience and Future Prospects - Agnès Ricroch, Surinder Chopra, Shelby J. Fleischer, 2014
4. Plant Biotechnology and Agriculture: Prospects for the 21st Century, 2011
5. Plant Biotechnology - R.C. Mishra, 2006
6. Plant Biotechnology and Molecular Markers - A. Narula, Sheela Srivastava, 2004
7. Texbook of Biotechnology – H.K.Das
8. Gene Cloning and DNA Analysis (6th Edition) by T.A. Brown. John Willey & Sons Inc, USA, 2010.
9. Lewin's Gene XI (11th Edition) by Krebs JE, Kilpatrick ST and Goldstein ES. Jones and Bartlett Publishers, Inc, 2013.
10. Animal Cell and Tissue Culture (1st Edition) by Shivangi Mathur. Publisher: Agrobios (India), 2009.

11. Animal Biotechnology by Varun Mehta. Publisher: Campus Book International, 2011.
12. Culture of Animal Cells: A Manual of Basic Technique & Specialized Applications (6th Edition)-R. Ian Freshney. John Willey & Sons Inc, USA, 2010.
13. Molecular Cloning: A Laboratory Manual (4th Edition) by Michael R. Green and Joseph Sambrook. Cold Spring Harbor Laboratory Press, USA, 2012.
14. Animal Cell Culture-A Practical Approach (3rd Edition) by John R. Masters. Publishers: Oxford University Press, 2000.
15. Animal Biotechnology-Models in Discovery and Translation (1st Edition), Editors: Ashish S. Verma and Anchal Singh, Elsevier 2014.

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

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc – BIOTECHNOLOGY, III SEMESTER

Paper Code &Title : 20 BIT304 : Genetic Engineering

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

❖ **Course Learning Objective(s):**

1. Genetic engineering or genetic modification refers to the process of manipulating the characteristics and functions of the original genes of an organism.
2. The objective of this process is to introduce new physiological and physical features or characteristics.
3. The aim of this core-course is to acquaint the students to versatile tools and techniques employed in genetic engineering and recombinant DNA technology.

UNIT – I

Tools

Isolation of gene/DNA fragments.Restriction mapping, DNA sequencing by chemical and enzymatic methods.Host controlled Restriction and Modification systems.Classification and Nomenclature of Restriction Enzymes.Enzymes used in Molecular Cloning.
Chemical synthesis of Gene (Solid phase synthesis).

.

UNIT – II

Molecular markers

PCR-principle & Applications.Variations in PCR - Inverse, multiplex PCR, Real time PCR Mechanism of c DNA synthesis.Strategies used to obtain full length c DNA (5' and 3' RACE).DNA Libraries: Genomic and cDNA libraries.RAPD and its significance
RFLP and its significance.AFLP and its significance.

UNIT – III

Vectors

Vectors for construction of Genomic Libraries: cosmids, Bacterial Artificial Chromosomes (Bacs), Yeast Artificial Chromosomes (Yacs). Vectors for construction of c DNA libraries- lamda ZAP.
Multipurpose vectors- pUC 18/19, Blue script vectors,
SV 40, Binary vector.Expression Vectors: Types – promoters used in expression vectors – lac, tac, T7 promoters and their significance in constructing expression vectors.
Promoter-probe vectors – Reporter genes (lacZ, g*f*p, Gus, luciferase)

UNIT – IV

Introducing cloned gene into host

Insertion of desired DNA into vector DNA – ligation (cohesive and blunt end), linkers, adapters, homopolymer tailing.Introduction of cloned genes into host – Transformation, alpha complementation, conjugation, transfection, electroporation, particle bombardment, microinjection, and liposome mediated DNA delivery. Screening of genomic/cDNA libraries – genetic, molecular hybridization, immunochemical techniques.
Problems associated with expression of cloned genes-Inclusion bodies.

The biology and types of stem cells. Stem cell plasticity; Transdifferentiation; Cell cycle dynamics of different stem cells. Stem cell therapies – treatment process, examples: neurodegenerative disease- Parkinson's; tissue system failures – diabetes and cardiomyopathy.

