S.S. JAIN SUBODH P.G. COLLEGE
(Autonomous)

Syllabus
For Session 2023-26

Curriculum Framework
B.Sc. (Biology/ Life Science)
Sub: Biotechnology
Based on National Education Policy- 2020
CBCS Based

SCHEME OF EXAMINATION AND COURSES OF STUDY
FACULTY OF SCIENCE

Contents:

1. Eligibility :

10+2 with 48% from Rajasthan Board / CBSE from Rajasthan state and 60% for CBSE or any other equivalent recognized Board from other state in Science Stream with (Chemistry, Biology and Physics).

2. Scheme of Examination:

S.No	Paper	ESE	CIA	Total
1.	Theory	70%	30%	100
2.	Practical	60%	40%	100

Each theory paper syllabus is divided into four units. Each theory paper 3 hours duration.

Each Practical /Lab work 4 hours duration

The number of papers and the maximum marks for each paper/ practical shall be shown in the syllabus for the paper concerned. It will be necessary for a candidate to pass in theory part as well as practical part of a subject separately.

Note: Maximum marks for a theory paper is 50 marks which include 35 marks for ESE and 15marks for internal assessment.

Examination Question Paper Pattern for all semester Exams.

Attempt all questions

I 10 Questions (very short answer questions) 7x 1 Mark = 7

II 4 Questions (1 question from each unit with internal choice) 4x7 Marks = 28

Total of End Sem. Exam - 35

Internal Assessment – 15

Maximum Marks - 50

Minimum Marks – 20

3. Semester Structure

The details of the course with code, title and the credits assign are as given below.
Abbreviations Used.

Semester	Subject 1/ Discipline1 (DSC/DSE) (credits)	Subject 2 / Discipline 2 (DSC/DSE) (credits)	Subject 2 / Discipline 2 (DSC/DSE) (credits)	Generic Elective (GE) (credits)	Ability Enhancement Course (AECC) (credits)	Skill enhancement course (SEC) (credits)	Internship/ Apprentice-ship/Project/ Community	Value addition course (VAC) (credits)	Total Credits
I	DSC-1(2) DSC-2(2) DSCP(2)	DSC-3(2) DSC-4(2) DSCP(2)	DSC–5 (2) DSC–6 (2) DSCP(2)		English (2)			Choose one from a pool of courses (0)	20 credits
II	DSC-7(2) DSC-8(2) DSCP(2)	DSC-9(2) DSC–10(2) DSCP(2)	DSC-11(2) DSC–12(2) DSCP(2)		Hindi(2)			Choose one from a pool of courses (0)	20 credits
	Students on exit shall be awarded Undergraduate Certificate in Science after securing the requisite 40 creditsin Semesters I and II								***40+4***
III	DSC-13(2) DSC-14(2) DSCP(2)	DSC–15 (2) DSC–16 (2) DSCP(2)	DSC-17(2) DSC–18 (2) DSCP(2)	Chooseonefrom pool of courses, GE -1 (2)**		Computer Science(2)		Choose one from a pool of courses (0)	22 credits
IV	DSC-19(2) DSC-20(2) DSCP(2)	DSC–21 (2) DSC–22 (2) DSCP(2)	DSC-23(2) DSC–24 (2) DSCP(2)	Chooseonefrom poolofcourses GE - 2 (2)**		Env.Sc.and Sustainable Dev. (2)		Choose one from a Pool of courses (0)	22 credits
	Students on exit shall be awarded Undergraduate Diploma in Science after securing the requisite 84 credits on completion of Semester IV								***84+4***
V	Choosetwofrom poolof courses, DSE – 1 (2)	Choose two from Pool of courses, DSE – 3 (2)	Choose two from Pool of courses, DSE – 5 (2)			Mentalability & reasoning (2)		Choose one from a pool of courses (0)	20 credits
	DSE–2(2)	DSE–4(2)	DSE–6(2)						
	DSEP (2)	DSEP (2)	DSEP (2)						
VI	Choose two from pool of courses, DSE-7(2)	Choose two from pool of courses, DSE–9(2)	Choose two from pool of courses, DSE–11(2)			Anandam-Joy of giving (2) orNCC/NSS /Roversand Rangers/ RedRibbon Club/Sports /Extra-curricularan dco-curricular activities(2)		Choose one from a pool of courses (0)	20 credits
	DSE-8(2)	DSE–10(2)	DSE–12(2)						
	DSEP (2)	DSEP (2)	DSEP (2)						
	Students on exit shall be awarded Bachelor of Science (3years) after securing the requisite 124 credits on completion of SemesterVI								124+4

Course Category

CCC: Compulsory Core Course
ECC: Elective Core Course
OEC: Open Elective Course
SC: Supportive Course
SSC: Self Study Course
SEM: Seminar
PRJ: Project Work
RP: Research Publication

Contact Hours

L: Lecture
T: Tutorial
P: Practical or Other
S: Self Study

B. Sc. Biology /Life Science Group (Biotechnology)

Semester Subject Structure: The details of the courses withtitle assigned are as given below.

Duration: 6 Semesters (3 Years)

Semester–I	**Name of Paper**	**Credits**	**Total Credits**
Paper I -	Cell and Molecular Biology	2	6
Paper II-	Bio-techniques	2	
Lab-	Practicals Based on Theory Papers	2	
Semester –II			
Paper I-	Genetics	2	6
Paper II-	Introduction to Microbial World	2	
Lab-:	Practicals Based on Theory Papers	2	
Semester III			
Paper I-	Plant Biotechnology	2	6
Paper II-	Cellular Biophysics and Biochemistry	2	
Lab-	Practicals Based on Theory Papers	2	
Semester IV			
Paper I-	Animal Biotechnology	2	6
Paper II-	Immunology	2	
Lab-	Practicals Based on Theory Papers	2	
Semester V			
Elective-I	Environmental and Agri-Biotechnology	2	6
Elective-II	Industrial Biotechnology	2	
Elective-III	Recombinant DNA Technology	2	
Lab-	Practical's Based on Elective Papers	2	
Semester VI			
Elective-I	Medical Biotechnology	2	6
Elective-II	Bioinformatics and Nanotechnology	2	
Elective-III	Biosafety, Bioethics and IPR in Biotechnology	2	
Lab-	Practical's Based on Elective Paper	2	

***Students have to choose any two elective papers out of three in fifth and sixth semester.**

****Department will offer theory elective papers for the students based on options submitted by the students and availability of Faculty to teach the course.**

Marks Break up: End Semester Exam 35 Marks + Internal Assessment 15 Marks = 50 Marks per paper.

Practical Marks: External Practical's 35 Marks + Internal Practical 15 marks = 50

Theory Classes: Three hrs per week for each of the paper: end semester exam duration of 3 hrs for each of the papers.

Practicals Classes: Four hrs practical classes per week: End semester Practical examination of Four hrs duration.

