BSc Biotechnology Program (4 years Honors) Syllabus

Choice Based Credit System (CBCS)

2020-21

Members of BOS (Contact details)		
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Dr. Gore Mustan Shaik (Member)	Aditya Degree College, Kakinada	-

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Note: BOS is to provide final soft copy in PDF and word formats and four copies of hard copies in bounded form to the office of Dean Academic affairs.

1. Resolutions of the Board of Studies

Meeting held on 22-01-2021
Time: 10:00 AM
At: N.T.R Convention Centre,
Adikavi Nannaya University, Rajamahendravaram

Agenda:

1. Adoption of revised-common program structure and revising/updating course-wise syllabi (in the prescribed format) as per the guidelines issued by APSCHE
2. Adoption of regulations on scheme of examination and marks/grading system of the UG program
3. Preparation of Model question papers in prescribed format
4. List of equipment / software requirement for each lab/practical
5. Eligibility of student for joining the course
6. Eligibility of faculty for teaching the course
7. Any specific instructions to the teacher/paper-setter/student/ chief-superintendent/ paper-evaluator
8. List of paper-setters/paper evaluator with phone, email-id in the prescribed format

Members present:

1. Dr A. Matta Reddy
2. Dr S. Murali Mohan
3. Sri Y. Ravi Chand

Resolutions:
It is resolved to add three practical aspects in the following papers from II SEM and IV SEM

1. BT-201: Microbiology, Cell and Molecular Biology (practical added - Demonstration, use and care of microbial equipment is added)
2. BT-401 (i) Plant and Animal Biotechnology (practical added -cytology of callus)
3. BT-401 (ii) Environmental & Industrial Biotechnology (practical added -Production of citric acid by submerged fermentation)

2. DETAILS OF PAPER TITLES & CREDITS

Sem	Course no.	Course Name	Course type (T/L/P)	Hrs./ Week (Arts/ Commeerce:5 and Science: 4+2)	Credits (Arts/ Commeerce:4 and Science: 4+1)	Max. Marks Cont/ Internal/Mid Assessment	Max. Marks Sem-end Exam
I	1	Bio-molecules & Analytical Techniques	T and L	4+2	4+1	25	75
II	2	Microbiology, Cell and Molecular Biology	T and L	4+2	4+1	25	75
III	3	Immunology and rDNA technology	T and L	4+2	4+1	25	75
IV	4	Plant and Animal Biotechnology	T and L	4+2	4+1	25	75
	5	Environmental & Industrial Biotechnology	T and L	4+2	4+1	25	75
V							

Note: *Course type code: T: Theory, L: Lab, P: Problem solving

a. Proposed combination subjects: Biotechnology, Microbiology, Chemistry; Biotechnology, Biochemistry, Chemistry

b. Student eligibility for joining in the course: Intermediate / 10+2 or any other equivalent course with Biology

c. Faculty eligibility for teaching the course: M.Sc. Biotechnology

d. List of Proposed Skill enhancement courses with syllabus, if any

e. Any newly proposed Skill development/Life skill courses with draft syllabus and required resources

f. Required instruments/software/ computers for the course (Lab/Practical course-wise required i.e., for a batch of 15 students)

Sem. No.	Lab/Practical Name	Names of Instruments/Software/ computers required with specifications	Brand Name	Qty Required
1	Bio-molecules & Analytical Techniques Lab	Photo Colorimeter, UV VIS Spectrophotometer, PH meter, Double Distillation unit	Elico/ Equiptronics	2
2	Microbiology, Cell and Molecular Biology Lab	Autoclave, Compound microscope, Gel Electrophoresis, PCR Machine, Gel Doc	Olympus microscope, Biorad PCR	1
3	Immunology and rDNA technology Lab	ELISA Kit, Water bath, Ice making machine,	Thermo	1
4	Plant and Animal Biotechnology	Lab Centrifuge, PCR Machine	Systronics	1
5	Environmental & Industrial Biotechnology Lab	Lab fermenter	Steri Fermenter	1

g. List of Suitable levels of positions eligible in the Govt/Pvt organizations
Suitable levels of positions for these graduates either in industry/govt organization like., technical assistants/ scientists/ school teachers., clearly define them, with reliable justification

S.No	Position	Company/ Govt organization	Remarks	Additional skills required, if any
1	Project Assistant	CSIR Institutes/ other central and State Research laboratories	none	Job training/ certificate program/ apprentice
2	Trainee/Apprentice/Skilled Assistant/ Field Assistants	State/ Central Agricultural Research laboratories; Pharma/ Biotech	none	Certificate course

h. List of Govt. organizations / Pvt companies for employment opportunities or internships or projects

S. No	Company/ Govt organization	Position type	Level of Position			
1	Pharma/Biotech companies	Research Assistant	-			
2	ICAR/CSIR institutes	Scientific Assistant/ Junior Scientist	-			

i. Any specific instructions to the teacher /paper setters/Exam-Chief Superintendent

3. Program objectives, outcomes, co-curricular and assessment methods

BSc	Biotechnology

1. Aim and objectives of UG program in Subject:

   The Biotechnology degree program provides students with robust science concepts and an application-oriented undergraduate education. The program is aimed to prepare students for employment opportunities in the biotechnology industry. In addition, students gain the in-depth knowledge and core set of skills that span across basic sciences, technology. This is an unique program in the State of Andhra Pradesh to integrate plant, animal, medical and environmental biotechnology into an undergraduate curriculum.
2. Learning outcomes of Subject:
   The courses are strongly interdisciplinary in nature and they will give an insight into basic aspects of microbiology, immunology, molecular biology, biochemical, biophysical aspects and different application in medical, industrial biotechnology and environmental biotechnology