UNIT – V

Applications of Genetic engineering

Applications of genetic engineering in agriculture, animal husbandry, medicine and in industry. Genetically modified organisms.Gene therapy.Antisense technology and its application.Use of transposon tagging.

- **Course Learning Outcome(s):**

1. To illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences.
2. To expose students to applications of recombinant DNA technology in biotechnological research.
3. To train students in strategizing research methodologies employing genetic engineering techniques.

- **Text books :**

1. Molecular biology, Vol-7, 1991. E.J. Murray ed. Humana Press. Clifton, NJ. PP.439. Genes IV. 1990. B. Lewin. Oxford University Press. PP 857
2. Guide to molecular cloning technique: Methods in enzymology. 152. 1987. S.L. Berger and A.R. Kimmel Ed. Academic Press. PP812
3. Methods in molecular genetic: Molecular microbiology techniques. Vol. 3. 1994, Knneth W. Adolph. Ed, Academic Press. PP2150
4. Laboratory manual in molecular genetic: 1994. Z.F. Burton and J.M. Kaguni. Harcort Brace.PP224
5. Methods in Molecular Genetics. Vol.5, 1994. Kenneth. W. Adolph. Harcourt Brace. PP 425,
6. Molecular Cloning: A Laboratory Manual. 1989. 2nd ed. J. Sanbrook, E.F. Fritsch and T. Maniatis. Cold Spring Harbour Laboratory Press.
7. Methods in Enzymology: Vol. 152. Guide to Molecular Cloning Techniques. 1987. S.L. Bergerand A.R. Kimmel. Eds. Academic Press.
8. Recombinant DNA Laboratory Manual. 1989. J. W. Zyskind and S.I. Bernstein. Academic Press
9. Methods in Molecular Genetics. Vol. 7, Viral Gene Techniques. Ed. By Kenneth W. Adolph, Academic Press, 1995.
10. Gene Transfer and expression protocol: Methods in Molecular Biology, Vol. 7. 1991. E.J. Murray Ed. Human Press. Clifton, NJ. PP349.

- **Reference books:**

- **E- content / E-books (optional)**

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003

DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY

M.Sc –BIOTECHNOLOGY, III SEMESTER

Paper Code &Title: 20 BIT305: Immunology & Bio- informatics & Bio-statistics lab

No. of hours per week: 8 Total credits: 4

Total marks: 100 (Continuous evaluation: 30 M & External: 70 M)

- **List of experiments :**

Immunology & Immunotechniques

1. Isolation of immune organs from rat
2. Blood film preparation and identification of cells. Differential count of WBC, RBC.
3. Blood typing
4. Lymphoid organs and there microscopic organization
5. Immunization and production of polyclonal antibodies.
6. Double diffusion and Immuno Electrophoresis
7. Single radial immuno diffusion
8. WIDAL test
9. VDRL test
10. HCG detection in urine
11. Purification of IgG from serum
12. Separation of mono nuclear cell by Ficoll-Plaque
13. Con-A induced proliferation of thymocytes (by MTT method)

Bio- informatics & Bio- statistics

1. Measures of central tendency (Mean, Mode, Median)
2. Measures of dispersions
3. Correlation and regression
4. CHI-square
5. Tests of hypothesis and test of significance
6. Analysis of variance
7. Searching data from NCBI
8. Sequence identification and sequence format
9. Database search using BLAST
10. Pairwise alignment
11. Multiple sequence alignment
12. Visualizing 3D structure of protein

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003

DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY

M.Sc –BIOTECHNOLOGY, III SEMESTER

Paper Code &Title: 20 BIT306 : Cell & Tissue Culture Techniques & Genetic Engineering lab

No. of hours per week: 8 Total credits: 4

Total marks: 100 (Continuous evaluation: 30 M & External: 70 M)

- **List of experiments**

Cell & Tissue Culture Techniques

1. Callus Culture
2. Organogenesis
3. Anther Culture
4. Embryogenesis
5. Suspension Culture
6. Secondary metabolite Production in a Cell Suspension Culture
7. Isolation of Protoplast (Mechanical Method)
8. Isolation Of Protoplast (Enzymatic Method)
9. Protoplast Fusion & Protoplast Staining
10. Preparation of single cell suspension from lymphoid organs
11. Estimation of cell number using Haemocytometer
12. Assessment of cell Viability
13. Observation of embryonic cell fusions
14. Effect of cold and warm tripsinization on disaggregation of cells
15. Isolation of DNA from animal tissue and determination of Molecular weight using Electrophoresis