4. Programme Specific Outcomes:

By the end of the course, a student should be able to:

1. Students develop global competencies in the area of basic and applied biological sciences.
2. Enhancing the subject knowledge of students by using traditional and modern ICT based teaching methods and learning by doing.
3. To enrich students' knowledge and train them in various branches of Biotechnology such as genetics, molecular biology, biochemistry, immunology, fermentation technology, environmental biotechnology and tissue culture techniques.
4. To groom the students to meet futuristic challenges and national interests
5. To bestow the students with all the research skills required to work independently
6. To develop scientific temperament and social responsibilities in the students.
7. To inculcate nature care by imparting knowledge of advance modern techniques
8. As Biotechnology is an interdisciplinary course, empower the students to acquire technological knowhow by connecting disciplinary and interdisciplinary aspects of biotechnology.
9. Acquire knowledge in students of biotechnology enabling their applications in industry and research.

Course Outcomes:

1. Graduates will have a deep and comprehensive understanding of core biotechnology concepts, including molecular biology, genetics, bioinformatics, and bioprocessing.
2. Graduates will be proficient in designing, conducting, and analyzing complex biotechnological experiments, using advanced laboratory techniques and tools.
3. Graduates will be adept at applying biotechnological methods to solve real-world problems in healthcare, agriculture, environment, and industry.
4. Graduates will have hands-on experience and technical expertise in genetic engineering, recombinant DNA technology, cell culture, and other modern biotechnological practices.

5. Course Details:

- The syllabus has also been framed in such a way that the basic skills of subject are taught to the students, and everyone might not need to go for higher studies and the scope of securing a job after graduation will increase BSc Biotechnology Admissions are mainly done on the basis of merit list.
- The BSc Biotechnology Courses are offered in Full Time Education.
- The syllabus of BSc in Biotechnology includes subjects like Biophysics & Instrumentation, Bioinformatics, Cell Structure & Dynamics, Principles of Microbiology, Molecular Genetics, etc.
- The different Job profiles after completion of the degree are Biotech Analyst, BioChemist, Research scientist and many more.
- Also, it is being recommended that the Project Work and Industrial Tour/ Institute visit is compulsory for all the students as per their respective semester curriculum.

First Semester

S.NO.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per-Week			EoSE Duration (Hrs.)	
					L	T	P	Thy	P
1.	BSBT101	Cell and Molecular Biology	DSC	2	2	-	-	3	-
2.	BSBT102	Biotechniques	DSC	2	2	-	-	3	-
3.	BSBT151	Practicals Based on Theory Papers	DSCP	2	-	-	4	-	4

Second Semester:

S.NO.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per-Week			EoSE Duration (Hrs.)	
					L	T	P	Thy	P
1.	BSBT201	Genetics	DSC	2	2	-	-	3	-
2.	BSBT202	Introduction to Microbial World	DSC	2	2	-	-	3	-
3.	BSBT251	Practicals Based on Theory Papers	DSCP	2	-	-	4	-	4

Third Semester:

S.NO.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per-Week			EoSE Duration (Hrs.)	
					L	T	P	Thy	P
1.	BSBT301	Plant Biotechnology	DSC	2	2	-	-	3	-
2.	BSBT302	Cellular Biophysics and Biochemistry	DSC	2	2	--	-	3	-
3.	BSBT351	Practicals Based on Theory Papers	DSCP	2	-	-	4	-	4

Fourth Semester:

S.NO.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per-Week			EoSE Duration (Hrs.)	
					L	T	P	Thy	P
1.	BSBT401	Animal Biotechnology	DSC	2	2	-	-	3	-
2.	BSBT402	Immunology	DSC	2	2	-	-	3	-
3.	BSBT451	Practicals Based on Theory Papers	DSCP	2	-	-	4	-	4

In Fifth Semester and Sixth Semester, students can choose any two electives. Departments will offer two theory elective courses for the semester based on options submitted by students and availability of Faculty to teach the course.

Fifth Semester:

S.NO.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per-Week			EoSE Duration (Hrs.)	
					L	T	P	Thy	P
1.	BSBT501	Environmental and Agri-Biotechnology	ESC	2	2	-	2	3	-
2.	BSBT502A	Industrial Biotechnology	ESC	2	2	-	2	3	-
3.	BSBT502B	Recombinant DNA Technology	ESC	2	2	-	2	3	-
4.	BSBT551	Practical's Based on Elective Papers	ESCP	2	-	-	4	-	4

Sixth Semester:

S.NO.	Subject Code	Course Title	Course Category	Credit	Contact Hours Per-Week			EoSE Duration (Hrs.)	
					L	T	P	Thy	P
1.	BSBT601	Medical Biotechnology	ESC	2	2	-	2	3	-
2.	BSBT602A	Bioinformatics and Nanotechnology	ESC	2	2	-	2	3	4
3.	BSBT602B	Biosafety, Bioethics and IPR in Biotechnology	ESC	2	2	-	2	3	-
4.	BSBT651	Practical's Based on Elective Paper	ESCP	2	-	-	4	-	4

*Departments will offer minimum two and maximum five theory elective course for the semester based option submitted by students and availability of faculty to teach the course.

CBCS Syllabus Pattern SCIENCE: UG (Biology/ Life Science)

Choice Based Credit System (CBCS)

B.Sc. Semester-I

Max. Marks :Theory- 100 , Practical- 50
Teaching Hours per week for every paper: 3

Nomenclature P.Code	P.No		External Theory	Internal Theory	Total Max.Marks	Total Min.Marks
BSBT101	Paper I	Cell and Molecular Biology	35	15	50	20
BSBT102	Paper II	Biotechniques	35	15	50 100	20
BSBT151	Lab	Practicals Based on Theory Papers	35	15	50	20

B.Sc.SemesterII

Max. Marks: Theory- 100, Practical- 50
Teaching Hours per week for every paper: 3

Paper code	Nomenclature		External Theory	Internal Theory	Total Max.Marks	Total Min.Marks
BSBT201	PaperI	Genetics	35	15	50	20
BSBT202	PaperII	Introduction to Microbial World	35	15	50 100	20
BSBT251	Lab	Practicals based on Theory Paper	35	15	50	20

B.Sc. Semester III

Max. Marks : Theory- 100 , Practical- 50
Teaching Hours per week for every paper: 3

Paper code	Nomenclature		External Theory	Internal Theory	Total Max.Marks	Total Min.Marks
BSBT301	Paper I	Plant Biotechnology	35	15	50	20
BSBT302	Paper II	Cellular Biophysics and Biochemistry	35	15	50 100	20
BSBT351	Lab	Practicals based on Theory Paper	35	15	50	20

B.Sc. Semester IV

Max.Marks: Theory- 100, Practical- 50

Teaching Hours per week for every paper: 3

Paper code	Nomenclature		External Theory	Internal Theory	Total Max.Marks	Total Min.Marks
BSBT401	Paper I	Animal Biotechnology	35	15	50	20
BSBT402	Paper II	Immunology	35	15	50	20
					100	
BSBT451	Lab	Practicals based on Theory Paper	35	15	50	20

