Dr. Babasaheb Ambedkar Marathwada University

Chhatrapati Sambhajinagar- 431001

B.Sc. Degree Programme

(Three Year / Four Years (Hons) /Four Years (Hons with Research)

Course Structure and Syllabus for B. Sc. 1st Year

(Revised)

(AS PER NEP-2020)

Subject (Major): Biotechnology (Single Major)

Effective from 2024-25

PREFACE

As we stand on the threshold of a new era in education, the dawn of the National Education Policy 2020 illuminates our path toward a holistic, inclusive, and progressive educational landscape. The Bachelor of Science (B. Sc.) curriculum outlined herein reflects the ethos and aspirations of this transformative policy, aiming to equip learners with the knowledge, skills, and values necessary to thrive in the dynamic world of the 21st century.

At its core, the National Education Policy 2020 envisions an educational framework that is learner-centric, multidisciplinary, and geared towards fostering creativity, critical thinking, and innovation. It emphasizes the integration of knowledge across disciplines, breaking down traditional silos to encourage holistic understanding and application of concepts. The Bachelor of Science (B. Sc.) curriculum embodies these principles by offering a diverse array of courses spanning various scientific domains, while also incorporating interdisciplinary studies to nurture well-rounded graduates capable of addressing complex challenges with agility and insight.

Furthermore, the curriculum is designed to promote experiential learning, research, and hands-on exploration, recognizing the importance of practical engagement in deepening understanding and cultivating real-world skills. Through laboratory work, field experiences, internships, and project-based learning opportunities, students will have the chance to apply theoretical knowledge in practical settings, develop problem-solving abilities, and cultivate a spirit of inquiry and discovery.

Integral to the National Education Policy 2020 is the commitment to inclusivity, equity, and access to quality education for all. The Bachelor of Science (B. Sc.) curriculum reflects this commitment by embracing diversity in perspectives, backgrounds, and experiences, and by fostering an inclusive learning environment where every student feels valued, supported, and empowered to succeed.

Moreover, the curriculum emphasizes the cultivation of ethical values, social responsibility, and global citizenship, instilling in students a sense of accountability towards society and the environment. By integrating courses on ethics, sustainability, and social sciences, the Bachelor of Science (B. Sc.) program aims to produce graduates who are not only proficient in their respective fields but also compassionate, ethical leaders committed to making a positive impact on the world.

As we embark on this journey of educational transformation guided by the National Education Policy 2020, the Bachelor of Science (B. Sc.) curriculum stands as a testament to our collective vision of a more equitable, inclusive, and enlightened society. It is our hope that through rigorous academics, innovative pedagogy, and unwavering dedication to excellence, we can inspire the next generation of scientists, scholars, and change-makers to realize their full potential and contribute meaningfully to the advancement of knowledge and the betterment of humanity.

Introduction to Undergraduate Degree course in Biotechnology:

As per the recommendations of the NEP-2020, the undergraduate degree course in Biotechnology is a six/ eight semester course spread over three/ four academic years. The teaching – learning process is student-centric and it involves both theory and practical components. It offers a flexibility of programme structure while ensuring that the student gets a strong foundation in the subject and gains in-depth knowledge. Besides the Discipline Specific Core (DSC) courses, a student can opt courses from the syllabus comprising of Discipline Specific Electives (DSEs), Generic Electives (GEs), Skill Enhancement Courses (SECs), Ability Enhancement courses (AECs) and Value Addition Courses (VACs). Thereby, bringing out the multidisciplinary approach and adherence to innovative ways within the curriculum framework. Moreover, it allows a student maximum flexibility in pursuing his/her studies at the undergraduate level to the extent of having the liberty to eventually design the degree with multiple exit options depending upon the needs and aspirations of the student in terms of his/her goals of life, without compromising on the teaching learning, both in qualitative and quantitative terms. This will suit the present day needs of students in terms of securing their paths towards higher studies or employment.

Courses of Study: Courses of the study indicate pursuance of study in a particular discipline. Every discipline shall offer four categories of courses of study, viz. Discipline Specific Core (DSC) courses, Discipline Specific Electives (DSEs), Skill Enhancement Courses (SECs) and Generic Electives (GEs). Besides these four courses, a student will select Ability Enhancement Courses (AECs) and Value-Added Courses (VACs) from the respective pool of courses offered by the University.

a) **Discipline Specific Core (DSC):** Discipline Specific Core is a course of study, which should be pursued by a student as a mandatory requirement of his/ her programme of study. In Bachelor of Science (Hons.) Biotechnology programme, DSCs are the core credit courses of Biotechnology which will be appropriately graded and arranged across the semesters of study, being undertaken by the student, with multiple exit options as per NEP 2020.

b) **Discipline Specific Elective (DSE):** The Discipline Specific Electives (DSEs) are a pool of credit courses of Biotechnology from which a student will choose to study based on his/ her interest.

c) **Generic Elective (GE):** Generic Electives is a pool of courses offered by various disciplines of study (excluding the GEs offered by the parent discipline) which is meant to provide multidisciplinary or interdisciplinary education to students. In case a student opts for DSEs beyond his/ her discipline specific course(s) of study, such DSEs shall be treated as GEs for that student.

d) **Ability Enhancement course (AEC), Skill Enhancement Course (SEC) and Value Addition Course (VAC):** These three courses are a pool of courses offered by

all the Departments in groups of odd and even semesters from which a student can choose.

i. **AEC:** AEC courses are the courses based upon the content that leads to knowledge enhancement through various areas of study. They are based on Language and Literature, and Environmental Science which are mandatory for all disciplines.

ii. **SEC:** SECs are skill-based courses in all disciplines and are aimed at providing hands-on training, competencies, proficiency and skills to students. SEC courses may be chosen from a pool of courses designed to provide skill-based instruction.

iii. **VAC:** VACs are common pool of courses offered by different disciplines and aimed towards personality building, embedding ethical, cultural and constitutional values; promote critical thinking, Indian knowledge systems, scientific temperament, communication skills, creative writing, presentation skills, sports and physical education and team work which will help in all round development of students.

Structure of B. Sc. (Three / Four Years / with Research Degree) Programme with Multiple Entry and Exit Options

Subject (Major): Biotechnology

B.Sc First Year: 1st Semester

Course Type	Course Code	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major (Core) M1 Mandatory **Biotechnology**	DSC-1	**Biomolecules-I**	2		2		2+2 = 4
	DSC-2	Practical based on M1-DSC-1		4		2	
Major (Core) M2 Mandatory	DSC-1	**Instrumentation -I**	2		2		2+2 = 4
	DSC-2	Practical based on M2- DSC-1		4		2	
Major (Core) M3 Mandatory	DSC-1	**Microbiology I**	2		2		2+2 = 4
	DSC-2	Practical based on M3- DSC-1		4		2	
Generic / Open Elective (GE/OE) (Choose any two from pool of courses) **It should be chosen compulsorily from the faculty other than that of Major**	GE/OE-1	To be chosen from other faculty	2		2		2
SEC (Skill Enhancement Courses) (Choose any one from pool of courses)	SEC-1	**i) Microbial cultivation and Identification** ii) **Diagnostic Biology**	1		1		2
	SEC-2	**i) Practicals based on Microbial cultivation and Identification ii) Practicals based on Diagnostic Biology**		2		1	
AEC, VEC, IKS	AEC-1	English (Common for all the faculty)	2		2		2+2 =4
	IKS-1	Choose any one from pool of courses	2		2		
OJT/ FP/CEP/CC/RP	CC-1	Health and Wellness (Common for all the faculty)		4		2	2
			13	**18**	**13**	**09**	**22**