Genetic Engineering

1. PCR
2. RT-PCR
3. Random Amplified Polymorphic DNA
4. Restriction Fragment Length Polymorphism
5. AFLP - demonstration
6. Southern Hybridization
7. Northern Hybridization- demonstration
8. Bacterial Transformation
9. Bacterial conjugation

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003

DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY

M.Sc – BIOTECHNOLOGY, IV SEMESTER

Paper Code &Title: 20 BIT401 : MOOCS COURSE

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

Procedure for conduct and evaluation of MOOCS:

Please Refer Column No.**5.8** of Krishna University Academic regulations(R20) for M.Sc, M.A and M.Com (https://kru.ac.in/directorates-of-krishna-university/directorate-of-academic-audit-daa/regulations-daa/) .

- **Course Learning Objective(s):**
  - To make students to understand the

- **Course Learning Outcome(s):**

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

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003

DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY

M.Sc – BIOTECHNOLOGY, IV SEMESTER

Elective -I

Paper Code &Title: 20 BIT402.1 : Developmental Biology

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

- **Course Learning Objective(s):**

  1. To make student to understand the how complex multicellular organisms with diverse forms and cell types arise from single cells. The field spans molecular biology, genetics, cell biology, ecology and evolution.

UNIT – I

History & basic concepts of development : Overview of how the modern era of developmental biology emerged through multidisciplinary approaches, stages of development- zygote, blastula, gastrula , neurula, cell fate & commitment – potency- concept of embryonic stem cells, differential gene expression, terminal differentiation ,lineages of three germ layers, fate map, Mechanisms of differentiation-cytoplasmic determinants, embryonic induction, concept of morphogen, mosaic and regulative development, Pattern formation-- axis specification, positional identification (regional specification), Morphogenetic movements, Model organisms

UNIT – II

Early Development in invertebrate /vertebrate models -Drosophila, C.elegans, Xenopus, Mouse/ human: Cleavage, gastrulation, Axis specification (Dorsoventral, anterior posterior), & body plan patterning, left right asymmetry in vertebrates

UNIT – III

Late Development in invertebrate /vertebrate models :Organogenesis- development of ectodermal organs, mesodermal organs, endodermal organs, vulval formation in C.elegans

UNIT – IV

Plant Development : Introduction and overview of plant development in Arabidopsis thaliana.

Developmental strategies of plants: gamete production in plants-gametophytes, icrosporogenesis, pollination, fertilization; Embryo development-embryogenesis, dormancy, germination, vegetative growth, Development of root, shoot and leaf; vegetative to reproductive transition; senescence

UNIT – V

Germ cell specification& migration **.** Medical implications of developmental biology - Genetic errors/ teratogenesis/ stem cell therapy etc

❖ **Course Learning Outcome(s):**

1. The student will gain knowledge on stages and morphological changes of development common to most multicellular organisms (Plants and Animals).
2. The student able to explain the hierarchy of gene activation that occurs in early development of invertebrates and vertebrates.
3. The student understands how gene activation plays a role in differentiation and development

- **Text books :**
- Developmental Biology- Scott F Gilbert and Michael Barresi,11 th edition
- Essential Developmental Biology - Jonathan Slack
- Principles of Development - Lewis Wolpert
- Developmental Biology,-Werner A Muller
- Website: virtual embryo- http://people.ucalgary.ca/~browder/virtualembryo/dev_biol.html

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

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003

DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY

M.Sc – BIOTECHNOLOGY, IV SEMESTER

Elective -I

Paper Code &Title: 20 BIT402.2 : Environmental Biotechnology

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

❖ **Course Learning Objective(s):**

1. The student will gain knowledge on the role and status of biotechnology in environment protection and pollution mitigation.

UNIT – I

Environmental Biotechnology: Definition, Scope and role of Biotechnology in Environment Protection, Current Status of Biotechnology in Environment Protection.