B.Sc. Semester V

Max. Marks: Theory- 100, Practical- 50
Teaching Hours per week for every paper: 3

Paper code	Nomenclature		External Theory	Internal Theory	Total Max.Marks	Total Min.Marks
BSBT501	Paper I	Environmental and Agri-Biotechnology	35	15	50	20
BSBT502A	Paper II	Industrial Biotechnology	35	15	50	20
BSBT502B	Paper III	Recombinant DNA Technology	35	15	50 100	20
BSBT551	Lab	Practicals based on Theory Paper	35	15	50	20

B.Sc. Semester VI

Max. Marks: Theory- 100 , Practical- 50
Teaching Hours per week for every paper: 3

Paper code	Nomenclature		External Theory	Internal Theory	Total Max. Marks	Total Min. Marks
BSBT601	Paper I	Medical Biotechnology	35	15	50	20
BSBT602A	Paper II	Bioinformatics and Nanotechnology	35	15	50	20
BSBT602B	Paper III	Biosafety, Bioethics and IPR in Biotechnology	35	15	50 100	20
BSBT651	Lab	Practicals based on Theory Paper	35	15	50	20

B.Sc. Biology/Life Science (Biotechnology)

Semester-I

Max. Marks: 35

30 Hrs. (3 hrs/week)

Scheme of Examination: There will be two parts in end semester theory paper. Part A of the paper shall contain seven short answer questions of 7 marks. Each question will carry one mark for correct answer. Part B of the paper will contain eight questions, out of which four questions are to be attempted from each unit with internal choice. Each question will carry 7 marks

PAER-I CELL AND MOLECULAR BIOLOGY

Objective of Course: This course introduces the students to the basics of cell and its components. This gives them a strong foundation on the basic unit of life and understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, Molecular biology deals with nucleic acids and proteins and how these molecules interact within the cell to promote proper growth, division and development.

Unit-I

Cell as a Basic unit of Living Systems: Discovery of cell, Ultra-structure of prokaryotic and eukaryotic cell (both plant and animal cells).

Cellular Organelles: Structure and functions of cell organelles Vacuole, Cytosol and Cytoskeleton structures (Microtubules, Microfilaments and Intermediate filaments).

Surface Architecture: Structural organization and functions of plasma membrane and cell wall of eukaryotes and cell wall of prokaryotes.

Unit-II

Chromosomes: Discovery, Morphology and structural organization–Centromere, Euchromatinand Heterochromatin, Chemical composition and Karyotype. Special type of chromosomes: Salivary gland and Lamp brush chromosomes.

Cell cycle: An overview of cell cycle; Components of cell cycle control system; Intracellular and Extra-cellular control of cell division. Elementary idea about Programmed cell death (Apoptosis) and Senescence.

Unit-III

DNA structure and replication: DNA as genetic material, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semi conservative nature of DNA replication. DNA damageand repair.

Transcription and RNA processing: RNA structure and types of RNA,Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains.

Unit- IV

Regulation of gene expression and translation: Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Mechanism of initiation, elongation and termination of polypeptides, Post translational modifications of proteins.

Suggested Readings:

1. Chouhan R. (2018). Molecular Biology and Biotechnology. Second edition. CBH Publication, Jaipur.
2. Cooper, G. M. and Hausman, R. E. (2009). The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
3. De Robertis, E. D. P. and De Robertis, E. M. F. (2006).Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
4. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
5. Glick, B.R and Pasternak J.J (1998).Molecular biotechnology, Principles and application of recombinant DNA, Washington D.C. ASM press
6. Howe. C. (1995). Gene cloning and manipulation, Cambridge University Press, USA
9. Rigby, P.W.J. (1987) Genetic Engineering Academic Press Inc. Florida, USA.
10. Sambrook et al (2000) Molecular cloning Volumes I, II & III, Cold spring Harbor Laboratory Press New York, USA
11. Walker J. M. and Ging old, E.B. (1983). Molecular Biology & Biotechnology (Indian Edition) Royal Society of Chemistry U.K.

B.Sc. Biotechnology
Semester-I

Max. Marks: 35

30 Hrs. (3 hrs/week)

PAPER- II BIOTECHNIQUES

Objective of Course: This skill based course will teach the students the various instrumentations that are used in the analytical laboratories. This course covers both fundamental and applications of the instruments that are routinely used for the characterization of biomolecules.

Unit -I

Microscopy- Principles Applications of Bright field and Dark-field Microscopy and fluorescent Microscopy, Phase contrast Microscopy, Confocal Microscopy. Electron Microscope-Principles and Applications of Transmission Electron Microscope (TEM), Scanning Electron Microscope (SEM), Sample preparation for Electron Microscopy.

Unit- II

Centrifugation: Basicprinciplesofsedimentation.Typesofcentrifuges: Preparative,analytical, high speed, low speed, ultracentrifuge, differential and density gradient centrifugation.

Chromatography: General principle of chromatographic separation. Principle, instrumentation and applications of Paper Chromatography, TLC.

Unit- III

Electrophoresis

Basic principle and types of electrophoresis. Electrophoretic mobility. Factors affecting electrophoretic migration, Technique and uses of agarose gel electrophoresis, PAGE, SDSPAGE,Two-dimensional electrophoresis and Isoelectric focussing.

Unit -IV

Spectroscopy-Beer-Lambert law and its limitations. Light absorption and transmission. Extinction coefficient. Basic design of photoelectric colorimeter and spectrophotometer. Applications of UV-visible spectroscopic techniques. Flame Photometry.

Crystallography-Principle, instrumentation and applications of X-Ray Crystallography.

Suggested Readings:

1. Boyer, R.F. (2000). Modern Experimental Biochemistry, 3rd Edition, Prentice Edition. Wiley-Inter science, USA.
2. Friefelder, D.M. (1983). Physical Biochemistry: Applications to Biochemistry Hall publishers, USA.
3. Hammes, G. G. (2007). Physical Chemistry for the Biological Sciences, 1st Techniques. 4th Edition, MKU, Madurai.
4. P.Asokan. (2003). Analytical Biochemistry. 2nd Edition. China publications.
5. P.Palanivelu and M.Salihu. (2009). Analytical Biochemistry and Separation and Molecular Biology. 2nd Revised edition. W. H. Freeman, USA.
6. Pavia, D.L., Lampman, G.M., Kriz , G.S. (2000). Introduction to Spectroscopy. 3rd Revised edition. Brooks Cole Publishing Company, USA.
7. Upadhyay and UpadhyayNath. (2009). Biophysical Chemistry, Principles and Techniques. Himalaya Publishing House.
8. Wilson and Walkar. (2000). A Biologist Guide to Principles and Techniques of Practical Biochemistry, 5th Edition, Cambridge University Press, UK.
9. Work and Work (2009). Laboratory Techniques in Biochemistry and Molecular Biology. Elsevier Science.