GE/OE-1: **Introduction to Biotechnology** (This course will be available for the students from other faculty)

BSc First Year: 2nd Semester

Course Type	Course Code	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major (Core) M1 Mandatory	DSC-3	**Biomolecules-II**	2		2		2+2 = 4
	DSC-4	Practical based on DSC-3		4		2	
Major (Core) M2 Mandatory	DSC-3	**Instrumentation-II**	2		2		2+2 = 4
	DSC-4	Practical based on DSC-3		4		2	
Major (Core) M3 Mandatory	DSC-3	**Microbiology II**	2		2		2+2 = 4
	DSC-4	Practical based on DSC-3		4		2	
Generic / Open Elective (GE/OE) (Choose any two from pool of courses) **It should be chosen compulsorily from the faculty other than that of Major**	GE/OE-2	To be chosen from other faculty	2		2		2
VSC (Vocational Skill Courses) (Choose any one from pool of courses)	VSC-1	**i) Biofertilizers Production** ii) **Plant Tissue culture**	1		1		2
	VSC-2	**i) Practicals based on Biofertilizers Production ii) Practicals based on Plant Tissue culture**		2		1	
AEC, VEC, IKS	AEC-1	English (Common for all the faculty)	2		2		2+2 =4
	VEC-1	Constitution of India (Common for all the faculty)	2		2		
OJT/ FP/CEP/CC/RP	CC-2	Yoga Education / Sports and Fitness (Common for all the faculty)		4		2	2
			13	**18**	**13**	**09**	**22**
Exit Option : Award of UG Certificate in 3 Majors with 44 credits and an additional 4 credits of core NSQF course / Internship OR continue with Major and Minor							

GE/OE-2 : **Agricultural Biotechnology** (This course will be available for the students from other faculty)

Detailed Illustration of Courses included in 1st and 2nd semester:

1) **Major** (Core) subject are mandatory.

   DSC-1 : This is a 2 credit theory course corresponding to Major (core) subject
   DSC-2 : This is a 2 credit practical course based on DSC-1
   DSC-3 : This is a 2 credit theory course corresponding to Major (core) subject
   DSC-4 : This is a 2 credit practical course based on DSC-3

2) **Generic / Open Elective (GE/OE)**: (Needs to be chosen (any two) from pool of courses available at respective college). **These courses should be chosen compulsorily from faculty other than that of Major.**

   GE/OE -1 : This is a 2 credit theory course should be chosen compulsorily from faculty other than that of Major.
   GE/OE -2 : This is a 2 credit theory course should be chosen compulsorily from faculty other than that of Major.

3) **SEC** (Skill Enhancement Courses) : Choose any one from pool of courses. These courses needs to be designed to enhance the technical skills of the students in specific area.

   SEC-1 : This is a 1 credit theory course to enhance the technical skills of the students in specific area.
   SEC-2 : This is a 1 credit practical course based on SEC-1.

4) **VSC** (Vocational Skill Courses) : Choose any one from pool of courses. These courses should be based on Hands on Training corresponding to Major (core) subject.

   VSC-1 : This is a 1 credit theory course based Hands on Training corresponding to Major (core) subject.
   VSC-2 : This is a 1 credit practical course based on VSC-1

5) **AEC** (Ability Enhancement courses): The focus of these courses should be based on linguistic and communication skills.

   AEC-1 : English
   This is a 2 credit theory course based on linguistic proficiency. It will be common for all the faculty.

   AEC-2 : English
   This is a 2 credit theory course based on linguistic proficiency. It will be common for all the faculty.

6) **IKS** (Indian Knowledge System) : The courses related to traditional and ancient culture of India will be included in this section. The respective college will have to choose one of the courses from the pool of courses designed by the University.

IKS-1 : To be chosen from the pool of courses designed by the University
This is a 2 credit theory course based on Indian Knowledge System. It will be common for all the faculty

7) **VEC** (Value Education Courses): The courses such as understanding India, Environmental Science / Education, Digital and Technological solutions etc will be part of Value Education Courses.

VEC-1 : Constitution of India
This is a 2 credit theory course based on value education. It will be common for all the faculty

8) **CC** (Curricular Courses): The courses such as Health and wellness, Yoga education, Sports and Fitness, Cultural activities, NSS/NCC, Preforming Arts.

CC-1 : Health and Wellness
This is a 2 credit practical course based on Co-curricular activities. It will be common for all the faculty

CC-2 : Yoga education / Sports and Fitness
This is a 2 credit practical course based on Co-curricular activities. It will be common for all the faculty

Programme Educational Objectives (PEOs) :

Programme Educational Objectives (PEOs) for the Bachelor of Science in Biotechnology Curriculum under the National Education Policy 2020:

1. **Mastery of Discipline-Specific Knowledge**: Graduates of the Bachelor of Science in Biotechnology program will demonstrate a deep understanding of fundamental principles, theories, and methodologies in their chosen scientific discipline, enabling them to analyze complex problems, propose innovative solutions, and contribute to advancements in their field.

2. **Interdisciplinary Proficiency**: Graduates will possess the ability to integrate knowledge and skills from multiple scientific disciplines, fostering a holistic approach to problem-solving and innovation. They will be equipped to address multifaceted challenges by drawing upon diverse perspectives and methodologies.

3. **Critical Thinking and Analytical Skills:** Graduates will develop strong critical thinking abilities, enabling them to evaluate information rigorously, analyze data effectively, and make informed decisions based on evidence. They will demonstrate proficiency in applying logical reasoning and scientific methods to solve problems and generate new knowledge.

4. **Leadership and Innovation:** Graduates will demonstrate leadership qualities and entrepreneurial mindset, capable of initiating and driving positive change in their organizations and communities. They will exhibit creativity, resilience, and adaptability, harnessing innovation to address complex challenges and seize opportunities for growth and advancement.

5. **Global Citizenship and Cultural Sensitivity**: Graduates will possess a global perspective and cultural sensitivity, recognizing the inter connectedness of diverse communities and the importance of collaboration across borders. They will engage in cross-cultural dialogue, embrace diversity, and contribute to the advancement of knowledge and understanding on a global scale.

These Programme Educational Objectives serve as guiding principles for the Bachelor of Science curriculum, reflecting our commitment to nurturing well-rounded graduates who are prepared to excel in their careers, contribute to society, and lead meaningful lives in a rapidly changing world.

Programme Outcomes (POs) :

The National Education Policy (NEP) 2020 for India emphasizes several key aspects for Bachelor of Science (B.Sc.) programs, aiming to produce graduates who are not only well-versed in their respective disciplines but also equipped with skills necessary for holistic development and employability. While specific program outcomes may vary between institutions and disciplines within B.Sc. programs, here are some common outcomes aligned with NEP 2020:

- **PO1. The citizenship and society:** Apply broad understanding of ethical and professional skill in science subjects in the context of global, economic, environmental and societal realities while encompassing relevant contemporary issues.

- **PO2. Environment and sustainability**: Apply broad understanding of impact of science subjects in a global, economic, environmental and societal context and demonstrate the knowledge of, and need for sustainable development.

- **PO3. Ethics:** Apply ability to develop sustainable practical solutions for science subject related problems within positive professional and ethical boundaries.

- **PO4. Individual and team work:** Function effectively as a leader and as well as team member in diverse/ multidisciplinary environments.