Bioreactors for Waste–Water Treatment: Aerobic biological Treatments (Activated sludge process, biological filters, Rotating Biological Contactors (RBC), Fluidized Bed reactors (FBR). Anaerobic Biological treatments: Contact Digesters, Packed column reactors, Anaerobic Baffled reactor, Upflow Anaerobic Sludge Reactor (UASB).

UNIT – II

Biomass based energy: Biofuels and Production of first, second and third generation Biofuels. Role of microbes in energy production, biogas production (Methanogenic bacteria), microbial hydrogen production, ethyl alcohol production from sugarcane and single cell protein (SCP).

UNIT – III

Biofertilizers: Use of microbes as biofertilizers to improve crop productivity, Role nitrogen fixing bacteria in the enrichment of soil, Algal and fungal biofertilizers (VAM).Composting of organic wastes. Vemicomposting. Biopesticides: Bacterial (Bt pesticides) and fungal (Trichoderma).

UNIT – IV

Bioremediation: Definition, need and scope of bioremediation, types of bioremediation. Bioremediation of soil and water contaminated with oil spills, heavy metals and pesticides by soil microorganisms. Phytoremediation- cleaning up the environment by plants. Phytoremediation of heavy metal contaminated soils.

UNIT – V

Microbial Mining – Use of microbes in biomineralization. Bioleaching. Biotechnology for air pollution abatement and odor control: Deodorization process - bioscrubbers, biobeds, Biotrickling filters. Conservation of biodiversity using Biotechnology.

❖ **Course Learning Outcome(s):**

1. The student will able to explain the Scope and role of Environmental Biotechnology in near future and types of bioremediation technologies.
2. Use of microbes in different processes of mining.

➢ **Text books :**

1. A textbook of Biotechnology- R.C.Dubey
2. Textbook of Biotechnology-H.K.Das
3. Biotechnology- Dr.U.Satyanarayana
4. Plant Biotechnology- H.S.Chawla
5. Plant Biotechnology & Genetic Engineering by C.M.Govil, Ashok Agarwal & Jitender sharma
6. Plant Biotechnology-Willliam G.Hopkins
7. Environmental Biotechnology by T.Srinivas, 1st Edition, New Age International Publications.
8. Environmental bio technology Theory and Application, Gareth M. Evans & Judith Furlong, Wiley Publications.
9. Biotechnology: A Biosystems Approach, Daniel A. Vallero, AP Publications.
10. Environmental Biotechnology. S.V.S.Rama Rastogi Publications.
11. Introduction to Environmental Biotechnology A.K.Chatterji, P.Hall of India.
12. Environmental Biotechnology Basic Concepts & Applications by Indu Shekhar Thakur

➢ **Reference books:**

➢ **E- content / E-books (optional)**

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003

DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY

M.Sc – BIOTECHNOLOGY, IV SEMESTER

Elective -II

Paper Code &Title: 20 BIT403.1 : Bio-Process Engineering& Technology

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

- **Course Learning Objective(s):**
  To educate students about the fundamental concepts of bioprocess engineering & technology and its related applications, thus preparing them to meet the challenges of the new and emerging areas of biotechnology industry.

UNIT – I

Isolation, screening and maintenance of industrially important microbes; microbial growth 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; conventional fermentation v/s biotransformation; Solid substrate, surface and submerged fermentation; Fermentation economics; Fermentation media; Fermenter design - mechanically agitated; pneumatic and hydrodynamic fermenters; Large scale animal and plant cell cultivation and air sterilization: Upstream processing; media formulation; sterilization; aeration and agitation in bioprocess; Measurement and control of bioprocess parameters; Scale up and scale down process.

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; Large scale production and purification of recombinant therapeutics (streptokinase, epidermal growth factor, insulin).

UNIT – V

Industrial production of recombinant proteins (riboflavin, streptomycin, tPA). Scenario of Indian biotech industries (local, state and national wide).

- **Course Learning Outcome(s):**

  The student will gain knowledge about important microbial/ industrial processes in beverage, pharma, food and nutraceutical industry and present unit operations together with the fundamental principles for basic methods in production technique for bio-based products.