Semester I Lab: Practicals Based on Theory Papers

1. Safety measures in Biotechnology laboratory
2. Cleaning and sterilization of glasswares.
3. To make an inventory study the principle and applications of important instruments (Hot Air oven, autoclave, LAF, Hot plate and Water bath) used in the Biotechnology laboratory.
4. Organization and working of optical microscopes: Dissecting and Compound Microscope.
5. Principle and experimentation of tissue fixation, staining.
6. Demonstrate the micrometry with stage and ocular lenses.
7. Study of the structure of Prokaryotic (Bacterial cell) and Eukaryotic cell(Buccal Epithelium).
8. Preparation of polytene chromosomes from *Drosophila* salivary gland.
9. Demonstration of Beer-Lambert law.
10. Separation of amino acids by paper chromatography
14. Demonstrate the basic principle of centrifugation
15. Agarose gel electrophoresis of genomic DNA.

B.Sc. Biotechnology

Semester II

Max. Marks: 35

30 Hrs. (3 hrs/week)

PAPER - I GENETICS

Objective of Course: The student will gain a basic understanding on human genetics and hereditary. Studies how individual genes or groups of genes are involved in health and disease.

Unit-I

History of Classical and Modern Genetics: Concept and organization of Genetic material in Bacteria, Plant and Animal (*E.coli, Arabidopsis thaliana, Coenorhabditis elegans*). Structure, types, forms and functions of DNA and RNA.

Unit-II

Conceptof Gene: Allele, multiplealleles, pseudoalleles and complement test. **Cytogenetics**: Human karyotype, Banding techniques, Human genetic diseases. Pedigree analysis.

Unit-III

Mendelian principles and laws of inheritance: Law of dominance, segregation, independent assortment, co-dominance and incomplete dominance and pleiotrophy. Back cross and Test cross.

Unit-IV

Structural and numerical alterations of chromosome: Deletion, Inversion, Duplication, Translocation. Ploidy and their genetic implications.

Mutation:(SpontaneousandInduced) Mutagens.Biochemicalbasisofmutation.

Suggested Readings:

1. Alberts.(2002).Molecular Biology of the Cell –.Garland publication, Fourth Edition.
2. GardenerE.J,Simmons M. Jand Snustad, D.P.(2005).Principles of Genetics– JohnWiley& Sons Publications.

3. PaulA.(2011).TextBookofGenetics-fromGenestoGenomesBooksandAllied(P)Ltd, Kolkata. Third Edition.

4. Robertis*et.al*.,(1995)EighthEdition.CellandMolecularBiology– Waverlypublication.

5. Strickberger, M.W.,(1997).Fourth Edition. Genetics. Printice Hall.

B.Sc.Biotechnology
Semester II

Max. Marks: 35

30 Hrs. (3 hrs/week)

PAPER-II INTRODUCTION TO MICROBIAL WORLD

Objective of Course: This fundamental paper discusses the types of microorganisms in and around humans, and gain knowledge and skills to: importance of microorganisms, diversity of microorganisms, bacterial cell structure and function

Unit-I

Fundamentals, History and Evolution of Microbiology:Classification of microorganisms: Microbial taxonomy, Microbial phylogeny and current classification of bacteria.

Microbial Diversity: Distribution and characterization Prokaryotic and Eukaryotic cells,Morphology and cell structure of major groups of microorganisms e.g. Bacteria, Fungi, and Unique features of viruses.

Unit-II

Cultivation and Maintenance of microorganisms: Different nutritional categories of micro-organisms, different methods of isolation (Streak plate, pour plate spread plate method), Purification and preservation of Micro-organisms.

Unit-III

Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria.

Microbial Metabolism: Metabolic pathways, amphicatabolic and biosynthetic pathways.

Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospore and sporulation in bacteria.

Unit-IV

ControlofMicroorganisms:Byphysical,chemicalandchemotherapeuticAgents.

Water Microbiology: Bacterial pollutants of water, coliforms and noncoliforms.Sewage composition and its treatment.

Food Microbiology: Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Preservation of various types of foods. Fermented Foods.

Suggested Readings:

1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). Introductory Mycology. 4 th edition. John and Sons, Inc.
2. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7thedition, CBS Publishers and Distributors, Delhi, India.
3. Kumar HD. (1990). Introductory Phycology. 2nd edition. Affiliated East Western Press.
4. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/Benjamin Cummings.
5. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
7. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9 th edition. Pearson Education.

Semester II

Lab-Practicals Based on Theory Papers

1. Preparation of Nutrient Agar and broth media & sterilization methods.
2. Perform the different types of streaking methods.
3. Demonstration of Serial dilution.
4. Demonstration the pour plate and spread plate method of culture.
5. Staining methods: simple staining, Gram staining, acid fast staining
6. Methods of Isolation of bacteria from different sources (Air, water and soil)
7. Mendel's law of Genetics-Mono and Dihybrid crosses.
8. Rearing morphology of Drosophila (mutant types identification)
9. Observation of Genetic model organisms (*Arabidopsis thaliana* and *Coenorrabditiselegans*)- By Permanent slides
10. Identification of Barr body from blood cells

B.Sc. Biotechnology
Semester- III

Max. Marks: 35
30 Hrs. (3 hrs/week)

PAPER- I PLANT BIOTECHNOLOGY

Objective of Course: The objectives of this course are to introduce students to the principles, practices and applications of plant biotechnology plant genome and plant tissue culture, Students learn about transgenic plants, their application in pharmaceutical industry, cloning and its importance.

Unit-I

Introduction to Plant Biotechnology: Definition. History and development of plant biotechnology. Modern trends in plant biotechnology. Various techniques of plant cell and tissue culture, culture media, growth factors and laboratory facilities.

Unit–II

Callus and suspension culture: Initiation and maintenance of callus and suspension culture and single cell clone. Tissue and micro-propagation, callus formation, regeneration, production of haploids, protoplast culture and somatic hybridization.

Unit-III

Gene transfer in plants using Agrobacterium: Ti- Plasmids, transfer of T-**DNA,** Direct gene transfer in plants: Physical (Particle gun delivery, electroporation, microinjection, fibre mediated DNA delivery, Laser induced DNA uptake, Sonication) and Chemical methods of gene transfer (Poly ethylene glycol, Poly vinyl alcohol, Calcium phosphate). Bt. Cotton.

Unit-IV

Production of transgenic plants and their applications: Improving agronomic traits – genetic manipulation of plants for salt resistance, herbicide resistance, fungi and virus resistance, insect and other pest resistance. Modification of production traits - delayed fruit ripening, improving seed storage proteins.