3. Recommended Skill enhancement courses: (Titles of the courses given below and details of the syllabus for 4 credits (i.e., 2 units for theory and Lab/Practical) for 5 hrs class-cum-lab work

4. Details of course-wise Syllabus

BSc	Biotechnology (Semester: I)	Credits: 5
Paper: 1	Bio-molecules & Analytical Techniques	**Hrs/Wk: 6**

4.1 Aim and objectives of Course:

To ensure students gain knowledge about the structure, properties and functions of biomolecules and characterization of biomolecules using analytical techniques

4.2 Learning outcomes of Course (in consonance with the Bloom's Taxonomy):

The course will provide an insight into various aspects of basic aspects of biomolecules and different aspects of biophysical and biochemical techniques applied in the field of biology

4.3 Detailed Syllabus (Five Units with each having 12 hours of class work)

B.Sc., Biotechnology: I Semester W.E.F. 2020-21
Paper 1: Bio-molecules & Analytical Techniques

Total Hours: 60 **Credits: 4**

Unit-I-Carbohydrates, Protein and Lipids

Classification, structure, properties of carbohydrates. Classification, structure and properties of amino acids, peptide bond and peptides. Classification, structure (primary, secondary, tertiary, quaternary) and functions of proteins. Denaturation and renaturation of proteins. Classification structure and properties of saturated and unsaturated fatty acids. Structure and functions of glycolipids, phospholipids, and cholesterol.

Unit-II- Nucleic acid, Vitamins and Bioenergetics

Structure and functions of DNA and RNA. Source, structure, biological role and deficiency manifestation of vitamin A, B, C, D, E and K. Free energy, entropy, enthalpy and redox potential. High energy compounds, Glycolysis, TCA cycle, Electron-Transport System and Oxidative Phosphorylation.

Unit-III-Centrifugation, Chromatography and Electrophoresis

Basic principles of sedimentation and types of centrifugations. Principle, instrumentation and application of partition, absorption, paper, TLC, ion exchange, gel permeation, affinity chromatography. Introduction to HPLC, GCMS and LCMS. Basic principles and types of electrophoresis, factors affecting electrophoretic migration. PAGE (Native, SDS-PAGE). Introduction to 2D & Isoelectric Focusing.

Unit - IV-Spectroscopy, Microscopy and Laser Techniques

Beer-Lambert law, light absorption and transmission. Extinction coefficient, Design and application of photoelectric calorimeter and UV-visible spectrophotometer. Introduction to crystallography and application. Types and design of microscopes - compound, phase contrast, fluorescent electron microscopy (TEM, SEM). Introduction to radioisotopes, measurement of radioactivity (scintillation counter and autoradiography).

Unit –V- Biostatistics

Mean, median, mode, standard deviation, One-way Anova, Two-way Anova, t-test, F-test and chi-square.

Recommended Books:

1. Outlines of Biochemistry, 5th Edition, (2009), Erice Conn & Paul Stumpf; John Wiley and Sons, USA
2. Principles of Biochemistry, 4th edition, (1997), Jeffory Zubey; McGraw-Hill College, USA
3. Principles of Biochemistry, 5th Edition (2008), Lehninger, David Nelson & Michael Cox; W.H. Freeman and Company, NY
4. Fundamentals of Biochemistry, 3rd Edition (2008), Donald Voet & Judith Voet; John Wiley and Sons, Inc. USA
5. Biochemistry, 7th Edition, (2012), Jeremy Berg & Lubert Stryer; W.H.Freeman and Company, NY
6. Textbook of Biochemistry with Clinical Correlations, 7th Edition, (2010), Thomas M. Devlin; John Wiley and Sons, USA
7. Proteins: biotechnology and biochemistry, 1st edition, (2001), Gary Walsch; Wiley, USA
8. Biochemical Calculations, 2nd Ed., (1997), Segel Irvin H; John Wiley and Sons, NY
9. Biophysical Chemistry Principles & Techniques Handbook, (2003), A. Upadhyay, K. Upadhyay, and N. Nath
10. Enzymes: Biochemistry, Biotechnology & Clinical chemistry, (2001), Palmer Trevor, Publisher: Horwood Pub. Co., England.
11. Analytical Biochemistry, 3rdedition, (1998), David Holmes, H.Peck, Prentice-Hall, UK
12. Introductory Biostatistics, 1st edition, (2003), Chap T. Le; John Wiley, USA.
13. Methods in Biostatistics, (2002), B. K. Mahajan –Jaypee Brothers.
14. Statistical methods in biology, (1995), Bailey, N. T.; Cambridge university press

Paper 1: Bio-molecules & Analytical Techniques Lab

Total Hours: 30 **Credits: 1**

Details of Lab/Practical/Experiments/Tutorials syllabus:

1.Introduction to basic instruments (Principle standard operation procedure) demonstration and record
2.Calculation of molarity, normality and molecular weight of compounds.
3.Qualitative analysis of carbohydrates (sugars)
4.Quantitative analysis of carbohydrates
5.Quantitative estimation of protein - Lowery method
6.Estimation of DNA by diphenylamine reagent
7.Estimation of RNA by orcinol reagent
8.Assay of protease activity
9.Preparation of starch from potato and its hydrolyze by salivary amylase
10Preparation of standard buffer and pH determination
11.Separation of amino acids by paper chromatography
12.Separation of lipids of TLC
13.Agarose gel electrophoresis
14.Calculation of mean, median and mode