- **Text books :**

1.Principle of fermentation technology by Stanbury, 2nd Edition, Elsevier.

2. Industrial Biotechnology by Creuger & Creuger, 2nd Edition, Panima publishers.

3. Industrial Microbiology: An Introduction by MJ Waites et al., 1st Editon, Blackwell Science Ltd.

4. Modern Industrial Microbiology and Biotechnology by Nduka Okafor & BC Okeke, 2nd 43 Edition, CRC Publishers.

5. Industrial Microbiology by LE Casida Jr., 2nd Edition, New Age International Publishers.

6. Biochemical engineering fundamentals by Bailey & Ollis, 2nd Edition, Intl. Pub.

7.Molecular Biotechnology: Principles and applications of recombinant DNA technology by BR Glick, JJ Pasternak & CL Patten, 4th Edition, ASM Press.

8. Biotechnology and genomics by PK Gupta, Rastogi Publications. 9. Environmental Biotechnology by Forster CF & Wase DAJ, Ellis Horwood Ltd.

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

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY

M.Sc – BIOTECHNOLOGY, IV SEMESTER

Elective -II

Paper Code &Title: 20 BIT403.2 : Molecular Therapeutics

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

- **Course Learning Objective(s):**

Unit - I

Gene therapy; Intracellular barriers to gene delivery; Overview of inherited and acquired diseases for gene therapy; Retro and adeno virus mediated gene transfer; Liposome and nanoparticles mediated gene delivery.

Unit- II

Cellular therapy; Stem cells: definition, properties and potency of stem cells; Sources: embryonic and adult stem cells; Concept of tissue engineering; Role of scaffolds; Role of growth factors; Role of adult and embryonic stem cells; Clinical applications; Ethical issues.

Unit -III

Recombinant therapy; Clinical applications of recombinant technology; Erythropoietin; Insulin analogs and its role in diabetes; Recombinant human growth hormone; Streptokinase and urokinase in thrombosis; Recombinant coagulation factors.

Unit - IV

Immunotherapy; Monoclonal antibodies and their role in cancer; Role of recombinant interferons; Immunostimulants; Immunosupressors in organ transplants; Role of cytokine therapy in cancers; Vaccines: types, recombinant vaccines and clinical applications

Unit - V

Gene silencing technology; Antisense therapy; si RNA; Tissue and organ transplantation; Transgenics and their uses; Cloning; Ethical issues

Texts/References:

1. Bernhard Palsson and Sangeeta N Bhatia, Tissue Engineering, 2nd Edition, Prentice Hall, 2004.

2 .Pamela Greenwell, Michelle McCulley, Molecular Therapeutics: 21st century medicine, 1st Edition, Sringer, 2008.

- **Course Learning Outcome(s):**

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

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003

DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY

M.Sc – BIOTECHNOLOGY, IV SEMESTER

Paper Code &Title: 20 BIT404: Molecular Virology

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

- **Course Learning Objective(s):**

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

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

Unit - IV

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

Unit - V

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

- **Text 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.

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

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003

DEPARTMENT OF BIOSCIENCES & BIOTECHNOLOGY

M.Sc –BIOTECHNOLOGY, IV SEMESTER

Paper Code &Title:: 20 BIT405 : Molecular Virology lab

No. of hours per week: 8 Total credits: 4

Total marks: 100 (Continuous evaluation: 30 M & External: 70 M)

- **List of experiments**

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

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003

DEPARTMENT OF BIOSCIENCES & BIOTECHNOLOGY

M.Sc –BIOTECHNOLOGY, IV SEMESTER

Paper Code &Title:: 20 BIT406 : Project Work

Total credits: 8

Total marks: 200 (Internal evaluation: 50 M & External: 150 M)

- **PROJECT:**

Project midterm review	50 marks
Project evaluation	150 marks

- **Procedure for Conduct and Evaluation of Project Midterm review:**

After selecting the specific project topic, the student shall collect the information and prepare an abstract, showing his/her understanding of the proposed project topic as a summary and submit the same to the department before implementation of the project in the beginning of the IV Semester. The status of the project work will be reviewed and the presentation shall be evaluated by the departmental committee consisting of Head of the Department, Project supervisor and a senior faculty member after two months of the project. It shall be evaluated for 50 marks. A student shall acquire 2 credits assigned to the Project midterm review, when he/she secures 40% or more marks for the total of 50 marks. There shall be no external evaluation for Project midterm review.

