Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR - 416004, MAHARASHTRA
PHONE:EPABX-2609000, www.unishivaji.ac.in, bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर -४१६००४,महाराष्ट्र
दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१—२६०९०९४
०२३१—२६०९४८७

Ref.No.SU/BOS/Science/434 **Date: 15/07/2025**

To,

The Principal,
All Concerned Affiliated Colleges/Institutions
Shivaji University, Kolhapur.

Subject: Regarding revised syllabi of B.Sc. Part-II (Sem.III & IV) degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0)

Ref: No.SU/BOS/Science/270 & 271 Date: 03/05/2025 Letter.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the syllabi, nature of question paper of B.Sc. Part-II (Sem.III & IV) degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0).

B.Sc.Part-II (Sem. III & IV) as per NEP-2020 (2.0)			
1.	Botany	8.	Geology
2.	Statistics	9.	Zoology
3.	Mathematics	10.	Chemistry
4.	Microbiology	11.	Electronics
5.	Plant Protection	12.	Industrial Microbiology
6.	B.A./B.A.B.Ed. Geography	13.	Biotechnology(Voc/Opt)
7.	Biotechnology(Entire)		

This syllabus, nature of question and equivalence shall be implemented from the academic year 2025-2026 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020@suk(Online Syllabus)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2025 & March/April 2026. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Dy Registrar
Dr. S. M. Kubal

Encl: As above

for Information and necessary action

Copy to:

1	Dean, Faculty of Science & Technology	6	Appointment Section A & B
2	Director, Board of Examinations and Evaluation	7	I.T.Cell /Computer Centre
3	Chairman, Respective Board of Studies	8	Eligibility Section
4	B.Sc.-M.Sc. Exam Section	9	Affiliation Section (T.1) (T.2)
5	Internal Quality Assurance Cell (IQAC Cell)	10	P.G. Seminar Section

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दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्याससमंडळे विभाग दुरध्वनी ०२३१—२६०९०९४
०२३१—२६०९४८७

Ref.No.SU/BOS/Science/270 **Date: 03/05/2025**

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All Concerned Affiliated Colleges/Institutions
Shivaji University, Kolhapur.

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B.Sc.Part-II (Sem. III & IV) as per NEP-2020 (2.0)			
1.	Botany	8.	Geology
2.	Physics	9.	Zoology
3.	Statistics	10.	Chemistry
4.	Mathematics	11.	Electronics
5.	Microbiology	12.	Drug Chemistry
6.	Plant Protection	13.	Industrial Microbiology
7.	Astrophysics and Space Science	14.	Sugar Technology (Entire)

This syllabus, nature of question and equivalence shall be implemented from the academic year 2025-2026 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020@suk(Online Syllabus)

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Yours faithfully,

By Registrar
Dr. S. M. Kubal

Encl: As above

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SHIVAJI UNIVERSITY, KOLHAPUR

Accredited By NAAC with A^{++} Grade

Structure and Syllabus in Accordance with

National Education Policy - 2020 (NEP 2.0)

with Multiple Entry and Multiple Exit

Syllabus For B.Sc. Part II Biotechnology - Major

Optional / Vocational

(Faculty of Science and Technology)

SEMESTER III AND IV

(To Be Implemented from Academic Year 2025-26)

SHIVAJIUNIVERSITY,KOLHAPUR

NEP-2020(2.0):Credit Framework for UG (B.Sc.) Programme under Faculty of Science and Technology