- **PO5. Communication:** Communicate effectively on complex science subject related activities with the scientific community in particular and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

- **PO6. Project management and finance**: Demonstrate knowledge and understanding of the first principles of science and apply these to one's own work as a member and leader in a team, to complete project in any environment.

- **PO7. Life-long learning**: Recognize the need for lifelong learning and have the ability to engage in independent and life-long learning in the broadest context of technological change.

These program outcomes align with the broader goals of NEP 2020 to transform higher education in India and prepare students for the challenges and opportunities of the 21st century. Board of Studies designing B.Sc. curricula are encouraged to incorporate these outcomes into their program objectives and learning outcomes.

Programme Specific Outcomes (PSOs):

On completion of the 03/ 04 years Degree in B.Sc. (Biotechnology) **students will be able to:**

- **PSO 1.Disciplinary Knowledge:** Bachelor degree in Biotechnology is the culmination of in-depth knowledge of Biotechnology, Molecular Biology, R- DNA technology, Genetics, Biochemical mechanism, Plant animal tissue culture, and several other branches of Biotechnology. This also leads to study the related areas. By acquiring this sound knowledge in the subject, Graduate in Biotechnology can be eligible for pursuing higher education and research / postgraduate education.
- **PSO 2.Specialized skill:** Students will gain knowledge and develop specialized skill in the different area of Biotechnology. Graduate candidates will develop a sense of societal and ethical responsibility pertaining to bioinformatics, health, agriculture, dairy, genetic engineering, and fermentation industry.
- **PSO 4**. **Knowledge about research/thirst area in Biotechnology:** The graduated student in Biotechnology will develop understanding about various research domains in Biotechnology field.
- **PSO 5.Information/digital Literacy:** The completion of this programme will enable the learner to use not only the fundamental tools Biotechnology but also its domainslike Bioinformatics and Biostatics.
- **PSO 6.** This knowledge shall promote our graduates to stand independently amidst the growing technological innovations in the subject.
- **PSO7** The students completing this programme will develop ability of working independently and to make an in-depth study of various domains of Biotechnology.

Semester – I

Major-1
DSC-1 : (Biomolecules-I)

Total Credits : 02 Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

i. To acquaint the students with general introduction to the basic concepts of Biochemistry of different Biomolecules.
ii. To inculcate the knowledge on different types of carbohydrates and their structure.
iii. To add the knowledge on the structure and types of amino acids, proteins and theirorganization.
iv. To impart the fundamental knowledge about lipids, their types and DNA, RNA.

Course Outcomes (COs) :

After completion of the course, students will -

i. Gain knowledge about the chemical and molecular foundations of life and the role of energy rich compound in biological systems.
ii. understand the role of sugars in energy production and living systems
iii. Be able to Apply the link between the structure and functions of proteins in biological context
iv. Analyze the role of lipds and apply the techniques to identify their purity

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	**Carbohydrates** General classification of Carbohydrates, Structural Classification of Monosaccharides, aldoses and ketoses, Ring formation in Monosaccharides, Mutarotation, Oligosaccharide Glycosidic bond, Disaccharides (Sucrose, Maltose, Lactose) Polysaccharides (e.g. Starch, Glycogen, Cellulose, Heparin, Pectin), Biological functions of Carbohydrates. Molecules involved in generation of Mechanical Stability: Peptidoglycan, Polysaccharide (Cellulose in Plant).	**10 Hrs**
II	**Amino acid & Protein** Amino acid & Protein: Structural classification of amino acids	**10 Hrs**

	based on R side chain, Structural levels of Proteins, Classification of Proteins based on Composition, Functions of Proteins. Introduction to Enzyme.	
III	**Lipids** Classification, Function of lipids, Fatty acids: (physical and chemical properties, Nomenclature, Even and odd carbon, Saturated, unsaturated). essential fatty acids, Triacylglycerols, Phospholipids, Glycerophospholipids, glycolipids, spingolipids lipoproteins, steroids, Cholesterol, Ergosteril, Membrane lipids: Ampipathic lipids.	**10 Hrs**

Text Books:

- Physical Biochemistry: Applications to Biochemistry and Molecular Biology, David, M. Freifelder, ACS publication, 1983.
- Agarwal, G. R. Agarwal K., Agarwal O. P. (2005) Text Book of Biochemistry, 13th edn., Goel Publishing House, Krishna Prakashan Media Pvt. Ltd., Meerut, India.
- Jain, J.L., Jain,S. and Jain,N. (2005) Fundamentals of Biochemistry, 6th edn., S. Chand and Company Ltd., Delh

Reference Books:

- Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006) Biochemistry, VI Edition, W.H Freeman and Co.
- Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants, American Society of Plant Biologists.
- Nelson, D.L., Cox, M.M. (2004) Lehningers' Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
- Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology, John Wiley and Sons, Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology Wadsworth Publishing Co. Ltd.
- Satyanarayana, U. and Chakrapani U. (2010) Biochemistry, Books and Allied Pvt. Ltd., Kolkata, India.

Major -1, DSC-2 : Lab Course-I (Based on DSC-1)	
Total Credits : 02 Maximum Marks : 50	Total Contact Hours : 60 Hrs
Course Objectives	● To acquaint students with various techniques used like extraction, detection, estimation and separation ● To develop skill-full hand of the students
Course Outcome	**After successful completion of this course, students are expected to:** ◆ perform qualitative tests for carbohydrates, lipids and amino acids ◆ extract carbohydrate and proteins ◆ estimation carbohydrates, lipids and proteins
1.	Estimation of glucose by DNSA method.
2.	Qualitative tests for carbohydrates
3.	Isolation and detectin of starch from potatoes/maize/wheat.
4.	Qualitative tests for amino acids
5.	Estimation of amino acid by Ninhydrin method.
6.	Estimation of protein by Biuret method & Lowry method.
7.	Estimation of Acid value of given oil sample
8.	Estimation of Saponification value of given oil sample
9.	Estimation of DNA by DPA method
10.	Estimation of RNA by Orcinol Method
11.	Qualitative tests for lipids
12.	Qualitative test for amylase
13.	Extraction and detection of Casein from milk

Text Books:

- Jayaraman, J. (2011). Laboratory Manual in Biochemistry, New Age International (P) Ltd. Publishers, New Delhi.
- Sadashivam, S. and Manikam, A. (2018). Biochemical Methods, 3rdedition, New Age International (P) Ltd. Publishers, New Delhi.

Reference Books:

- Wilson, K. and Walker, J. (2003). Practical Biochemistry: Principles and techniques, 5thedition, Cambridge University Press, UK.
- Plummer, D. T. (2017). An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw Hill Publishing Company Ltd., New Delhi.
- Oser, B. L. (ed.) (1965). Hawk's physiological chemistry, 14thedition, McGraw-Hill Book Company, New York, USA
- Rao, B. S. and Deshpande, V. (2005). Experimental Biochemistry: A student companion, I. K. International Pvt. Ltd., New Delhi.

Major-2
DSC-1 : (Basic Instrumentation Techniques- I)

Total Credits : 02 Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

By the end of this course, Students should able to: -

- Introduction of different Instruments: Understanding of all basic instruments which require to do all practical purpose.
- Understand the theory and operating procedure of basic Instruments.
- Application of instruments in Biotechnology.