In case, if a student fails in Project midterm review, a re-review shall be conducted within a month. In case if he/she fails in the re-review also, he/she shall not be permitted for Project Evaluation. Further, such students shall reappear as and when IV semester regular examinations are conducted.

Procedure for Conduct and Evaluation of Project Evaluation:

Out of a total of 200 marks, 50 marks for **Project Review** and for the **Project Evaluation**, 100 marks shall be for Project report/thesis/record and 50 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 – 521003

Open Electives offered by the Department of Biosciences and Biotechnology

- M..Sc : **II semester**

- OPEN ELECTIVE -1

Paper Code &Title 20 OEBIT 207 : Entrepreneurship in Biotechnology

This Paper offered to all programs other than M.Sc Biotechnology, M.Sc Botany and M.Sc Zoology.

- M..Sc : **III semester**

- OPEN ELECTIVE -2

Paper Code &Title : 20 OEBIT 307: Disease and Health Management

This Paper offered to all programs other than M.Sc Biotechnology, M.Sc Botany and M.Sc Zoology.

Note : Students who are having these papers/content of these papers in their curriculum are not allowed to opt for the above cited open electives**.**

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc : **II** semester**, OPEN ELECTIVE -1**

Paper Code &Title 20 OEBIT 207 : Entrepreneurship in Biotechnology

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

Course Learning Objective(s):

- To understand the processes of value addition to develop novel products, services and their possible commercialization.

UNIT - I

Integration of Science, technology and business. Basic principles and practices of management-Definition, concepts and application; Organization types, coordination, control and decision making in management .Entrepreneurship in the biotechnology context; Case studies of successful and unsuccessful bio-entrepreneurs.

UNIT - III

Biotechnology: emerging industries with examples from Transgenic, Environmental biotechnology, New drug development, DNA chip technology, Stem cell research, Tissue engineering. Contract Research Organization, marketing consultancy, bio-learning module etc.

UNIT - IV

Factors affecting biotech business: (finance, infrastructure, equipment, manpower , resources , project location, end product, quality issues, etc).Core concept of Market: Identification and evaluation of market potential of various bio-entrepreneur sectors. Marketing, Marketing research- concept and techniques. Role of Indian government and schemes, financial institutions in fostering bio-entrepreneurship.

UNIT- V

Personality and attitude, Organizational behavior, Leadership Principles of effective communication Body language, public speaking, presentations, business proposal writing. Communication aid and application of technology. Career Opportunities in the Life Sciences Industry. Public policy, regulatory and ethical challenges facing the entrepreneurial biotechnology firm.

Learning outcome (s):

- The Student will gain knowledge about value addition to develop novel products, services and their possible commercialization

Recommended Books:

1. Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies (2014); Craig Shimasaki, ed. Elsevier Inc.
2. Innovation and Entrepreneurship in Biotechnology, An International Perspective Concepts, Theories and Cases (2006); Damian Hine and John Kapeleris Edward Elgar Publishing Limited.
3. Information for startups from Indian Govt website, BIRAC website.

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc : **III** Semester**, OPEN ELECTIVE -2**

Paper Code &Title : 20 OEBIT 307: Disease and Health Management

No. of hours per week: 04 Total credits: 04

Total marks: 100 (Internal: 30 M & External: 70 M)

- **Course Learning Objective(s):**

- To understand the Disease prevention and control measures.
- Water borne diseases and Food infections and their control measures.
- Basic knowledge about antibiotics & vaccines

UNIT-I

Disease : Types of diseases. Concepts of Disease, Phases of Disease, The Disease Causative Agents, Host Factors of Disease, Modes of Transmission of Disease, Disease Prevention and Control, Air borne infections and control of air-borne microorganisms. Cause, mode of infection, symptoms and control measures of COVID-19 and Tuberculosis. Antibiotics- narrow spectrum, broad spectrum, sensitivity and resistance .Vaccines- principle and types (briefly).