SEM (Level)	COURSES			OE	VSC/SEC	AEC/VEC/IKS	OJT/FP/CEP /CC/RP	Total Credits	Degree/Cum.Cr. MEME
	Course-1	**Course-2**	**Course-3**						
SEMI (4.5)	DSC-I(2) DSC-II(2) DSCP-I(2)	DSC-I(2) DSC-II(2) DSCP-I(2)	DSC-I(2) DSC-II(2) DSCP-I(2)	OE-1(2)(T/P)		IKS-I(2)		**22**	**UG Certificate 44**
SEMII (4.5)	DSC-III(2) DSC-IV(2) DSCP-II(2)	DSC-III(2) DSC-IV(2) DSCP-II(2)	DSC-III(2) DSC-IV(2) DSCP-II(2)	OE-2(2)(T/P)		VEC-I(2) (Democracy, Election and Constitution)		**22**	
Credits	**8(T)+4(P)=12**	**8(T)+4(P)=12**	**8(T)+4(P)=12**	**2+2=4 (T/P)**	**--**	**2+2=4**	**--**	**44**	**ExitOption:4credits NSQF/Internship/Skill courses**
	MAJOR		**MINOR**						
SEMIII(5.0)	Major V(2) Major VI (2) Major PIII(2)	--	Minor V(2) Minor VI (2) Minor PIII(2)	OE-3(2)(T/P)	VSCI(2)(P) (Major specific) SECI(2)(T/P)	AECI(2) (English)	CC-I(2)	**22**	**UG Diploma 88**
SEMIV (5.0)	Major VII(2) Major VIII(2) Major PIV(2)	--	Minor VII(2) Minor VIII(2) Minor PIV(2)	OE-4(2)(T/P)	SEC-II(2)(T/P)	AEC-II(2) (English) VEC-II(2) (Environmental studies)	CEP-I(2)	**22**	
Credits	**8(T)+4(P)=12**		**8(T)+4(P)=12**	**2+2=4(T/P)**	**4(T/P)+2(P)=6**	**2+4=6**	**2+2=4**	**44**	**ExitOption:4credits NSQF/Internship/Skill courses**
SEM V(5.5)	Major IX(2) Major X (2) Major PV(4)	Major I (ELEC)(2) Major P-I (ELEC)(2)	-	OE-5(2)(T/P)	VSCII(2) (Major specific)(P)	AECIII(2) (English)	**OJT (04)**	**22**	**UG Degree 132**
SEMVI(5.5)	Major XI(2) Major XII (2) Major PVI(4)	Major II (ELEC)(2) Major P-II(2) (ELEC)	-		VSCIII(2) (Major specific) (P) SECIII(2) (T/P)	AECIV(2) (English) IKS2(Major specific)(2)	**FP-(02)**	**22**	
Credits	**8(T)+8(P)=16**	**4(T)+4(P)=8**	**-**	**2(T/P)**	**2(T/P)+4(P)=6**	**4+2=6**	**4+2=6**	**44**	
Total Credits	**40+20=60**		**24**	**10**	**12**	**16**	**10**	**132**	**Exit Option**

SEMVII (6.0)	Major -XIII(4) Major -XIV(4) Major(P).-VII(4) Major(P).-VIII(2)	MAJORIII (4)(ELEC)	RM-I(4)	-	-	-		**22**	**UG Honours Degree 176**
SEMVIII (6.0)	Major -XV(4) Major -XVI(4) Major(P)-IX(4) Major(P).-X(2)	MAJORIV (4)(ELEC)	-	-	-	-	**OJT(04)**	**22**	
Credits	**16(T)+12(P)=28**	**8(T)**	**4**	**-**	**-**	**-**	**04**	**44**	
									Exit Option
Total Credits	**68+28=96**		**28**	**10**	**12**	**16**	**14**	**176**	
SEMVII (6.0)	Major-XIII(4) Major-XIV(4) Major(P).-VII(2)	MAJOR(4) (ELEC)	RM-I(4)	-		-	**RP-4**	**22**	**UG Honours withResearchDegree176**
SEMVIII (6.0)	Major-XV(4) Major-XVI(4) Major(P)-VIII(2)	MAJOR(4) (ELEC)		-		-	**RP-8**	**22**	
Credits	**16(T)+4(P)=20**	**8(T)**	**4**	**-**	**-**	**-**	**12**	**44**	
Total Credits	**60+28=88**		**28**	**10**	**12**	**16**	**22**	**176**	

Shivaji University, Kolhapur

Revised Syllabus for Bachelor of Science Part – II: Biotechnology

1. TITLE: Biotechnology (OPTIONAL / VOCATIONAL)

2. YEAR OF IMPLEMENTATION:- Revised Syllabus will be implemented from June, 2025 onwards.

3. PREAMBLE:

This syllabus is framed to give sound knowledge with understanding of Biotechnology to undergraduate students at first year of three years of B.Sc. degree course.

Students learn Biotechnology as a separate subject from B.Sc. I. The goal of the syllabus is to make the study of Biotechnology popular, interesting and encouraging to the students for higher studies including research.

The new and updated syllabus is based on a basic and applied approach with vigor and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research.

The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields.

The units of the syllabus are well defined, taking into consideration the level and capacity of students.

3. Program Learning Outcome (PO)

Student develop global competencies

PO1: Students develop global competencies in the area of basic and applied biological sciences.

PO2: Enhancing the subject knowledge of students by using traditional and modern ICT based teaching methods and learning by doing.

PO3: 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.