Course Outcomes (COs) :

After completion of the course, students will able to: -

- Understand and explain the principles and SOP of laboratory instruments. -
- Explain the principle and working of Autoclave, pH meter, Hot air oven, Colorimeter etc.
- Demonstrate different instruments and techniques.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Basic Instruments: Theory, Principle and application of Autoclave, pH meter, Incubator, Hot Air oven, Laminar Air flow system, Weighing balance.	10
II	Biophysical methods: Concept of sedimentation, Centrifugal force. Centrifugation-types, preparative, analytical and differential, sedimentation velocity and sedimentation equilibrium.	10
III	Colorimeter & UV-Visible Spectroscopy: Basic principles, theory, instrumentation and applications of colorimeter & UV-visible spectroscopy.	10

References:

- Biophysical Chemistry by Nath and Upadhyay.
- Analytical Biochemistry by Holme.
- Instrumental methods of chemical analysis by Chatwal and Anand.

Major -2, DSC-2 : Lab Course-II

Total Credits : 02 Total Contact Hours : 60 Hrs
Maximum Marks : 50

Course Objectives	**By the end of this course, Students should able : -** ● To understand the principles of various instruments. ● To acquaint students with various techniques used like qualitative and quantitative analysis of Biomolecules ● To develop skill-full hand of the students
Course Outcome	**After successful completion of this course, students are expected to:** ● principles and SOP of laboratory instruments ● Perform qualitative tests various biomolecule. ● Understand the application of instruments in Biotechnology.
1	Operation and handling of Laminar Air flow system
2	Operation and handling of pH meter
3	Sizing yeast cells using centrifugation technique.
4	Operation and handling of Autoclave .
5	Operation and handling of Hot air oven
6	Operation and handling of Incubator
7	Operation and handling of weighing balance
8	Operation and handling of colorimeter
9	Operation and handling of UV-Visible spectroscopy
10	Absorption spectra of protein.
11	Determination of Lambda max of methyl red dye.
12	Determination of Lambda max of Malachite green dye

Reference Books:

- Wilson, K. and Walker, J. (2003). Practical Biochemistry: Principles and techniques, 5thedition, Cambridge University Press, UK.
- Plummer, D. T. (2017). An Introduction to Practical Biochemistry, 3rd edition, Tata McGraw Hill Publishing Company Ltd., New Delhi.
- Oser, B. L. (ed.) (1965). Hawk's physiological chemistry, 14thedition, McGraw-Hill

Book Company, New York, USA

Rao, B. S. and Deshpande, V. (2005). Experimental Biochemistry: A student companion, I. K. International Pvt. Ltd., New Delhi.

Major-3
DSC-1 : (Microbiology-I)

Total Credits : 02 Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

v. To acquaint the students with general introduction to the basic concepts of Biochemistry of different Biomolecules.
vi. To inculcate the knowledge on different types of carbohydrates and their structure.
vii. To add the knowledge on the structure and types of amino acids, proteins and theirorganization.
viii. To impart the fundamental knowledge about lipids, their types and DNA, RNA.

Course Outcomes (COs) :

After completion of the course, students will -

v. Gain knowledge about the chemical and molecular foundations of life and the role of energy rich compound in biological systems.

vi. understand the role of sugars in energy production and living systems
vii. Be able to Apply the link between the structure and functions of proteins in biological context
viii. Analyze the role of lipds and apply the techniques to identify their purity

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	**Unit 1: Introduction to Microbiology** Definition of microbiology. History of microbiology: Theory of spontaneous generation, Biogenesis and Abiogenesis. Types of microorganisms. Importance of microorganisms in various fields (health, industry, and environment).General properties and importance of Bacteria, Virus, Archaebacteria, Fungi and Rickettsia.	**10 Hrs**
II	**Unit II: Microbial Cell Structure and Function** Prokaryotic vs. eukaryotic cells Bacterial classification depending on cell wall and other characteristics. Structure and function of bacterial cell components (cell wall, plasma membrane, cytoplasm, ribosomes, flagella, pili)	**10 Hrs**

	Ultra-structure of a typical endospore, Classification of bacteria based on types and position of endospore.	
III	**Unit III: Stains and Staining Procedure** Nature of strains, principles, mechanism, methods and types of staining A. Negative staining, B. Monochrome staining, C. Differential staining examples –Grams staining, Acid Fast staining, Capsule staining, Cell wall staining, Flagella staining, staining of PHB granules, Endospore staining .	**10 Hrs**

Text Books:

- PGeneral Microbiology –R. Y. Stanier VIth edition.
- Microbiology –Pelczar
- Principles of Bacteriology –A. J. Salle
- Microbiology by Prescott
- Text book of Microbiology by Tortora

Reference Books:

- Microbiology by Brock
- General Virology –S. E. Luria
- Chemical Microbiology –Rose

Major -3, DSC-2 : Lab Course-III	
Total Credits : 02 Maximum Marks : 50	Total Contact Hours : 60 Hrs
Course Objectives	**By the end of this course, Students should able : -** ● Basic Microbiological techniques. ● Microbial staining ● Observation o falgae, fungi and bacteria
Course Outcome	**After successful completion of this course, students are expected to:** ● Hands on on Basic Microbiological techniques. ● Importance of Microbial staining ● Understand the Structural difference between algae, fungi and bacteria.
1	Simple staining/Monochrome staining
2	Negative staining
3	Differential staining –Grams staining and Acid Fast staining
4	Cell wall staining
5	Capsule staining
6	Flagella staining
7	Spore staining
8	Wet mount of fungi
9	Microscopic observation of algae with classification in brief
10	Staining of Actinomycetes

Reference Books:

- Textbook of Microbiology by Ananthanarayan and Panikers tenth edition, University press.
- Microbiology by Micael J. Pelczer. 5th edition Tata McGraw-Hill publisher,
- General Microbiology by Stenier R. Y. *et al* Mc millan press. Inc.
- Fundamentals Principles of Bacteriology by Salle A. J.

SEC1 : (Microbial cultivation and Identification)

Total Credits : 01 Total Contact Hours : 15 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

1) To provide basic understanding of Microbiology and related concept.
2) To make student aware of various techniques in Microbiology.
3) To demonstrate practical utility of the microbial world.

Course Outcomes (COs) :
After completion of the course, students will be able to -

1) Understand and explain importance of Microbial world.
2) Students will use identification techniques for microbial study.
3) Awareness of Practical advances in culture identification.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	**Microorganisms and its Cultivation** Microbiology-Introduction, History in brief, Microorganism and its types, Pure culture & Staining technique, Microscopy in brief. Microbial Nutrition: Common nutrient requirements, Nutritional types of microorganisms, growth factors. Uptake of nutrients by cells. Culture Media: Synthetic or defined media. Commonly used media. Types of Media- Selective, differential and enrichment media. Aseptic Techniques: Disinfection, Sterilization. Cultivation of fungi, actinomycetes, yeasts, algae and photosynthetic bacteria. Pure culture: Concept of pure culture. Methods of pure culture of microorganisms — Spread plate, streak plate and pour plate.	**08 Hrs**
II	**Microbial identification** Bacterial Identification: Introduction and Overview (in brief). Morphological and cultural characteristics in detail. Biochemical identification: IMVIC, Sugar fermentation, Enzyme test. Advance Molecular techniques for bacterial identification (in	**07 Hrs**

	brief about 16s rDNA, Metagenomics for consortium identification).	

Text Books:

1. Textbook of Microbiology by Ananthanarayan and Panikers tenth edition, University press.
2. Microbiology by Micael J. Pelczer. 5th edition Tata McGraw-Hill publisher,

Reference Books:

1. General Microbiology by Stenier R. Y. *et al* Mc millan press. Inc.
2. Fundamentals Principles of Bacteriology by Salle A. J.McGrw-HILL BOOK COMPANY, INC. NEW YORK AND LONDON.