Recommended books:

1. An Introduction to Practical Biochemistry, 3rd Edition, (2001), David Plummer; Tata McGraw Hill Edu. Pvt.Ltd. New Delhi, India
2. Biochemical Methods,1st Edition, (1995), S.Sadashivam, A.Manickam; New Age International Publishers, India

4. Recommended Co-curricular activities: (Co-curricular Activities should not promote copying from text book or from others' work and shall encourage self/independent and group learning)

   A. Measurable:
      1. Assignments on:
      2. Student seminars (Individual presentation of papers) on topics relating to:
      3. Quiz Programmes on:
      4. Individual Field Studies/projects:
      5. Group discussion on:
      6. Group/Team Projects on:

   B. General
      1. Collection of news reports and maintaining a record of paper-cuttings relating to topics covered in syllabus
      2. Group Discussions on:
      3. Watching TV discussions and preparing summary points recording personal observations etc., under guidance from the Lecturers
      4. Any similar activities with imaginative thinking.

5. Recommended Continuous Assessment methods:

5. MODEL QUESTION PAPER (Sem-end. Exam)

UG program: B.Sc. Biotechnology
Semester: I
Paper 1: Bio-molecules & Analytical Techniques

Time: 3 hours **Max Marks: 75M**

SECTION – A

Answer any 5 questions. Each question carries 5 marks (5 X 5M = 25M)
(Total 8 questions and at least two questions should be given from each unit)

1. Denaturation and Renaturation of Proteins
2. Structure and functions of cholesterol
3. Entropy and Enthalpy
4. High energy compounds
5. Types of centrifugations
6. Factors affecting electrophoretic migration
7. Beer-Lambert's law
8. Extinction coefficient

SECTION – B

Answer all the questions. Each question carries 10 marks (5 X 10M = 50M)

9. Write about classification, structure and properties of amino acids

or

Write about structure and classification of saturated and unsaturated fatty acids

10. Explain biological role and deficiency manifestations of vitamin – A, B, C, D, E and K

or

Explain Glycolysis process with a flow chart

11. Explain gel filtration chromatographic technique

or

Explain about UV VIS spectrophotometer

12. Describe the basic principles and types of electrophoresis

or

Explain the measurements of radioactivity

13. Explain about One-way and Two-way ANOVA

or

Define mean, median and mode with examples

MODEL QUESTION PAPER
UG program: B.Sc. Biotechnology
Semester: I

Paper 1: Bio-molecules & Analytical Techniques Lab

Time: 3 hours **Max Marks: 50M**

1. Estimation of DNA by Diphenylamine method 20M
2. Write principle of paper chromatography and separate aminoacids 10M
3. A) Principles of qualitative analysis of carbohydrates 2- ½

   b) Find normality of a given compound with equation 2- ½
4. Spotter

   1) Spectrophotometer - 2- ½

   2) Centrifuge - 2- ½
5. Record 5 M
6. Viva 5 M

BSc	Biotechnology (Semester: II)	Credits: 5
Paper: 2	Microbiology, Cell and Molecular Biology	Hrs/Wk: 6

Aim and objectives of Course:

To ensure students gain knowledge about the microbiology, cell and molecular biology aspects

Learning outcomes of Course:
The course will provide an insight into basic aspects of microbiology, cell and molecular biology

B.Sc., Biotechnology

B.Sc., -II Semester W.E.F. 2020-21

TOTAL HOURS: 60 **CREDITS: 4**

Paper 2: Microbiology, Cell and Molecular Biology

Course Objectives: To acquaint students with concepts of microbiology, cell and molecular biology. This course is aimed to give an understanding of the basics of microbiology, dealing types of microbes, classification and their characterization, structure and function of prokaryotic and eukaryotic cell organelles, cell division and basics of molecular biology including DNA replication, transcription, translation and regulation of gene expression.

Unit-I- Scope and Techniques of Microbiology

History and contribution of Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister and Alexander Fleming. Ultrastructure of bacteria and growth curve. Pure culture techniques. Sterilization techniques, principles and application of physical methods (autoclave, hot air oven, incineration), chemical methods and radiation methods. Simple, gram and acid-fast staining.

Unit-II-Microbial Taxonomy and Metabolism

Concepts of microbial species and strains. Classification of bacteria based on morphology, nutrition and environment. General characteristics, transmission and cultivation of viruses. Structure and properties of plant (tobacco mosaic virus, TMV), animal (Newcastle disease virus, NDV), human (Human immunodeficiency virus, HIV) and bacterial viruses (T4 phage). Emerging and reemerging viruses (dengue virus), zoonotic viruses (rabies, SARS-CoV-2). Microbial production of penicillin. Bacterial toxins, tuberculosis, typhoid. Introduction to fungi, algae and mycoplasm.

Unit-III- Cell Structure and Functions

Structure, properties and functions of cellular organelles (E.R, Golgibodies, Mitochondria, Ribosomes and Vacuoles) of eukaryotic cells. Cell cycle and cell division (mitosis and meiosis). Chemical composition and dynamic nature of the membrane, cell signaling and communication, endocytic pathways.

Unit-IV- DNA Replication, Repair and Regulation of Gene Expression

DNA replication in prokaryotes and eukaryotes (semiconservative, dispersive, conservative, uni and bi-direction, rolling circle). Mechanism of DNA replication, enzymes and protein involved in DNA replication. DNA damage and repair. Regulation of gene expression in prokaryotes Lac and Trip operon concept.