Suggested Readings:

1. Chawla,(2003).IntroductiontoPlantBiotechnology(2edn)OxfordandIBH Publishers
2. Chrispeel M.J, Sadava D.E,(1994). Revised edition, Plants, Genesand Agriculture, Jones and Barlett Publication, Boston.
3. R.KeshavaChandranandK.V.Peter.(2008). Plant Biotechnology.Firstedition. University Press (India) Pvt. Ltd, Hyderabad.
4. R.C.Dubey, (2006). A TextBookof Biotechnology. S.Ch and & Co Ltd, New Delhi.
5. Ramawat K.G,(2003).PlantBiotechnology,S.ChandandCo,Edition2
6. Satyanarayana. U,(2008).Biotechnology, Books and Allied (p)Ltd.
7. Aneja.K.R.(2007).LaboratoryManualofMicrobiologyandBiotechnology,NewAge International Publisher

B.Sc. Biotechnology
Semester III

Max. Marks: 35
30 Hrs. (3 hrs/week)

Paper –II CELLULER BIOPHYSICS AND BIOCHEMISTRY

Objective of Course: Students gain fundamental knowledge through this course The students are exposed to importance of biological macromolecules, structure and function of the major membrane components and understand different types of chemical reactions and how they are used by living organisms.

Unit-I

Biophysics: Introduction, Application and scopes of Biophysics.

Bioenergetics: Entropy, Biochemical equilibria, Dissociation and association constants, pH and buffers.

Chemical bonding: Ionic bond, covalent bond, hydrogen bond, peptide bond, Vander walls forces, Principles of thermodynamics.

Interactions in biological systems: Intra and intermolecular forces, Hydrophobic and hydrophilic molecules and forces, Debye-Huckel theory.

Unit-II

Amino acids: Classification and properties due to intra, centre and side-chain and functions.

Proteins: Classification based on structure and functions, structural organization of proteins (Primary, secondary, tertiary and quaternary structure).

Unit-III

Carbohydrates: Structure, properties and classification with examples, Carbohydrates as a source of Energy.

Lipids: Definition, Structure, properties and classification and functions.

Unit-IV

Enzymes: Introduction, classification, enzyme kinetics, factors influencing enzyme activity, co-Enzymes and co-factors.

Vitamins: Introduction, types, water soluble and fat-soluble vitamins, Dietary source and

functions. **Hormones**: Introduction, Classification and their Functions (Steroid hormones, &Glucocortocoidhormones)

Suggested Readings:

1. Narayanan, P(2000) Essentials of Biophysics, New AgeInt. Pub.New Delhi.
2. Bliss,C.J.K.(1967) Statisticsin Biology, Vol.IMcGrawhill. NewYork.
3. CampbellR.C.(1974)Statistics for Biologists, Cambridge University, Press, Cambridge
4. Daniel(1999)Biostatistics(3rdedition) Panima Publishing, Compotation
5. D.L.Lehninger(2017).PrinciplesofBiochemistry(seventhedition)Macmillan Publishers
6. L.Ubret. Stryer (2018).Biochemistry-Freeman International Edition.
7. DebA.C.(2001).FundamentalofBiochemistry,Publisher:NewCentralBookAgency, Kolkata
8. SoniP.L.(2017)Text bookof Organic Chemistry (AModernapproach), Sultan Chandand Sons, Publishers.
9. RogerL.P.Adams, JohnT.KnowerandDavidP. Leader

(1992).TheBiochemistryof Nucleic acid-tenth Edition- Chapman and Hall Publications

Semester III

Lab:Practicals Basedon Theory Papers

1. Extraction of Chlorophyll A and B.
2. Isolation of genetic DNA from plant tissue.
3. Preparation of MS media.
4. Establishment of shoot tip culture using MS medium
5. Isolation of protoplasts using enzymatic method.
6. Establishment and maintenance of somatic embryogenesis (Demo).
7. Preparation of synthetic seeds (Entrapment method).
8. Separation of Chlorophyll A& Busing Column Chromatography.
9. Qualitative tests of Sugars, amino acids and lipids
10. Separation of amino acids by Thin layerchromatography

B.Sc Biotechnology Semester-IV

Max. Marks: 35
30 Hrs. (3 hrs/week)

PAPER- I ANIMAL BIOTECHNOLOGY

Objective of Course: This course teaches organization and expression of animal genome and animal tissue culture, Students learn about transgenic animal, their application in pharmaceutical industry, Animal cloning and its importance.

Unit-I

Introduction to animal biotechnology: Definition, history, importance and scope of animal biotechnology. Applications of animal biotechnology.Various techniques of animal cell and tissue culture, culture media, growth factors and laboratory facilities.

Unit-II

Gene manipulation of animals: Animal viral genome, animal cloning vectors. Gene transfer methods in eukaryotic systems - retroviral vector method, DNA microinjection method, engineered embryonic stem cell method. Selection of clones by using different methods.

Unit-III

Characteristics of cells in culture: Contact inhibition, anchorage dependence, cell-cell communication. Primary culture, immortal cells, cell lines. Maintenance of cell lines in thelaboratory.Tissue engineering.

Unit-IV

Transgenic animals: Introduction, method and application of transgenic animals. Production of transgenic mice, fish, sheep.Transgenic animals as bioreactors- recombinant proteins produced by animal bioreactors.Transgenic animals as models of human diseases.Xenotransplantation.Embryo transfer technologies in cattle and its application.

Essential Readings:

1. Dubey R. C., (2018). A Text Book of Biotechnology. S. Chand & Co Ltd, New Delhi.
2. Gangal S., (2010). Animal Tissue culture. Second edition. University Press (India) PvtLtd. Hyderabad.
3. Ranga, M. (2006). Animal Bioteclmology, Studam publishers.
4. Sasidhara, R. (2006). Animal Biotechnology, MJP Publishers.
5. Satya and Das (2005). Essential Biotechnology for students. Pee Pee Publishers. New Delhi
6. ShivangiMathur (2012). Animal cell and tissue culture. Agrobios Publisher, India
7. Sverdrup H.U.,(1942). Oceans & their Physics, Chemistry & Biology – Johns & R. H. Fleming, Prentice Hall Inc.
8. Satyanarayana, U. (2008). Biotechnology, Books and Allied (p) Ltd, Kolkata.

B.Sc. Biotecnology
Semester-IV

Max. Marks: 35
30 Hrs. (3 hrs/week)

PAPER- II IMMUNOLOGY

Objective of Course: Students should be able to: Gain fundamental knowledge of immunology: include study of the tissues, cells and molecules involved in host defence mechanisms. Immunologists attempt to understand how the immune system develops, how the body defends itself against disease.

Unit-I

Immune system, Organs and cells of immune system: Historical perspective and terminologies, Innate immune response and its role in protection, Adaptive immune responseInnate v/s Adaptive immune response. Humoral and cellular component of immune response, complement system, cytokines, Cells and organs of the immune system (primary and secondary lymphoid organ).