SEC1 : ii) Diagnostic Biology

Total Credits : 01 Total Contact Hours : 15 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

- To acquaint the students with the practical applications of molecular diagnostics in the clinical laboratory. Students will learn to perform technical molecular biology assays on proteins, DNA, RNA that can be used in the diagnosis of human diseases.

Outcomes of course

On the completion of the course, the student should be able to:

- Understand the difference between Quality Control and Quality Assurance in the molecular laboratory
- Understand the importance of good pipetting techniques
- Understand and perform simple and serial dilutions
- Describe methods for quantification of nucleic acids
- Report results for molecular testing
- Follow a protocol to perform testing
- Understand the use and purpose for isolating DNA, RNA and proteins 8. Explain the
- principle of electrophoresis as it applies to nucleic acids and proteins

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	**Unit I**: **Blood Analysis**: Blood Typing, Types of Blood groups, rare blood groups, Importance of Blood grouping. Differential WBC Count, Types of WBC, Biological role of Leucocytes, Significance of different parameters tested in Complete Blood Count (CBC). Biological role of Hemoglobin, Normal level, significance of test. **Antigen-Antibody reactions in diagnosis**: Widal test; Introduction to Typhoid , causative agent, Symptoms, Test for diagnosis for Enteric fever, Widal test types, Procedure and interpretation. ELISA: Types, ELISA as tool in clinical Biology.	**08 Hrs**
II	**Microbiological analysis:** Introduction, Microbial culture methods (from biological samples), Biochemical tests for diagnosis of enteric pathogens, Interpretation of tests plates. Antibiotic sensitivity test:	**07 Hrs**

	Introduction, different types of antibiotics, mode of action. Blood Sugar, Dietary Sources, hyperglycemia, hypoglycemia, Estimation, Clinical significance	

References

1. F. C. Hay, M. R. Olwyn, P. N. Westwood and N. L. Hudson, Practical Immunology, 4th ed. UK: Blackwell Company Ltd, 2002.
2. G. P. Talwar, Hand Book of Practical and Clinical Immunology, 2nd ed. Vol. II, New Delhi: CBS Publishers and Distributors, 2009.

SEC-2 : Lab Course - Based on SEC-1 (i)

Total Credits : 01 Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

- To make students familiar with the microbial isolation cultivation techniques.
- To make students familiar with the microbial identification techniques.
- To make student aware about safety measures while handling microrganisms.

Course Outcomes (COs) :

After completion of the course, students will be able to -

i) Student will gain knowledge about microbial isolation cultivation techniques.
ii) Student will gain knowledge about microbial identification techniques.
iii) Student will gain knowledge aboutsafety measures while handling microrganism

Practical No./ Module No.	Topics / actual contents of the syllabus
1.	Demonstration of working and principles of basic instruments in MicrobiologyLaboratory.
2.	Operation and handling of Laminar Air flow system
3.	Demonstration of Preparation of culture media for growth
4.	Isolation of Microorganisms (bacteria and fungus) using pure culture techniques.
5.	Effect of temperature and pH on bacterial growth.
6.	TMicroscopic observation of Microorganisms and staining techniques.
7.	Biochemical characterization of Microorganisms using IMVIC test
8.	Biochemical Identification using Sugar fermentation test
9.	Ennzyme test for Identification: Catalase, Starch hydrolysis .

Text Books:

1.B.S. Vatsa and Suchi Vatsa,"Discrete Mathematics," Fourth Revised Edition, New Age International Publishers, (2009)...

Reference Books:

1.Swapan Kumar Sarkar,″ A Textbook of Discrete Mathematics,″ Ninth edition 2016, S. Chand, (Reprint 2021).

2. Kenneth H. Rosen,″ Discrete Mathematics and its Applications,″ Seventh Edition, McGraw-Hill Book Company

3. Krishnamurthy V., “ Combinatorics, Theory and Applications,” East-West Press, 2008.

4. Brualdi R.A,” Introductory Combinatorics,” 5th Edition, Pearson Education Inc., 2009.

SEC-2 : Lab Course - Based on SEC-1 (ii)

Total Credits : 01 Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

- To make students familiar diagnostics techniques in the clinical laboratory.
- To make students familiar with the microbial identification techniques.
- To make student aware about safety measures while handling microrganisms.

Course Outcomes (COs) :

After completion of the course, students will be able to -

Students will learn to perform technical molecular biology assays on proteins, DNA, RNA that can be used in the diagnosis of human diseases.

Practical No./ Module No.	Topics / actual contents of the syllabus
1	Antigen – Antibody reactions- Agglutination (Blood grouping testing).
2.	Blood cell counting (Both RBC and WBC)
3	Estimation of blood groups
4	Estimation of hemoglobin.
5	WIDAL test.
6	Antibiotic sensitivity test.
7	Estimation of Blood Sugar
8	Biochemical Identification using Sugar fermentation test

References

- F. C. Hay, M. R. Olwyn, P. N. Westwood and N. L. Hudson, Practical Immunology, 4th ed. UK: Blackwell Company Ltd, 2002.
- G. P. Talwar, Hand Book of Practical and Clinical Immunology, 2nd ed. Vol. II, New Delhi: CBS Publishers and Distributors, 2009.

This course will be available for the students from other faculty

GE/OE-1 : Introduction to Biotechnology

Total Credits : 02 Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

- To understand the students to different basic processes and basic techniques used inBiotechnology.
- To introduce students with different applications of Biotechnology in everyday life.
- Develop an interest in students to study Biotechnology as a discipline.

Course Outcomes (COs) :

After completion of the course, students will be able to -

- Understand fundamental principles involved in Biotechnology
- To bestow the students with all the research skills required to work independently
- To inculcate nature care by imparting knowledge of advance modern techniques.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	**Unit I- Basic concept of Biotechnology** Definition, Scope & importance of Biotechnology, Prokaryotic & Eukaryotic cell-Cell wall, Distinction between Prokaryotic & Eukaryotic cell, cell organelle, Cell membrane, Cytoplasm,nucleoid. Culture Media: Synthetic or defined media. Types of Media-Selective, differential and enrichment media. Pure culture: Concept & Methods of pure culture microorganisms – Spread plate, streak plate and pour plate.	**10 Hrs**
II	**Unit II- Branches of Biotechnology** Agricultural biotechnology, Environmental biotechnology, Medical biotechnology, Aqua/Marine Biotechnology, Industrial biotechnology, biotechnology and IPR, biotechnology in Food and nutrition, Traditional and Modern Biotechnology.	**10 Hrs**
III	**Unit III - Applications of Biotechnology** Biotechnology in Food Production, Pharmaceutical Biotechnology- Recombinant Insulin, Vaccines, Gene therapy, stem cell therapy, Plant & Agriculture Biotechnology- GM Food (GM Tomato) Fungal and Insect Resistant Plants, BT Cotton, , Modifications in Plant Quality, Golden Rice, Plant Tissue culture, Environmental Biotechnology- Biodegradation, Bioremediation.	**10 Hrs**

Reference Books:

1. Biotechenology by U. Satyanarayan
2. Alan Wiseman, Principles of Biotechnology, Surrey University press, 1983.
3. Plant Biotechnology- K. G. Ramavat S.Chand Publications
4. Experiments in Plant tissue culture- Dodds and Roberts- Cambridge UniversityPress.
5. Biotechnology: Environmental Processes- Rehm and Reed- Wiley
6. 6.. Molecular Biotechnology- Glick and Pasterman ASM Press
7. The world of the cell, Becker, Kleinsmith, Hardin. Cell biology- C.B.Powar
8. An Introduction to Biotechnology the science technology and Medical application,Godbey, W. T, Woodhead Publishing
9. Biotechnology by B.D.Singh.
10. Environmental Biotechnology y S.N. Jogadnad

Semester – II

Major -1
DSC-3 : (Biomolecules -II)

Total Credits : 02 Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

- To acquaint students with chemistry of biomolecules
- To make students understand the importance of biomolecules in life

Course Outcomes (COs) :

After completion of the course, students will be able to -

i) Concept of DNA and RNA
ii) Different types and importance of vitamins human
iii) Functions of different hormones

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	**Nucleic acids:** ◆ Definition and types of nucleic acid-DNA and RNA ◆ Structural Components of Nucleic acids: phosphoric acid, pentose sugar, nitrogenous bases - purines and pyrimidine ◆ Nucleosides and Nucleotides DNA structure (Watson and Crick Model,A, B and Z form of DNA ◆), Chargaff's Rule, ◆ Denaturation of DNA: definition and its effect on UV absorption, viscosity, and specific optical rotation. ◆ Effect of pH and temperature on DNA denaturation, ◆ Renaturation of DNA. ◆ RNA: Structure and Significance of: mRNA, tRNA and rRNA.	**10 Hrs**
II	**Vitamins** Classification, fat soluble (A,D,E,K), Metabolism and Biochemical functions,	**10 Hrs**

	Recommended dietary Allowance (RDA), Deficiency symptoms Fat insoluble, (C, B12, Complex) Metabolism and Biochemical functions, Recommended dietary Allowance, Vitamin like compounds.	
III	**Unit 3: Hormones** Classification : based on Chemical nature, based on mechanism of action: group I and II hormones. Hypothalamic hormones , Anterior pitutary hormones, growth hormones, abnormalities in it production, posteior pitutary hormones, Thyroid hormones: Biochemical functions, Androgens, estrogens, progesteros	**10 Hrs**

Reerences:

- U. Satyanarayana and U. Chakrapani (2007) 'Biochemistry' Third edition, Books and Allied (P) Ltd.
- Berg, J. M., Tymoczko, J. L., Gatto, G. J. (2019). Biochemistry (9th ed.). W. H. Freeman.
- This comprehensive biochemistry textbook covers biomolecules and their relevance in biological processes.
- Nelson, D. L., Cox, M. M. (2019). Lehninger Principles of Biochemistry (7th ed.). W. H. Freeman.

Major-1
DSC-2 : Lab Course-I (Based on DSC-1)

Total Credits : 02 Total Contact Hours : 60 Hrs
Maximum Marks : 50

Course Objectives	● To acquaint students with various techniques used like extraction, detection, estimation and separation ● To develop skill-full hand of the students
Course Outcome	**After successful completion of this course, students are expected to:** ◆ perform qualitative tests for nucleic acids, Vitamins and hormones, ◆ perform quantitative tests for nucleic acids, Vitamins and hormones, ◆ Perform purity test of biomolecules
Practical No./ Module No.	**Topics / actual contents of the syllabus**
1	Quantitative determination of DNA by spectrophotometric method and its purity check
2	Quantitative determination of RNA by spectrophotometric method and its purity check
3	Thermal denaturation of DNA
4	Estimation of DNA by DPA method
5	Estimation of RNA by Orcinol method
6	Simple assays for vitamins and hormones
7	Estimation of ascorbic acid from natural sources

Text Books:

- Jayaraman, J. (2011). Laboratory Manual in Biochemistry, New Age International (P) Ltd. Publishers, New Delhi.
- Sadashivam, S. and Manikam, A. (2018). Biochemical Methods, 3rdedition, New Age International (P) Ltd. Publishers, New Delhi.

Reference Books:

- Wilson, K. and Walker, J. (2003). Practical Biochemistry: Principles and techniques, 5thedition, Cambridge University Press, UK.
- Plummer, D. T. (2017). An Introduction to Practical Biochemistry, 3rd edition, Tata

McGraw Hill Publishing Company Ltd., New Delhi.

- Oser, B. L. (ed.) (1965). Hawk's physiological chemistry, 14thedition, McGraw-Hill Book Company, New York, USA
- Rao, B. S. and Deshpande, V. (2005). Experimental Biochemistry: A student companion, I. K. International Pvt. Ltd., New Delhi.

Major -2

DSC-1 : (Instrumentation II)

Total Credits : 02 Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

By the end of this course, Students should able to:

- Introduction of different Instruments: Understanding of all basic instruments which require to do all practical purpose.
- Understand the theory and operating procedure of basic Instrumental techniques.
- Application of instruments in Biotechnology.

Course Outcomes (COs) :

After completion of the course, students will be able to -

- Understand and explain the principles and SOP of laboratory instruments.
- Explain the principle and working of Microscope, Spectrophotometer etc.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	**Microscopy:** Concept, Principle and working of simple light Microscope and compound microscope, parts of microscope: Eye piece, Objectives, coarse adjustment, Fine adjustment, irisdiaphragm, condenser. Phase contrast Microscope-principle and working.	**10 Hrs**
II	**Chromatography:** Principle and working of paper, thin layer, coloumn chromatography- gel filtration, ion exchange and affinity chromatography.	**10 Hrs**
III	**Electrophoresis**: Principle of Paper and gel electrophoresis, types of gels (starch, agarose, and polyacrylamide) with advantages and disadvantages.	**10 Hrs**

References:

- Biophysical Chemistry by Nath and Upadhyay.
- Analytical Biochemistry by Holme.
- Instrumental methods of chemical analysis by Chatwal and Anand

Major2
DSC-2 : Lab Course-II

Total Credits : 02 Total Contact Hours : 60 Hrs
Maximum Marks : 50

Course Objectives	By the end of this course, Students should able to: ● Observe various types of microorganism under microscope. ● Understand different parts of microscopes. ● Separate biomolecules by chromatography or electrophoresis
Course Outcome	**After successful completion of this course, students are expected to:** ● Observe various types of microorganism under microscope. ● Understand different parts of microscopes. ● Separate biomolecules by chromatography or electrophoresis
Practical No./ Module No.	**Topics / actual contents of the syllabus**
1	Observation of Bacteria using Microscope.
2	Hanging drop technique (Motility).
3	Study of different parts of Microscope (Eye piece, objectives etc).
4	Absorption spectra of DNA.
5	Study of yeast cells morphology.
6	Separation of amino acids by paper chromatography.
7	Separation of serum proteins by agarose gel electrophoresis.

Text Books:

- Biophysical Chemistry by Nath and Upadhyay.
- Analytical Biochemistry by Holme.
- Instrumental methods of chemical analysis by Chatwal and Anand.

Major-3
DSC-1 : (Microbiology-II)

Total Credits : 02 Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

By the end of this course, Students should able to:

- Role of Major and Micro elements and growth factor in microbial growth.
- Concept and measurment of microbial growth.
- Methods of sterilization of micro-organisms.