Unit – V - Central Dogma of Molecular Biology

Genome organization of prokaryotic and eukaryotic organisms. Genetic code, prokaryotic and eukaryotic transcription, enzymes involved in transcription. Post-transcriptional modification (Capping Poly adenylation) and splicing.
Translation: mechanism of translation in prokaryotic and eukaryotic cells (initiation, elongation, termination). Post-translational modification (glycosylation and phosphorylation).

Recommended Books:

1. Microbiology–6th Edition, (2006), Pelczar M.J., Chan E.C.S., Krieg N.R.; The McGrawHill Companies Inc. NY
2. Prescott's Microbiology, 8th edition, (2010), Joanne M Willey, Joanne Willey, Linda Sherwood, Linda M Sherwood, Christopher J Woolverton, Chris Woolverton; McGrawHill Science Engineering, USA
3. Textbook of Microbiology, Anantnarayan and Paniker (2017)
4. Brock biology of microorganisms, 2003, Brock, T. D., Madigan, M. T., Martinko, J. M., & Parker, J.; Upper Saddle River (NJ): Prentice-Hall, 2003.
5. Genes XI, 11th edition, (2012), Benjamin Lewin; Publisher - Jones and Barlett Inc. USA
6. Molecular Biology of the Gene, 6th Edition, (2008), James D. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R.; Cold Spring Harbour Lab. Press, Pearson Pub.
7. Molecular Biology, 5th Edition, (2011), Weaver R.; McGraw Hill Science. USA
8. Fundamentals of Molecular Biology, (2009), Pal J.K. and Saroj Ghaskadbi; Oxford University Press.
9. Molecular Biology: Genes to Proteins, 4th edition (2011), Burton E Tropp Jones& Bartlett Learning, USA.
10. Cell and Molecular Biology: Concepts and Experiments, 6th Edition, Karp, G. 2010.; John Wiley & Sons. Inc.

11. Cell and Molecular Biology, 8th edition. De Robertis, E.D.P. and De Robertis, E.M.F. 2006; Lippincott Williams and Wilkins, Philadelphia.
12. Cell Biology, (2017), De Robertis & De Roberis, Blaze Publishers & Distributors Pvt. Ltd.
13. The Cell: A Molecular Approach. 5th edition. Cooper, G.M. and Hausman, R.E. 2009. ASMPress & Sunderland, Washington, D.C.; Sinauer Associates, MA.
14. The World of the Cell, 7thedition, Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 Pearson Benjamin Cummings Publishing, San Francisco.
15. George M. Malacinski. 2013. Freifeder's Essentials of Molecular Biology. Narosa Publishing House.

Semester: I
B.Sc. Biotechnology
Paper 2: Microbiology, Cell and Molecular Biology Lab

Total Hours: 30 **Credits: 1**

List of Practicals:-

1. Demonstration, use and care of microbial equipment
2. Cleaning and preparation of glassware
3. Preparation of nutrient agar medium for bacteria
4. Preparation of PDA medium for fungi
5. Sterilization techniques (autoclave, hot air oven, filter)
6. Isolation of bacteria from soil
7. Simple staining technique
8. Differential staining technique
9. Microbial counting by Haemocytometer
10. Identification of different bacteria
11. Motility test by hanging drop
12. Biochemical identification of bacteria
13. Preparation of pure culture by slab, slant, streak culture
14. Study of stages of mitotic cell division
15. Study of stages of meiotic cell division
16. Isolation of chloroplast
17. Extraction and isolation of DNA from bacteria.

Recommended books:

1. David A. Thompson. 2011. Cell and Molecular Biology Lab. Manual.
2. P.Gunasekaran. 2007. Laboratory Manual in Microbiology. New Age International.
3. D O Hall, S E Hawkins. 1974. Laboratory Manual of Cell Biology. British Society for Cell Biology, Published by Crane, Russia.
4. Mary L. Ledbetter. 1993. Cell Biology: Laboratory Manual. Edition: 2. Published by Ron Jon Publishing. Incorporated.
5. Gunasekaran, P. 2009. Laboratory Manual in Microbiology. 1st Edition. New Age International Publishers.
6. Dr. T. Sundararaj. Microbiology Laboratory Manual. 2005. Dr.A.L. MPGIBMS, University of Madras, Taramani, Chennai – 600 113.
7. James G. Cappuccino and Natalie Sherman. 2013. Microbiology: A Laboratory Manual. 10th Edition. Benjamin Cummings.
8. Dr. David A Thompson. 2011. Cell and Molecular Biology Lab Manual.

Recommended Co-curricular activities: (Co-curricular Activities should not promote copying from text book or from others' work and shall encourage self/independent and group learning)

A. Measurable:

1. Assignments on:
2. Student seminars (Individual presentation of papers) on topics relating to:
3. Quiz Programmes on:
4. Individual Field Studies/projects:
5. Group discussion on:
6. Group/Team Projects on:

B. General

1. Collection of news reports and maintaining a record of paper-cuttings relating to topics covered in syllabus
2. Group Discussions on:
3. Watching TV discussions and preparing summary points recording personal observations etc., under guidance from the Lecturers
4. Any similar activities with imaginative thinking.