UNIT-II

Drinking water: Impurities, Indicator organisms and water disinfection. Cause, mode of infection, symptoms and control measures of Water borne diseases - Cholera, Typhoid, and Hepatitis .

UNIT-III

Food borne infections- food poisoning and food intoxication - Food intoxication (Botulism and Staphylococcal poisoning), Food borne diseases (Salmonellosis and Shigellosis) and their detection. General account of food preservation (Heat, Dehydration, Osmotic Pressure, Chemical and Radiation Treatments).

UNIT-IV

Common Vector borne Diseases in India: Cause, symptoms and control measures of Malaria , Dengue Chikungunya and Filaria . Control of domestic/household pests like cockroaches, house flies and Rodents.

UNIT-V

Personal Hygiene : Personal Habits, Home Sanitation, Health impacts of Cigarette Smoking and Alcoholism, Mental Health and Daily Allowance of Nutrients. Sanitation in Education Institutions, hospitals, at public bathing places and swimming pools.

Learning outcome: The student will gain knowledge on disease and health management.

Recommended Books:

1. Textbook of Microbiology (6th edition) by Ananthanarayan and C.K.J.Paniker.
2. Textbook of Medical Parasitology (2013) by S.C. Panija.
3. Textbook of Medical Parasitology (6th edition) by C.K.J. Paniker.
4. Medical Microbiology (26th edition) by Jawetz et.al.
5. Medical Microbiology (26th edition) by Melnick andAdelberg
6. Medical Microbiology (16th edition) by D. Greenwood et.al.
7. Medical Microbiology (7th edition) by P. R.Murray

.

TEMPLATE FOR FIRST MIDTERM EXAMINATION PAPER

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc – Biotechnology, I SEMESTER

First Midterm Examination, Month & year

Paper Code &Title: 20 BIT101: Cell Biology & Genetics

(Model Paper w.e.f 2020-21 admitted batch)

Time : 90 Minutes Max. Marks : 30 Marks

Answer ALL questions **(5X2 = 10 Marks)**

1.
2.
3.
4.
5.

Answer Four questions choosing One question from each Unit.
All questions carry Equal marks.

(4X5 = 20 Marks)

6. UNIT-1

a.

(OR)

b.

7. UNIT-2

a.

(OR)

b.

8. UNIT-1 or UNIT-2

a.

(OR)

b.

9. UNIT-1 or UNIT-2 or UNIT-3

a.

(OR)

b.

TEMPLATE FOR SECOND MIDTERM EXAMINATION PAPER

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc – Biotechnology,I SEMESTER

Second Midterm Examination, Month & Year

Paper Code &Title: 20 BIT101: Cell Biology & Genetics

(Model Paper w.e.f 2020-21 admitted batch)

Time : 90 Minutes Max. Marks : 30 Marks

Answer ALL questions **(5X2 = 10 Marks)**

1.
2.
3.
4.
5.

Answer Four questions choosing One question from each Unit.
All questions carry Equal marks.

(4X5 = 20 Marks)

6. UNIT-4

a.

(OR)

b.

7. UNIT-5

a.

(OR)

b.

8. UNIT-4 or UNIT-5

a.

(OR)

b.

9. UNIT-3 or UNIT-4 or UNIT-5

a.

(OR)

b.

TEMPLATE FOR SEMESTEREND EXAMINATION PAPER

KRISHNA UNIVERSITY, MACHILIPATNAM – 521003
DEPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY
M.Sc – Biotechnology, I SEMESTER

Paper Code &Title: 20 BIT101 : Cell Biology & Genetics

(Model Paper w.e.f 2020-21 admitted batch)

Time : 3 hours Total marks: 70 M

1. **Answer all questions** (Two questions from each unit) (10x2=20 Marks)

a.
b.
c.
d.
e.
f
g.
h.
i.

Answer **Five Questions** choosing **One question** from **each unit** (A or B). (5x10=50 Marks)

All questions carry equal marks.

2. A).
   B).

3. A).
   B).

4. A).
   B).

5. A).
   B).

6. A).
   B).