Course Outcomes (COs) :

After completion of the course, students will able to understand -

- Types of microbes base on nutritional requirement.
- Different types of selective media.
- Concept and measurment of microbial growth.
- Methods of sterilization of micro-organisms.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	**MICROBIAL NUTRITION:** **Major and Micro elements and growth factors** –C, N, P, S, sources,Peptone, Tryptone, Meat extract, yeast extract, Various amino acids, various vitamins, trace elements. Nutritional classification of bacteria.Auxotroph and Prototroph, role of minimal medium in isolating/ or studying auxotrophic and prototrophic micro-organisms. **Construction of and application of** -Selective and Enrichment media with appropriate examples such as; *Enterobacter* from soil, *Escherichia coli* from water and clinical samples, sulphate reducing bacteria from anaerobic sludge and photoautotrophs. Indicator medium –with appropriate example. Selective and differential medium with suitable examples (lactose fermenter and non-lactose fermenters, deoxycholate agar, Salmonella Shigella agar).	**10 Hrs**
II	**MICROBIAL GROWTH:** Definition of growth. Growth curve with reference to stages	**10 Hrs**

	both by cell count and optical density, and diauxic growth curve –glucose and lactose as source of carbons, mechanism of glucose effect at introductory level only. Mathematical expression of growth (generation time, number of generations). Measurement of growth in terms of cell number, cell mass, cell constituents. Continuous growth, methods for obtaining continuous growth –turbidostat, Chemostat. Synchronous growth, methods to obtain synchrony – such as; nutritional Starvation, stationary phase induction, micromanipulator, filtration, helmstetter and Cummings.	
III	**CONTROL OF MICROORGANISMS:** **Methods of sterilization of micro-organisms.** Physical methods such as heat, radiation, filtration. **Disinfection: P**roperties of an ideal disinfectant should bear in. terminologies such as; antiseptic/sepsis, disinfection, antibiotic, stasis and cidal/lethal effect. Classes of chemical compounds applied as disinfectants, their mode of action and applications. Estimation of efficacy of disinfection ability of antiseptic strength by phenol coefficient method. **Antimicrobial compounds:** history, examples of chemical compounds used to treat wounds and infections before penicillin. Antibiotics affecting cell wall, antibiotics affecting cell membrane, antibiotics affecting protein synthesis, Antifungal antibiotics, antiviral compounds	**10 Hrs**

Text Books:

- PGeneral Microbiology –R. Y. Stanier VIth edition.
- Microbiology –Pelczar
- Principles of Bacteriology –A. J. Salle
- Microbiology by Prescott
- Text book of Microbiology by Tortora

Reference Books:

- Microbiology by Brock
- General Virology –S. E. Luria
- Chemical Microbiology –Rose

Major-3
DSC-2 : Lab Course-III

Total Credits : 02 Total Contact Hours : 60 Hrs
Maximum Marks : 50

Course Objectives	By the end of this course, Students should able to: ● Observe various types of microorganism under microscope. ● Understand different parts of microscopes. ● Separate biomolecules by chromatography or electrophoresis
Course Outcome	**After successful completion of this course, students are expected to:** ● Observe various types of microorganism under microscope. ● Understand different parts of microscopes. ● Separate biomolecules by chromatography or electrophoresis
Practical No./ Module No.	**Topics / actual contents of the syllabus**
1	Media construction, minimal and complex medium
2	Selective medium for Salmonella
3	Differential medium for Lactose fermenters and non-lactose fermenters
4	Sugar fermentation with Andrade's indicator,
5	Growth curve for *E. coli* strain and LB medium.
6	Testing efficiency of sterilization
7	Phenol coefficient –to test efficacy of disinfectant
8	IMViC test with both *Escherichia coli* and *Enterobacter aerogenes*
9	Bioassay for antimicrobial compounds such as
10	Penicillin –*Staphylococcus aureus*
11	Streptomycin –*Escherichia coli*
12	Isolation of soil, water and air bacteria by
13	Pour plate method
14	Spread plate method
15	Streak plate –four quadrant metho

Text Books: Biophysical Chemistry by Nath and Upadhyay.

- Analytical Biochemistry by Holme.
- Instrumental methods of chemical analysis by Chatwal and Anand.

VSC-1 : (i) Bio-fertilizer production

Total Credits : 01 Total Contact Hours : 15 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

- To make the students to understand role of bio fertilizers and its mechanism of action inagriculture.
- To make the students understand the basic principles of production of different biofertilizers as per need of agriculture.
- To teach isolation, characterization, mass inoculum production and field application of biofertilizers.

Course Outcomes (COs) :

After completion of the course, students will be able to -

- Understand advantages of bio fertilizers over chemical fertilizers.
- Explain isolation and role of various soil bacteria in bio fertilizer production.
- Describe production steps and specific requirements for each bio fertilizer.

ModuleNo.	Topics / actual contents of the syllabus	Contact Hours
I	**Unit 1**:- Introduction and types of fertilizers, chemical fertilizers, bio fertilizers, Comparison between Chemical and bio fertilizers, Applications, General account about the microbes used as bio fertilizer- Nitrogen and phosphate solubilizers (in brief) *Rhizobium*- isolation, identification, mass multiplication, and carrier based inoculant. IAA producing microorganisms.	08**Hrs**
II	**Unit 2:-** *Azotobacter*- classification, characteristics- crop response to azotobacter inoculum,maintenance and mass production. Cyanobacteria (blue green algae), Azolla and anabena association. Phosphate solubilizing microbes (any one) - isolation, characterization, mass inoculum production. Potassium solubilizing bacteria- isolation and characterization.	**07 Hrs**

Reference Books:

1) Biotechnology Kumaresan, V. (2005) Saras Publications, New Delhi.
2) Biotechnology of Biofertilizers Kanniyan, S., 920030, CHIPS, Texas.
3) Soil Microbiology Subha Rao, N.S. (2000), Oxford & IBH Publishers, New Delhi.
4) A Textbook of Biotechnology- Dubey, R.C., (2005) S. Chand & Co, New Delhi.
5) Hand book of Microbil Biofertilizers Rai, M.K., (2005), The Haworth Press, Inc. New York.

VSC-1 : ii) Plant tissue culture

Total Credits : 01 Total Contact Hours : 15 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

1. **To** grasp the fundamental principles of plant tissue culture, including cell physiology, growth, differentiation, and regeneration.
2. **Student should** proficient in the techniques involved in plant tissue culture, such as sterilization methods, explant preparation, media preparation, culture initiation, subculture, and maintenance , importance of aseptic techniques to prevent contamination.
3. **Exploring Different Culture Systems**: Students should be exposed to various culture systems used in plant tissue culture, such as organ culture, cell suspension culture, embryo culture, meristem culture, and protoplast culture. They should understand the applications and advantages of each system

Course Outcomes (COs) :

After completion of the course, students will be able to -

understand the fundamental principles of plant tissue culture
Will gain skills for PTC techniqoe.
Will gain knowledge of various plant organ culture systems

ModuleNo.	**Topics / actual contents of the syllabus**	**Contact Hours**
I	**Unit 1:** Basics - Totipotency, Competency, Determinism, Requirements of tissue culture facilities, Surface sterilization of materials, Basic procedure for Aseptic Tissue transfer, Culture media, Composition of media, Phytohormones, media components (Vitamins, Unidentified supplements, Carbohydrate for energy source, Nitrogen source and organic supplements, Complex substances, Activated charcoal) An appraisal of different media, Hormones: Auxins, Cytokinins, Gibberellins,Abscisic acid, Ethylene.	08**Hrs**