Recommended Continuous Assessment methods:

MODEL QUESTION PAPER (Sem-end. Exam)
UG program: B.Sc. Biotechnology
Semester: II

Paper 2: Microbiology, Cell and Molecular Biology

Time: 3 hours **Max Marks: 75M**

SECTION – A

Answer any 5 questions. Each question carries 5 marks (5 X 5M = 25M)
(Total 8 questions and at least two questions should be given from each unit)

1. Contributions of Leeuwenhoek
2. Simple staining
3. General characteristics of virus
4. Production of Penicillin
5. Mitochondria
6. Endocytic pathway
7. DNA repair
8. Post-transcriptional modifications

SECTION – B

Answer all the questions. Each question carries 10 marks (5 X 10M = 50M)

9. Give the ultra-structure of Bacteria and its growth curve with neat labelled diagram

or

Explain sterilization techniques

10. Explain classification of bacteria based on different criteria

or

Explain the structure properties of animal cells

11. Explain the cell cycle and cell division

Or

Explain the structure and properties of cell organelles

12. What is replication and explain the process of replication in eukaryotes

or

What is Operon concept? Explain positive and negative control methods of lac operon

13. Explain the process of transcription in eukaryotes

or

Write a note on post-translational modifications in prokaryotes

MODEL QUESTION PAPER
UG program: B.Sc. Biotechnology
Semester: II
Paper 2: Microbiology, Cell and Molecular Biology Lab

Time: 3 hours **Max Marks: 50M**

14. Write procedure for isolation of bacteria from soil and carryout the experiment 20M

15. Write principle and procedure of simple staining and experiment 10M

16. Identify given spotters 5 x 2=10

    a) HOT-air oven

    b) Stages of meiosis

    c) Types of bacteria based on shape

    d) HIV

    e) Okazaki fragments

17. Record 5M

18. VIVA-Voce

    5M

BSc	Biotechnology (Semester: III)	Credits: 5
Paper: 3	Immunology and rDNA technology	Hrs/Wk: 6

Aim and objectives of Course:

To acquaint students with concepts of immunology and recombinant DNA technology. This course is aimed to give an understanding of the basics of immunology dealing cells and organs of the immune system, types of immune responses, antigen-antibody interactions, vaccines and tools, techniques and strategies and applications of genetic engineering.

Learning outcomes of Course:
The course will provide an insight into basic aspects of immunology and rDNA technology

B.Sc., Biotechnology

Semester - III

Total Hours: 60 **Credits: 4**

Paper 3: Immunology and rDNA technology

Unit- I –Concepts, Cells and Organs of the Immune System

Terminology, antigen, hapten, antibody (types), antigenicity, immunogenicity and types of immunity. Innate and adaptive immunity. Hematopoiesis, organs, tissues, cells and mediators of the immune system (primary and secondary lymphoid organs, lymphocytes and cytokines). Introduction to complement components, MHC. Basic concepts of humoraland cell-mediated immune response.

Unit-II-Vaccinology and Clinical Immunology

Live, killed, attenuated, subunit and recombinant vaccines. Role and properties of adjuvants. Hybridoma technology, monoclonal antibodies and their application in immunodiagnosis. Antigen and antibody interactions - precipitation, agglutination, immune diffusion and ELISA. Introduction to hypersensitivity and autoimmunity.

Unit-III –Introduction, Tools and Techniques of rDNA Technology

Introduction to rDNA technology, steps involved in cloning, tools of genetic engineering (Genes, Cloning vectors - plasmids and cosmids, Enzymes – restriction endonucleases and DNA Ligase, Hosts – bacteria and yeast). Principles and application of PCR. Southern, Northern and Western Blotting. Introduction to DNA sequencing (Sanger Sequencing) and Site-directed Mutagenesis.

Unit-IV-Cloning Strategies and Application of rDNA Technology

cDNA library, construction, methods of transformation, recombinant selection and screening methods. Applications of rDNA technology in agriculture (transgenic plants, edible vaccines and antibodies) and medicine (disease diagnosis and DNA fingerprinting).

Unit-V-Bioinformatics

Databases (PubMed, NCBI, EMBL and ExPASy), nucleotide and protein BLAST analysis, CLustal W and phylogenetic tree construction. Introduction to omics (proteomics, genomics and transcriptomics). Introduction to nanotechnology.

Recommended Books:

1. Kuby immunology, Judy Owen, Jenni Punt, Sharon Stranford., 7th edition (2012), Freeman and Co., NY
2. Textbook of basic and clinical immunology, 1st edition (2013), Sudha Gangal and Shubhangi Sontakke, University Press, India
3. Immunology, 7th edition (2006), David Male, Jonathan Brostoff, David Roth, Ivan Roitt, Mosby, USA.
4. Immuno diagnostics, 1996, By S.C. Rastogi, Publ: New Age
5. Introduction to Immunology- 2002, C. V. Rao- Narosa Publishing House
6. Textbook of Biotechnology - 2007, By H.K. Das (Wiley Publications)
7. Principles of Gene Manipulation - 7th edition, 2006, By R.W. Old & S.B. Primrose, Publ: Blackwell
8. Molecular Biology & Biotechnology- 1996, By H.D. Kumar, Publ: Vikas
9. Molecular Biotechnology - 4th edition, 2010, G.R. Click and J.J. Pasternak, Publ: Panima
10. Genes and Genomes – 1991, By Maxine Singer and Paul Berg
11. Genes VII- 2000, By B. Lewin - Oxford Univ. Press
12. Molecular Biology - 4th Edition, 2008, By D. Freifelder, Publ: Narosa Publishing house New York, Delhi
13. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K.
14. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution.

Elsevier Academic Press, USA.

15. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington
16. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7thedition. Blackwell Publishing, Oxford, U.K.
17. Introduction to Bioinformatics – 2007, By V. Kothekar
18. Introduction to Bioinformatics – 2013, By Arthur M. Lesk
19. Bioinformatics: 2001, Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press
20. Biological Sequence Analysis: 1st Edition, 1998, Probabilistic Models of Proteins and Nucleic Acids by Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison, Cambridge University Press
21. Bioinformatics tools and Resources – free online tools, software packages, Bioinformatics books and Journals, Bioinformatics web-portals

Paper 3: Immunology and rDNA technology Lab

Total Hours: 30 **Credits: 1**

List of Practical: -

1. Determination of Blood Groups
2. Pregnancy test
3. Widal test
4. Ocuteroloney immunodiffusion
5. Radial immune diffusion
6. ELISA
7. Production of antibodies (theory exercise)
8. Bleeding, separation of serum and storage
9. Lymphoid organs (theory exercise)
10. Isolation of plasmid DNA (alkaline lysis method)
11. Analysis of plasmid DNA by Agarose gel electrophoresis
12. Southern blotting (theory exercise)
13. PCR Amplification (theory exercise)

Recommended books:

1. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rdedition. Cold Spring Harbor Laboratory Press.
2. Bioinformatics: 2004, A Practical Guide to the Analysis of Genes and Proteins, Andreas D. Baxevanis, B. F. Francis Ouellette, Wiley-Interscience

Recommended Co-curricular activities: (Co-curricular Activities should not promote copying from text book or from others' work and shall encourage self/independent and group learning)

A. Measurable:
1. Assignments on:
2. Student seminars (Individual presentation of papers) on topics relating to:
3. Quiz Programmes on:
4. Individual Field Studies/projects:
5. Group discussion on:
6. Group/Team Projects on:

B General

1. Collection of news reports and maintaining a record of paper-cuttings relating to topics covered in syllabus
2. Group Discussions on:

3. Watching TV discussions and preparing summary points recording personal observations etc., under guidance from the Lecturers
4. Any similar activities with imaginative thinking.

Recommended Continuous Assessment methods:

MODEL QUESTION PAPER (Sem-end. Exam)

UG program: B.Sc. Biotechnology
Semester: III

Paper 3: Immunology and rDNA technology

Time: 3 hours **Max Marks: 75M**

SECTION – A

Answer any 5 questions. Each question carries 5 marks (5 X 5M = 25M)
(Total 8 questions and at least two questions should be given from each unit)

1. MHC
2. Hematopoiesis
3. Properties of Adjuvants
4. Monoclonal Antibodies Applications
5. Sanger Sequencing
6. Principle of PCR
7. DNA Fingerprinting
8. Proteomics

SECTION – B

Answer all the questions. Each question carries 10 marks (5 X 10M = 50M)

9. Explain the different organs of immune system

   Or

   Write about immunity and explain the types of immunity

10. What is vaccine? Explain the different types of vaccines?

    or

    Explain the different types of Ag-Ab reactions

11. Write about tools and steps involved in genetic engineering

    or

    Explain blotting techniques

12. Write about applications of r-DNA technology in agricultural field

or

What is transformation? Write about methods of transformation

13. Explain about nanotechnology and its importance

Or

Explain about protein BLAST method

MODEL QUESTION PAPER
UG program: B.Sc. Biotechnology
Semester: III
Paper 3: Immunology and rDNA technology Lab

Exam: 3 hr **Max Marks: 50M**

14. Write principle and procedure for isolation of plasmid DNA and carryout experiment 20M

15. Determination of blood groups 10M

16. Identify the spotters 5 x2 =10M

    1) Lymhoid organs

    2) Cosmids

    3) ELISA

    4) BLAST

    5)RIA

4. Record 5M

5. Viva-voce 5M

BSc	Biotechnology (Semester: IV)	Credits: 5
Paper: 4	Plant and Animal Biotechnology	Hrs/Wk: 6

Aim and objectives of Course:

The objectives of this course are to introduce students to the principles, practices and application of animal biotechnology, plant tissue culture, plant and animal genomics, genetic transformation.

Learning outcomes of Course:
Students should be able to gain fundamental knowledge in animal and plant biotechnology and their applications.

B.Sc., Biotechnology: Choice based credit system

B.Sc., -IV Semester W.E.F. 2020-21

Paper-4: Plant and Animal Biotechnology

Unit – I

Plant tissue culture techniques & secondary metabolites production

Plant tissue culture: totipotency, media preparation – nutrients and plant hormones; sterilization techniques; establishment of cultures – callus culture, cell suspension culture ,applications of tissue culture-micro propagation; Somatic embryogenesis; synthetic seed production; protoplast culture and somatic hybridization - applications. Cryopreservation,Plant secondary metabolites- concept and their importance

Unit – II

Transgenesis and Molecular markers

Plant transformation technology-- Agrobacterium mediated Gene transfer (Ti plasmid), hairy root features of Ri plasmid,Transgenic plants as bioreactors. Herbicide resistance – glyphosphate, Insect resistance- Bt cotton,,**Molecular markers - RAPD, RFLP and DNA fingerprinting-principles and applications.**

Unit – III

Animal tissue culture techniques

Animal cell culture: cell culture media and reagents; culture of mammalian cells, tissues and organs; primary culture, secondary culture, cell lines,stem cell cultures; Tests: cell viability and cytotoxicity, Cryopreservation. Transfection methods (calcium phosphate precipitation, electroporation, Microinjection) and applications.