Unit-II

Antigen and Antibody structure and classes: Characteristics of antigen, antigens and immunogen, Haptens and adjuvants. Structure, Function and classification of immunoglobulins. Antigen- antibody reactions, agglutination and precipitation, ELISA, and hybridoma technology.

Unit-III

Antigen processing and Presentation: Major Histocompatibility Complex, Structure, types and function of MHC, Immune cells: T-cell maturation, activation and differentiation, B-cell maturation, activation and differentiation.

Unit-IV

Diseases related to immune system: Immunodeficiency diseases (AIDS), autoimmune diseases: Organ specific disease (e.g. Myasthenia gravis), and systemic autoimmune diseases (e.g.

Rheumatism), Transplantation immunology: Graft rejection, Evidences and mechanism, prevention of graft rejection and Immunosuppressive drugs.

SuggestedReadings:

1. Kuby,RA, Goldsby,ThomasJ.Kindt,Barbara,A.Osborne,(2006).“Immunology” 6thEdition, Freeman.
2. Janewayetal.,(2012)“Immunobiology”4thEdition,CurrentBiology Publications.
3. Paul,(2012)“FundamentalofImmunology,4thedition”,LippencottRaven

4RoittI.(2017).EssentialImmunology.WileyBlackwell,LondonU.K.

5. S.C.Rastogi(1996).“Immunodiagnostics”NewAge,RastogiPublication. Meerut,
6. Pelczar,M.J.,Chan,E.C.S.KreigandNR(2001).“Microbiology”McGrawHillEducation;5 edition. Noida, Uttarpradesh, India.
7. Satyanarayana, U.(2008). Biotechnology,BooksandAllied (p) Ltd, Kolkata.

Semester-IV

Lab:Practicals Based onTheoryPapers

1. Preparation of animal cell culture media.
2. Preparation & sterilization of balanced salt solution
3. Disaggregation of tissues by enzymatic and mechanical method (Demo).
4. Viability test and cell counting.
5. Isolation of genetic DNA from animal tissue.
6. Study different organs of immune system by slides.
7. Determine the blood group types and Rh factor of a blood sample.
8. Study the immune diffusion technique by Single Radial Immun-diffusion.
9. Study the reaction pattern of anantigen with a set of antibodies by Ouchterlony Double Diffusion method.
10. To learn the technique of Dot ELISA for the detection of anantigen.

B.Sc. Biotechnology
Semester-V

Max. Marks: 35

30 Hrs. (3 hrs/week)

ELECTIVE-I: ENVIRONMENTAL AND AGRI-BIOTECHNOLOGY

Objective of Course: This course aims to introduce fundamentals of environmental Biotechnology and Agri biotechnology.

Unit-I

Introduction to environmental biotechnology: Importance of biotechnology in environmental protection. Biodiversity, ecosystem and population diversity.Environmental hazards. Global environment issues: Ozone depletion, greenhouse effect, acid rain, sea level rise, global warming.

Unit-II

Xenobiotics Biomass utilization: Bioremediation, bioleaching, biodegradation, biostimulation, bioaccumulation, bioaugmentation and biomagnifications. Sewage water treatment and soil waste management.

Unit–III

Biotechnological methods of pollution detection: Bioassay, biosensors and biological indicators. Assessment of water and wastewater quality: COD, DO and BOD. Indication of faecal pollution and MPN and MF technique for coliform bacteria.

Unit-IV

Introduction and applications of GM Crops: (Bt- Cotton; and golden rice), Global area of biotech crops. Introduction to organic farming, green manure production, soil fertility and

management.Role of earthworms in soil structure, and productivity, Cost-benefit analysis of vermi-composting.*In-vitro* propagation and Conservation of forest and medicinal plants

SuggestedReadings:

1. Chatterji A. K.(2011). Environmental Biotechnology.Third edition. PHI Learning Pvt Ltd. New Delhi.
2. Singh.B.D.(2018).Text book of Biotechnology.
3. Dubey.R.C.(1993). AText Book of Biotechnology. S. Chand & Co Ltd, NewDelhi.
4. DasH.K.(2004).Textbook of Biotechnology. Wiley Publication..Wiley India Pvt. Limited,
5. Casida.L.E.(1968). Industrial Bitechnology. NewAgeInternationalPub.(P) Limited,
6. SatyaandDas.(2010). Essential Biotechnology Pee Pee Publishers and Distributors Pvt. Limited, India
7. Satyanarayana U.(2008). Biotechnology, Books and Allied (p) Ltd Kolkata

B.Sc Biotechnology
Semester-V

Max. Marks: 35
30 Hrs. (3 hrs/week)

ELECTIVE-II: Industrial Biotechnology

Objective of Course: The course aims to provide fundamental insights to exploit enzymes and microbes for the manufacturing of products which have a huge industrial significance for the purpose of producing goods and services.

Unit-I

Industrial Practices: Culture and media for fermentation, criteria for selection of industrial organisms, screening from natural habitat and strain improvement. Inoculums development for bacteria, yeast and fungi. Raw material: Molasses Hydrocarbons, antifoams and agriculture waste. Sterilization: Bioreactor, media, air exhaust and waste.

Unit-II

Fermentative production of Microbial biomass: Culture medium, process and recovery of fermentative products (Edible mushroom, Bakers yeast and SCP. **Fermentative production of Primary metabolites:** Citric acid, Alcohol, acetone- butanol and vitamin B12.

Unit–III

Fermentative production of Secondary metabolites: Secondary metabolism and its control. Product survey. Production of Antibiotics,antitumor agents, cholesterol-lowering drugs, Polyketide biosynthesis pathway. Application of biotechnology in pharmaceuticalinsustries.

Unit-IV

Quality control and quality assurance in food and pharmaceutical industries: concept of good manufacturing practices in pharmaceutical industry, role of biotechnology to improve food quality

food production and assessment of microbiological quality of various foods Fermentation, cultures of microorganisms, solid or semisolid cultures, batch culture, continuous culture, fed batch culture.

SuggestedReadings:

1. Patel,A.H.(2005).IndustrialMicrobiology–MacMillan Publishers
2. Alexendar N. Glazer & Hiroshi Nikaido Microbial Biotechnology (Fundamental of AppliedMicrobiology)
3. El –Mans, E.M.T., and Bryce, C.F.A. (2002) Fermentation Microbiology and Biotechnology. Taylor.
4. HuffnagleGB&WernickS.(2007).TheProbioticsRevolution:The Definitive Guide toSafe, Natural Health. Bantam Books.
5. KunLY.(2006).MicrobialBiotechnology.World Scientific.
6. Ponmurugan, P., Ramasubramanian, N., and Fredimoses. (2012). Experimental Procedures in Bioprocess technology and Downstream processing. Anjana Book House, Chennai.
7. PrimroseSB.(2001).MolecularBiotechnology.Panima.
8. Satyanarayana.U,2008.Biotechnology,BooksandAllied(p)Ltd. Kolkata.