PO4: To groom the students to meet futuristic challenges and national interests

4. Course outcomes (CO)

CO - 1 Explain the cellular transcription and translation

CO - 2 Summarize the concepts and applications of fermentation technology.

CO - 3 Infer bacterial growth curve, concepts of bacterial classification.

CO -4Summarize basic concepts of gene, DNA and chromosome and transfer of genetic material

5. GENERAL OBJECTIVES OF THE COURSE:

1) To impart knowledge of Science is the basic objective of education.
2) To develop scientific attitude is the major objective to make the students open minded, critical, curious.
3) To develop skill in practical work, experiments and laboratory materials and equipments along with the collection and interpretation of scientific data to contribute the science.
4) To understand scientific terms, concepts, facts, phenomenon and their relationships.
5) To make the students aware of natural resources and environment.
6) To provide practical experience to the students as a part of the course to develop scientific ability to work in the field of research and other fields of their own interest and to make them fit for society.
7) The students are expected to acquire knowledge of plant and related subjects so as to understand natural phenomenon, manipulation of nature and environment in the benefit of human beings.
8) To develop ability for the application of the acquired knowledge to improve agriculture and other related fields to make the country self reliant and sufficient.
9) To create the interest of the society in the subject and scientific hobbies, exhibitions and other similar activities.

6. DURATION

The course shall be a fulltime course.

7. MEDIUM OF INSTRUCTION:

The medium of instruction shall be in English.

8. ELIGIBILITY FOR ADMISSION:

As per guidelines given by Shivaji University, Kolhapur and by following rules and regulations given by Govt. of Maharashtra

9. PATTERN:-

Pattern of examination will be semester.

10. STRUCTURE OF THE COURSE - B. Sc. II Biotechnology (Optional/Vocational)
SECOND YEAR (SEMESTER III / IV) (NUMBER OF PAPERS 4)

Sr. No.	Subjects/Papers	Theory	Internal	Total Marks
1.	Paper-V	40	10	50
2.	Paper-VI	40	10	50
3.	Paper-VII	40	10	50
4.	Paper-VIII	40	10	50
	Practical-III			50
	Practical-IV			50
Total				**300**

11. Scheme of examination

• The semester examination will be conducted for both theory and practical at the end of each term.
• Theory paper will be of 40 marks each and 10 marks for internal evaluation conducted in the mid of the term. Two practical courses will be of 50 marks each.
• Question papers will be set in the view of the entire syllabus and preferably covering each unit of the syllabus.
• Standard of Passing As per rules and regulation of B.Sc. course.

12. Nature of Question Paper for B.Sc. Part – II (40 + 10 Pattern) according to Revised Structure as Per NEP - 2020 shall be as given below

Maximum Marks: 40
Duration: 1:30 hrs

Q. 1 Select the most correct alternative from the following **[8]**

i) to viii) MCQ one mark each with four options

A)

B)

C)

D)

Q.2 Attempt any TWO of the following **[16]**

A)

B)

C)

Q. 3 Attempt any FOUR of the following **[16]**

A)

B)

C)

D)

E)

F)

---xxx---

13. Syllabus.

SEMESTER-III
Biotechnology (Optional/Vocational)
Paper-V (Major-V): Biophysics and Enzyme technology

CREDITS: 2, LECTURE PERIOD: 2 PER WEEK
LECTURE HOURS: 2 PER WEEK, MARKS: 40

	Paper-V **(Major-V)**: Biophysics and enzyme technology	Lectures 30
	Objectives – • To explore biophysical techniques. • To understand how enzymes work • To learn biocatalyst applications.	
	Credit -1	
	2.1 Spectroscopy : Principle, working and applications of - - Florescence spectroscopy - Infra red spectroscopy 2.2 Immobilization of enzyme – Concept, Advantages, Disadvantages 2.3 Methods of immobilization - 1. Physical adsorption 2. Covalent bonding 3. Cross-linking 4. Entrapment 5. Encapsulation 2.4 Applications of immobilized enzyme. 2.5 Biosensor-Types & applications	15
	Credit -2	
	1.1 Enzyme- Definition 1.2 IUB Classification of Enzymes. 1.3 Active site of enzyme, Mechanism of action of enzyme- - Lock and Key hypothesis - Induced- fit hypothesis. 1.4 Factors affecting enzyme activity – Temperature, pH, Substrate concentration, inhibitors, enzyme concentration, Activators. 1.5 Structure and function of Isozyme. 1.6 Concept of activation energy 1.7 Derivation of Km., Significance of Km and Vmax 1.8 Allosteric enzymes – Definition, properties 1.9 Regulation of enzyme activity- - Feed back or end product inhibition.	15