Unit – IV

Transgenic animals & Gene Therapy

Production of vaccines, diagnostics, hormones and other recombinant DNA products in medicine (insulin,somatostatin, vaccines),IVF, Concept of Gene therapy, Concept of transgenic animals – Merits and demerits -Ethical issues in animal biotechnology

Unit V

Bioethics, Biosafety and IPR

Bioethics in cloning and stem cell research, Human and animal experimentation, animal rights/welfare. Bio safety-introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; GLP,GMP, Introduction to IP-Types of IP: patents, trademarks & copyright

List of Recommended Books ;

1.Introduction to Plant Tissue Culture..M.K. Razdan ,2003,Science Publishers

2.Plant Tissue Culture, kalyan Kumar De,199 M7, New Central Book Agency

3. Biotechnology – By U. Satyanarayana ;1997

4. Plant Cell, Tissue and Organ Culture, Applied and Fundamental Aspects By Y.P.S. Bajaj and A. Reinhard ,2001

5. Introduction to Plant Tissue Culture, M. K. Razdan, 2003,Science Publishers

6. A Textbook of Biotechnology,R C Dubey,S. 2014,Chand Publishing

7. Elements of Biotechnology,P. K. Gupta, 1994,Rastogi Publications

8. Daniel R. Marshak, Richard L. Gardner, David Gottllieb “Stem cell Biology” edited by Daniel 2001,Cold Spring Harbour Laboratory press, New York

9. M.M. Ranga, Animal Biotechnology; Agrobios (India) ,2006.

Paper 4: Plant and Animal Biotechnology Lab

Total Hours: 30 **Credits: 1**

List of Practicals:

- plant culture media and composition of MS media
- Raising of aseptic seedlings
- Induction of callus from different explants, cytology of callus
- Plant propagation through Tissue culture (shoot tip and Nodal culture)
- Establishing a plant cell culture (both in solid and liquid media)
- suspension cell culture
- Cell count by hemocytometer.
- Establishing primary cell culture of chicken embryo fibroblasts.
- Animal tissue culture – maintenance of established cell lines.
- Animal tissue culture – virus cultivation.
- Estimation of cell viability by dye exclusion (Trypan blue).
- ELISA – Demonstration

Recommended books:

1. R. Ian Freshney, "Culture of animal cells – A manual of basic techniques" 4th edition, John Wiley & Sons, 2000 ,Inc, publication, New York
2. Plant Tissue Culture : Theory and Practice By S.S. Bhojwani and A. Razdan,1998

Recommended Co-curricular activities: (Co-curricular Activities should not promote copying from text book or from others' work and shall encourage self/independent and group learning)

A. Measurable:
1. Assignments on:
2. Student seminars (Individual presentation of papers) on topics relating to:
3. Quiz Programmes on:
4. Individual Field Studies/projects:
5. Group discussion on:
6. Group/Team Projects on:

B. General

1. Collection of news reports and maintaining a record of paper-cuttings relating to topics covered in syllabus
2. Group Discussions on:
3. Watching TV discussions and preparing summary points recording personal observations etc., under guidance from the Lecturers
4. Any similar activities with imaginative thinking.

Recommended Continuous Assessment methods:

MODEL QUESTION PAPER (Sem-end. Exam)
UG program: B.Sc. Biotechnology
Semester: IV
Paper 4: Plant and Animal Biotechnology

Time: 3 hours **Max Marks: 75M**

SECTION – A

Answer any 5 questions. Each question carries 5 marks (5 X 5M = 25M)
(Total 8 questions and at least two questions should be given from each unit)

1. Micropropagation
2. Cryopreservation
3. RAPD
4. Ti-Plasmid
5. Somatic embryogenesis
6. Cell lines
7. IVF
8. Animal rights

SECTION - B

9. What are metabolites and explain different plant secondary metabolites

or

Explain different types of cultures

10. Explain the herbicide and insecticide resistance in transgenesis process

Or

What are transgenic plants? Write a note on transgenic plants as bioreactors

11. What are cell cultures and explain different types of cell cultures

or

What is transfection and explain different methods of transfection

12. Write a note on transgenic animals with merits and demerits

Or

Write about recombinant DNA products in medicine

13. Explain about human and animal experimentation

Or

Explain about biosafety and different levels in biosafety

UG program: B.Sc. Biotechnology
Semester: IV
Paper 4: Plant and Animal Biotechnology Lab

Exam: 3hr **Max Marks: 50M**

1. Write procedure for process of callus induction from different explants 20M
2. Suspension cultures 10M
3. Spotters 2 x 5 = 10M
    1) RFLP
    2) Bt-Cotton
    3) Bioreactor
    4) Plasmid
    5) Chick embryo fibroblast
4. Record 5M
5. Viva 5M

BSc	Biotechnology (Semester: IV)	Credits: 5
Paper: 5	Environmental & Industrial Biotechnology	Hrs/Wk: 6

Aim and objectives of Course (Environmental & Industrial Biotechnology)
This course aims to introduce fundamentals of Environmental Biotechnology. The course will also give an insight in introducing major groups of microorganisms and their industrial applications

Learning outcomes of Course:
Students should be able to gain fundamental knowledge in animal and plant biotechnology and their applications.

B.Sc., Biotechnology

Semester - IV

Paper-5: Environmental & Industrial Biotechnology

Unit – I

Pollution Types and Control

Environmental Biotechnology-Environmental Pollution: Types of pollution, air pollution & its control through Biotechnology, Biofilters, Bioscrubbers, Biotrickling filter. Water pollution and its management: Measurement of water, pollution, sources of water pollution. Microbiology of waste water treatment, aerobic processes, activated sludge, oxidation ponds, trickling filters, and rotating biological contactors. Anaerobic processes: Anaerobic digesters, upward flow anaerobic sludge blanket reactors.