B.Sc. Biotechnology
Semester-V

Max. Marks: 35
30 Hrs. (3 hrs/week)

ELECTIVE-III : RECOMBINANT DNA TECHNOLOGY

Objective of Course: Student of this course have knowledge on gene manipulation, gene expression, etc which prepares them for further studies in the area of genetic engineering.

Unit–I

Recombinant DNA Tool: Enzymes used in genetic engineering: Exonucleases, endonucleases - S1 nuclease, restriction endonucleases; ligases, polymerases, reverse transcriptase, terminal deoxynucleotidyltransferases, alkaline phosphatase. PCR technique and its application.

Unit–II

Gene transfer Strategy and biology of cloning vectors: Plasmids, lambda bacteriophage, cosmids, M-13bacteriophage, phagemid, *Agrobacterium tumifaciens*: binary and co-integration vector strategy.

Unit-III

Principles of recombinant DNA technology: Construction of recombinant DNA, rDNA expression, genomic and complimentary DNA (c-DNA) libraries. **Application of r-DNA technology:** Medicine, industry, agriculture, livestock, improvement, environmental protection.

Unit-IV

Transposons: Definition**,** types and classification with mechanism. **Strategies for production of recombinant molecules**: Design the vector for the over expression of recombinant proteins, Selection of suitable promoter sequences, ribosome binding sites, transcription terminator, and Plasmid copy number.

Suggested Readings:

1. Brown T. A., (2008). Genomes. 3rd Edition. New York: Garland Publishing Co. New York: Garland Science.
2. Dubey. R. C. A (2018) Text Book of Biotechnology. S. Chand & Co Ltd, New Delhi.
3. Primrose, S. B. and Twyman, R. M., (2006). Principles of Gene Manipulation and Genomics - 7th Edition. Blackwell Publishing Company.
4. Satyanarayana, U. (2008). Biotechnology, Books and Allied (P) Ltd .Kolkata
5. Tvan, R. S. (1997). Recombinant gene expression protocols. Human Press Inc., Tokiwa
6. Work and Work (2009). Laboratory Techniques in Biochemistry and Molecular Biology. Elsevier Science.
7. Aneja. K. R. (2007). Laboratory Manual of Microbiology and Biotechnology, New Age International Publisher.

Semester-V

Lab-Practicals based on Elective Papers

1. MPN test for coliform bacteria in water.
2. Water analysis: BOD.
3. Sauerkraut production.
4. Production of grapes wine.
5. Production of ginger wine.
6. Demonstration of Strain improvement.
7. Production of citric acid using *Aspergillus*by batch culture techniques.
8. Effect of pH on citric acid production
9. Effect of temperature on citric acid production
10. Demonstration of PCR technique with the help of thermocycler.

B.Sc Biotechnology
Semester-VI

Max. Marks: 35
30 Hrs. (3 hrs/week)

ELECTIVE-I – MEDICAL BIOTECHNOLOGY

Objective of Course: The students are introduced to the biological revolutions in this field. They are taught the role of biotechnology in the worldwide market,The students will be able to demonstrate the use of biotechnology in solving various medical problems.

Unit-I

Characteristics of Infectious diseases: Herd Immunity. Disease cycle (sources of disease, reservoir and carrier). Transmission of Pathogens (Air born, contact transmission and vector transmission). General account of fungal disease- mycosis, Subcutaneous and deep.

Unit-II

Bacterial and Viral Diseases-Epidemiology, Pathogenicity, laboratory diagnosis, prevention and control of the following disease. Anthrax, Tuberculosis, Typhoid, Whooping cough, tetanus, Chickenpox and SARS. COVID 19.

Unit-III

Mitochondrial diseases: LHON, MERRF. Gene therapy – ex-vivo and *in-vivo* gene therapy; somatic and germline gene therapy; Strategiesofgenetherapy:gene augmentation– ADAdeficiency;Prodrugtherapy/suicide gene- glioma

Unit-IV

Stem cells: Potency definitions; embryonic and adult stem cells; applications of stem cells – cell based therapies and regenerative medicine. Encapsulation technology and Therapeutics-Diabetes DNA based vaccines, subunit vaccines – Herpes Simplex Virus, Recombinant attenuated vaccines– Cholera

Suggested Readings:

1. Jones & Bartlett, (1993). Human Genetics Molecular Evolution, McConkey, Boston
2. Strachan,T; Read,Andrew P,(1939). Human Molecular Genetics,TomStrachen and A P Read, Bios Scientific Publishers, New York.
3. Jack J. Pasternak (2005).Introduction to Human Molecular Genetics – J.J Pasternak, John Wiley Publishers, Wiley.
4. PratibhaNallari, V.VenugopalRao (2010). Medical Biotechnology. Publisher Oxford Press
5. Glick and Pasternak (2010). Molecular Biotechnology.ASM Press, USA
6. Rimoin D. et. al., (2013).Principles and Practice of Medical Genetics, I, II, III Volumes by AEH Edts. Emery
7. Work and Work (2009). Laboratory Techniques in Biochemistry and Molecular Biology. Elsevier Science.

B.Sc. Biotechnology
Semester-VI

Max. Marks: 35

30 Hrs. (3 hrs/week)

ELECTIVE-II- BIOINFORMATICS AND NANOTECHNOLOGY

Objective of Course: This paper introduces to student's concepts in bioinformatics and Nanotechnology. The student will be able to apply basic principles of biology, computer science and mathematics to address complex biological problems.

Unit-I

Introduction to Bioinformatics:Definition, introduction, application and scopes of Bioinformatics. Biological Databases and Sequence analysis introduction, **Primary Databases:** Primary Sequence database. **Databanks**–GenBank,PubMed. BLAST, and NCBI **.**

Unit-II

Sequence Alignment: Introduction to sequence alignment and its applications. Pair wise sequence alignment: Concept of global and local alignment. **Molecular Structure Databases:** Protein Data Bank (PDB), Multiple sequence alignment**,**Uses of multiple sequence alignment. Introduction and application of microarray in relation to Biotechnology.

Unit-III

Elementary Idea about Nano-biotechnology– Concepts, definitions, prospects. Nanoparticles – size, shape, properties. Bionanoparticles – nanostarch, nanocomposites–dendrimers. Hot–Dotnanoparticles. Applications of nanobiotechnology in medicine.

Unit-IV

Biological synthesis of Nanoparticles: Concept of reducing and capping agents, introduction to biomolecules as reducing and capping agents- Bacteria, and plants. Advantages and applications of biologically synthesized nanomaterials. Introduction about Nanochips and Biosensors.

Suggested Readings:

1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.

2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.

3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.

4. Introduction to nanoscience and nanotechnology, CRC Press, Tylor and Francis Group, Boca Raton, G. L. Hornyak, H. F. Tibbals, J. Dutta and J J. Moore.