II	**Unit 2:** Tissue culture production of **Commercial Crops:** **Agricultural** – Banana - Collection of Suckers, Disinfection of propagule, inoculation & maintenance of shoots, rooting, hardening; Pomegranate - Collection of stem explants, Disinfection, inoculation & maintenance of shoots, rooting, hardening; **Ornamental** – Gerbera - Plant material and explant preparation, Culture establishment, Shoot regeneration, Acclimatization and transfer of plantlets to soil; **Medicinal plants** – Tulsi (*Ocimum Sanctum*) - Germination of Seeds, Plant Material and Culture Establishment, Rooting and Plantlet Development, Greenhouse Acclimatization	**07 Hrs**

References:

- Plant Tissue Culture: Theory and Practice, S.S. Bhojwani, M.K. Razdan - Elsevier Science.
- Damasco, O.P. 2005. Tissue culture of banana. pp. 59-62. In: F.S. dela Cruz et al. (eds). Towards management of Musa nematodes in Asia and the Pacific. International Plant Genetic Resources Institute (INIBAP), Laguna, Philippines.
- Perez, E.A. and C.R.R. Hooks. 2008. Preparing tissue-cultured banana plantlets for field planting. CTAHR Cooperative Extension Service Publication. BIO-8. 3 pp
- H. S. Chawla. 2018. Introduction to Plant Biotechnology, CBS Publishers & Distributors
- U Satyanarayana. 2020. Biotechnology, Publisher - Books & Allied Ltd.

VSC-2 Lab Course - Based onVSC-1 (i)

Total Credits : 01 Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

- To acquire knowledge on biofertilizer preparation
- To gain knowledge about isolation of cyanobacteria
- To develop skill for isolation of soil microflora

Course Outcomes (COs) :
After completion of the course, students will be able to -

i) Understand the mechanism of e biofertilizer preperation.
ii) Isolate cyanobacteria
iii) Isolate Nitrogen fixing and phsphate solubilizing microbes.

Practical No. ModuleNo.	Topics / actual contents of the syllabus
I	Isolation and characterization of *Rhizobium*
II	Production of liquid and solid biofertilizers from *Rhizobium*
III	Isolation and characterization of *Azospirillum* & *Azotobacter.*
IV	Production of liquid and solid biofertilizers from *Azospirillum* & *Azotobacter.*
V	Isolation and Characterization of cyanobacteria from water bodies.
VI	Production of Cyanobacteria based flakes.
VII	Isolation and Characterization of PSM from soil.
VIII	Isolation of IAA producers and production of IAA based biofertilizers.
IX	Production of liquid and solid biofertilizers from Phosphate solubilizing microorganisms
X	Industrial visit to Bio fertilizer production plant

References;

- Biotechnology Kumaresan, V. (2005) Saras Publications, New Delhi.
- Biotechnology of Biofertilizers Kanniyan, S., 920030, CHIPS, Texas.
- Soil Microbiology Subha Rao, N.S. (2000), Oxford & IBH Publishers, New Delhi.
- A Textbook of Biotechnology- Dubey, R.C., (2005) S. Chand & Co, New Delhi.
- Hand book of Microbil Biofertilizers Rai, M.K., (2005), The Haworth Press, Inc. New York.

VSC-2 Lab Course - Based onVSC-1 (ii)

Total Credits : 01 Total Contact Hours : 30 Hrs
Maximum Marks : 50

Course Objectives :

1. **To** grasp the fundamental principles of plant tissue culture, including cell physiology, growth, differentiation, and regeneration.
2. **Student should** proficient in the techniques involved in plant tissue culture, such as sterilization methods, explant preparation, media preparation, culture initiation, and subculture, and maintenance, importance of aseptic techniques to prevent contamination.
3. **Exploring Different Culture Systems**: Students should be exposed to various culture systems used in plant tissue culture, such as organ culture, cell suspension culture, embryo culture, meristem culture, and protoplast culture. They should understand the applications and advantages of each system

Course Outcomes (COs) :

After completion of the course, students will be able to -

- understand the fundamental principles of plant tissue culture
- gain skills for PTC technique.
- gain knowledge of various plant organ culture systems.

Practical No. ModuleNo.	Topics / actual contents of the syllabus
I	Preparation, storage of Phytohormones and nutrient stocks
II	Plant Regeneration from callus.
III	Anther culture
IV	Preparation of artificial seed
V	Isolation of protoplas
VI	Micropropagation of Tulsi
VII	Plant tissue culture media preparation and sterilization.

VIII	Micropropagation of Banana
IX	Micropropagation of Gerbera

References:

- Plant Tissue Culture: Theory and Practice, S.S. Bhojwani, M.K. Razdan - Elsevier Science.
- Damasco, O.P. 2005. Tissue culture of banana. pp. 59-62. In: F.S. dela Cruz et al. (eds). Towards management of Musa nematodes in Asia and the Pacific. International Plant Genetic Resources Institute (INIBAP), Laguna, Philippines.
- Perez, E.A. and C.R.R. Hooks. 2008. Preparing tissue-cultured banana plantlets for field planting. CTAHR Cooperative Extension Service Publication. BIO-8. 3 pp
- H. S. Chawla. 2018. Introduction to Plant Biotechnology, CBS Publishers & Distributors
- U Satyanarayana. 2020. Biotechnology, Publisher - Books & Allied Ltd.

This course will be available for the students from other faculty

GE/OE-2 : Agricultural Biotechnology

Total Credits : 02 Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Course Objectives

- To understand soil microflora & biofertilizers.
- Get knowledge about plant tissue culturing.
- To impart knowledge of plant disease and genetic modification in plants.

Course outcomes

- Student get knowledge about all types of biofertilizers
- Student would be aware of plant tissue culture techniques
- Student would know the basics of plant pathology and its genetic modification.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	**Unit: 1 Introduction to Biofertilizer and Microorganism** Vermicompostiong, Phosphate cycle, Nitrogen cycle, Nitrogen fixing bacteria (Azotobacter, cynobacteria), Isolation and purification, commercial production, application, Azospirillum, Azotobacter, Cyanobacteria, Mycorrihza (Endo and Exo).	**10 Hrs**
II	**Unit: 2 Plant Tissue culture** Introduction to cell and tissue culture, tissue culture media: composition and preparation, initiation and maintenance of callus and suspension culture, single cell clones, organogenesis: principle, concept and applications of somatic embryogenesis, embryo culture, anther, pollen and ovary culture for production of haploid plants and homozygous lines. Cryopreservation, slow growth and DNA banking for germplasm conservation.	**10 Hrs**
III	**Unit: 3 Plant pathology & and Genetically modified plants** Brief account of algal, fungal, bacterial disease. Mode of entry of pathogen Disease caused by Mycoplasma and nematode Steps involved in forming genetically modified plants, Examples of GM crops (BT cotton, Goldenrice), Ethical issues.	**10 Hrs**

References

1. Bagyaraj. D.J and A. Manjunath 1990. Mycorrhizal symbiosis.
2. Purohit S.S ,P.R. Kothari , S.K Mathur Basic and Agricultural BiotechnologySubbaRao ,N.S 1998. Biological nitrogen fixation;
3. Cook R.J. and Baker K.F. 1983 The nature and practice of biological control ofplant pathology

4. Biotechnology, A textbook of industrial Microbiology byCreuger and Creuger, Sinaeur associates.
5. Genetics and Biotechnology of Industrial Microorganisms by
6. C.l. Hershnergey, S.W.Queener and Q. Hegeman. Publisher.

ASM. Ewesis ET. Al1998. Bioremediation Principles. Mac Graw Hill

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