UNIT-II

Bioremediation

Biodegradation and Bioremediation – Concepts & principles of Bioremediation, Bioremediation of Hydrocarbons and its applications Degradation of pesticides and other toxic chemicals by microorganism. Role of genetically Engineered microbes, Concept of Phytoremediation, , environmental safety guidelines.

UNIT III

Biofuels

Biofuels-biogas, microbial groups involved in biogas production & interactions, factors affecting biogas production, Biofertilizers, Vermiculture.

Unit IV

Basic principles of Microbial technology

Industrially important microbes, its screening, selection and identification. Maintenance and preservation of industrially important microbial cultures. Strain Improvement, Basic concepts of fermentation; Design of fermenter and applications

Unit V

Commercial Production of Microbial products

Microbial technology products and applications; Microbial production of Organic acids (Lactic acid, citric acid), Amino acids (Glutamicacid, Aspartic acid and Lysine). Fermentation by microbes for food additives: dairy products (Cheese, Yogurt), beverages (Beer,Wine) and antibiotics (Streptomycin, Pencillin)

List of Recommended Books ;

1. K. Vijaya Ramesh, Environmental Microbiology, 2004,MJP Publishers, Chennai.
2. A.G. Murugesan, C. Raja Kumari, Environmental Science & Biotechnology - Theory & Techniques, 2005,MJP Publishers
3. Environmental microbiology by Raina M.Maier Ian L.Pepper & Charles P.Gerba,2000,Academic press
4. Environmental Chemistry, A.K. De. Wiley Eastern Ltd.,2001, New Delhi
5. Introduction of Biodeterioration, D. Allsopp and K.J. Seal, ELBS/Edward Arnold,2008
6. Power un seen: How microbes rule the world. By Dixon, B. Freeman/ Spectrum, 1994, Oxford.
7. Environmental Microbiology. By. Mitchell. R. Wiley,1992, New York
8. Introduction to Environmental Sciences, Y. Anjaneyulu ,2004, BS Publications
9. Industrial Microbiology by A.H.Patel,2009
10. Prescott & Dum (2002) Industrial Micrbiology, Agrabios (India) ,2005,Publishers
11. Creueger W. & Crueger A.A Text of Industrial Microbiology,2000, 2nd Edition, Panima Publishers corp.

Paper-5: Environmental & Industrial Biotechnology Lab

Total Hours: 30 **Credits: 1**

List of Practicals:

- Detection of coliforms for determination of the purity of potable water.
- Determination of total dissolved solids of water
- Determination of Hardness and alkalinity of water sample.
- Determination of dissolved oxygen concentration of water sample
- Determination of biological oxygen demand of sewage sample
- Determination of chemical oxygen demand (COD) of sewage sample.
- Isolation of industrially important microorganisms from soil.
- Isolation of amylase producing organisms from soil.
- Production of α – amylase from Bacillus Spp. by shake flask culture.
- Production of alcohol or wine using different substrates.
- Production of citric acid by submerged fermentation
- Estimation of citric acid by titrimetry.

B. Recommended Co-curricular activities: (Co-curricular Activities should not promote copying from text book or from others' work and shall encourage self/independent and group learning)

C. Measurable:
7. Assignments on:
8. Student seminars (Individual presentation of papers) on topics relating to:
9. Quiz Programmes on:
10. Individual Field Studies/projects:
11. Group discussion on:
12. Group/Team Projects on:

D. General
6. Collection of news reports and maintaining a record of paper-cuttings relating to topics covered in syllabus
7. Group Discussions on:
8. Watching TV discussions and preparing summary points recording personal observations etc., under guidance from the Lecturers
9. Any similar activities with imaginative thinking.

C. Recommended Continuous Assessment methods:

MODEL QUESTION PAPER
UG program: B.Sc. Biotechnology
Semester: IV
Paper-5: Environmental & Industrial Biotechnology

Time: 3 hours **Max Marks: 75M**

SECTION – A

Answer any 5 questions. Each question carries 5 marks (5 X 5M = 25M)
(Total 8 questions and at least two questions should be given from each unit)

1. Air pollution
2. Oxidation ponds
3. Hydro carbons applications
4. Phytoremediation
5. Biofertilizers
6. Vermiculture
7. Fermenter applications
8. Streptomycin

SECTION – B

9. Explain the microbiology of waste water treatment

   or

   Explain about biofertilizers and their application

10. Explain biodegradation and bioremediation processes

    or

    Write about role of genetically engineered microbes

11. Write about biogas production

or

Write about factors affecting biogas production

12. Explain about preservation of industrial microbial cultures

or

Explain design and process of fermentation with an example

13. Explain about microbial production of organic acids

or

What are food additives and explain the process of fermentation for food additives

MODEL QUESTION PAPER
UG program: B.Sc. Biotechnology
Semester: IV
Paper-5: Environmental & Industrial Biotechnology Lab

Time: 3 hours **Max Marks: 50M**

1. Write procedure for BOD determination and carryout experiment 20M
2. Write procedure for determination of hardness of water 10M
3. Spotters 2 x 5 = 10M
    1) Fermenter
    2) Principle of wine preparation
    3) Identify given product from the spotter
    4) Biodegradation principle
    5) Identify structure of amino acid
4. Record 5M
5. Viva 5M

6. DETAILS OF SYLLABUS ON SKILL ENHANCEMENT COURSES AND MODEL QUESTION PAPERS FOR THEORY AND LAB