5. Introductory Nanoscience: Physical and Chemical Concepts, CRC Press, Tylor and Francis Group, Boca Raton, M. Kuno.

6. Brown, T.A (1996). Gene cloning and DNA analysis Blackwell science, Osney Mead, Oxford.

7. Chouhan R. (2018). Molecular Biology and Biotechnology. Second edition.CBH Publication, Jaipur

8. Dubey, R. C. (2007). A textbook of Biotechnology, S.Chand& Company Ltd. New Delhi.

9. Gupta P.K: (2004). Biotechnology and Genomics, Rastogi publication, Meerut

10. Satyanarayana. U, (2008),.Biotechnology, Books and Allied (p) Ltd

11. Singh, B. D (2004). Biotechnology, Kalyani Publishers, New Delhi.

B.Sc Biotechnology
Semester-VI

Max. Marks: 35

30 Hrs. (3 hrs/week)

ELECTIVE –III:BIOSAFETY, BIOETHICS AND IPR IN BIOTECHNOLOGY

Objective of Course: This course is an introduction to the students on the ethical aspects of conducting research and safety aspects to be adhered in a research setting. This course also introduces the students to effective management of available resources and footprint of research activities.

Unit-I

The legal and socioeconomic impact of biotechnology, public education of the process of biotechnology involved in generating new forms of life for informed decision making, biosafety regulation and national and international guidelines, r-DNA guidelines, experimental protocol approvals, levels of containment, regulatory bodies in biotechnology, biosafety committee.

Unit-II

Ethical issues, moral values on experimental animals, ethical implications of biotechnological Productsandtechniques.Intellectualpropertyrights,WTO,TRIPS,International conventions,patents and copy rights, patent claims, methods of applications of patents.

Unit-III

Entrepreneurship: Starting an enterprise, stage in setting up an enterprise, business idea, Setting a business plan. Management team, Marketing, market research, market strategies (4p strategies) financial planning, Balance sheet, profit and loose statement.

Unit-IV

Legal implications, biodiversity and farmers right. Beneficial application and development of research focus to the need of the poor, identification of directions for yield effect in agriculture, aquaculture etc.

Suggested Readings:

1. Aneja. K.R. (2007). Laboratory Manual of Microbiology and Biotechnology, New Age International Publisher.
2. GoelAndParashar (2013). IPR, Biosafety and Bioethics. Pearson Education India
3. Nambisan, P. (2017). An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology, Academic Press.
4. Joshi R. (2007). Biosafety and Bioethics. Isha Book Publisher.
5. Sateesh M.K. (2010). Bioethics and Biosafety, I. K. International Pvt Ltd.
6. Sree Krishna V. (2007). Bioethics and Biosafety in Biotechnology, New Age international publishers.

B.Sc Biotechnology Semester-VI

Lab-Practicals based on Elective Paper

1. Study of a plant part infected with a microbes.
2. Study of HIV Virus
3. Study of viral born disease and symptoms
4. Identify any to fungal and bacterial born disease
5. Exploring NCBI and its resources.
6. Sequence information resourceDemonstrate the BLAST.
7. Sequence information resource Demonstrate the FASTA
8. To make an inventory study the principle and applications of important instruments used in the nanotechnology and Biotechnology laboratory.
9. Creating an e-mail account, sending and receiving mails. Search engines, websites, browsing and Downloading. Searching research articles in Medline and Pub med
10. Preparation of Bionanoparticals with the help of plant/ Mushrooms/ Algae.

Department of Biotechnology

Value Added Courses

1. Course Title: Entrepreneurship in Biotechnology

Course Objective: This course introduces the principles and practices of entrepreneurship in the biotechnology industry, including business planning, financing, marketing, and intellectual property management.

Course Duration: 15 hours

Examination Scheme: The examination will consist of a written exam that will test the student's understanding of the course material. The exam will include multiple-choice questions, short answer questions, and essay questions

Unit -I

Entrepreneurship and Financing Strategies:

Introduction to Entrepreneurship in Biotechnology. Definition and scope of Biotech entrepreneurship. Historical development of biotech entrepreneurship. Role of Biotech entrepreneurship in modern Biotech industry. Market Analysis and Business Planning. Market analysis and identification of opportunities. Business planning process and key components. Competitive analysis and differentiation Funding and Financing Strategies. Funding sources for biotech start-ups. Financing strategies and considerations. Venture capital and angel investing. Regulatory affairs and compliance. Regulatory requirements for biotech products.

Unit II

Product Development and Sales Strategies:

Product Development and Commercialization. Product development process and key components. Regulatory requirements for Biotech Product. Manufacturing and supply chain management. Pricing and reimbursement strategies. Sales and marketing strategies for Biotech products. Market segmentation and targeting. Branding and advertising. Leadership and Team Building. Leadership principles and practices. Team building and management strategies. Corporate culture and values.

2. Course Title: Bioinformatics

Course objectives: This course introduces the principles and applications of bioinformatics, including data analysis, database management, and computer programming in biological research.

Course Duration: 15hours

Unit -I

Introduction to Bioinformatics. Definition and scope of bioinformatics. Historical development of bioinformatics. Role of bioinformatics in modern biology research. Molecular Biology and Genetics Basics for Bioinformatics. Nucleic acids, proteins, and their properties. DNA sequencing technologies. Biological Databases and Data Retrieval. Types of biological databases. Sequence and structure databases. Gene expression and proteomics databases. Retrieval and analysis of data from databases.

Unit II

Sequence Alignment and Phylogenetic Analysis. Sequence alignment algorithms and tools. Multiple sequence alignment and applications. Phylogenetic analysis and tree-building methods. Applications of phylogenetic analysis. Genome Assembly and Annotation. Genome sequencing technologies. Genome assembly algorithms and tools. Gene prediction and annotation. Genome-scale analysis and applications. Transcriptomic and Gene Expression Analysis. RNA sequencing technologies.

3. Course Title: Clinical Trials Management

Course Objective: This course provides an overview of the management and conduct of clinical trials, including study design, protocol development, ethical considerations, data collection and analysis, regulatory requirements, and project management.

Course Duration: 15hours

Unit I

Clinical Trials and Protocol development process:

Introduction to Clinical Trials. Definition and types of clinical trials. Historical development of clinical trials. Ethical and legal considerations in clinical trials. Study Design and Protocol Development. Study design principles and considerations. Protocol development process and key components. Risk assessment and management. Regulatory requirements for clinical Trials. Regulatory agencies and their roles. Investigational New Drug (IND) application process. Institutional Review Board (IRB) requirements. Good Clinical Practice (GCP) guidelines.

Unit II

Data Collection and Statistical Analysis:

Study Monitoring and Data Collection. Study monitoring and site management. Data collection and management strategies. Quality control and assurance. Statistical Analysis and Reporting. Statistical analysis methods and software. Clinical Trial Management and Project Planning. Project management principles and techniques. Budget planning and management. Contract negotiations and vendor management