Learning Outcomes –

Students should be able to

- Learn biophysical techniques
- Understand enzyme immobilization
- Know about Biosensors

References

1. Fundamentals of Biochemistry - J.L. Jain
2. Biophysics - Daniel
3. Biophysics - Nath Upadhyay
4. Enzyme structure and function - Dixon
5. Biotechnology - R.C. Dubey
6. Enzymes – Trevar Palmer
7. Biochemistry - U. Satynarayanan
8. Principles and Techniques in Biochemistry and Molecular Biology- Willson & Walker
9. Bioinstrumentation- L.Veerakumari
10. Principles of Biochemistry-Albert L. Lehninger

Paper VI (Major VI): Gene Biotechnology

CREDITS: 2, LECTURE PERIOD: 2 PER WEEK
LECTURE HOURS: 2 PER WEEK, MARKS: 40

Topic No.	Paper –VI (Major VI): : Gene Biotechnology	Lectures
	Objectives – • To understand genetic principles • To application in research and industry • To ethical and safety considerations	30
	Credit- I	
	Gene Concept - History 1.2Units of gene – cistron Recon Muton 1.3 Spilt genes or (introns) – concept RNA splicing Genetic code and its properties 1.5 Overlapping genes 1.6 structural organisation of prokaryotic and eukaryotic gene. 1.7 Enzymes used in genetic engineering –i) Exonucleases	15

	ii) Endonucleases iii) Restriction endonucleases iv) S1 nuclease v) Alkaline phosphatase vi) Reverse transcriptase vii) DNA polymerase viii) DNA ligase 1.8 Tools of genetic engineering – Cloning vectors – introduction, characteristics i) Plasmid (PBR 322) ii) cosmid iii) Bacteriophages (lambda phage) iv)Plant vector(Ti) v) Animal vector (Ri) 1.7 Operon model - lactose Operon 1.8 Gene Cloning in prokaryotes Isolation of purification of DNA Lysis of cell Methods to purify DNA	
	Credit-II	
2.	2.1 Techniques in gene biotechnology- DNA fingerprinting (DNA profiling) - Introduction Genetic markers - RFLP, RAPD, AFLP Uses of Minisatellites & Microsatellites 2.2 Nucleic acid Blotting techniques i)Southern Blotting ii)Northern Blotting iii)Western Blotting 2.3 PCR-Concept ,Real time PCR. 2.3 Gene targeting 2.4 Human gene therapy - Introduction 2.5 Types of gene therapy - (a) Somatic (b) Germ Line (c) Enhancement (d) Eugenic genetic engineering	15

Learning Outcomes –

Students should be able to understand

- Fundamental concepts of genetics tools in Genetic Engineering.
- Basics of techniques used in Gene Biotechnology.

References:

1. Gene Biotechnology – S.N. Jogdand
2. Gene Manipulation- Old and Primrose
3. Genetic Engineering – Verma and Agarwal

4. Gene Biotechnology – Narain and Naha
5. Genetic engineering - Smita Rastogi, Neelam Pathak.
6. Text book of Biotechnology – R.C. Dubey

OE - 3: Food Biotechnology I (Credit-02)

Course Objectives:

- This course is providing the students with basic knowledge about the applications of Biotechnology in the food industry and in food-related sectors.
- The fundamental of the production of fermented foods, and the new biotechnological strategies for obtaining and transforming food products.

Topic No.	OE - 3 : Food Biotechnology	Lectures 30
1.	**Unit I: INTRODUCTION**. Food biotechnology: definition, history, current situation, social perception. General aspects of food technology and food industry. Quality attributes in food: sensory, nutritional and safetyproperties. Food spoilage: physical, chemical and microbiological agents. Strategies for the control of spoilage agents.	15
2.	**Unit II: FOOD FERMENTATIONS**. Starter cultures: classification, applications, market trends, legal aspects. Fermented dairy products: classification, characteristics, industrial production, microorganisms involved and targets for starter improvement. Cheese: types, improvement of starters. Products obtained by alcoholic fermentation: alcoholic drinks, bread, doughs. Other foods obtained by fermentation: vinegar, foods from soy fermentation, meatsubstitutes. Production of ingredient sand additives.	15

Course Outcomes:

After successful completion of the course the students will be able to:

i. Understand the importance of methods of preparation of technical products.
ii. Understand the genetically modified food. .

Books:

1. Food Biotechnology.“Introduction to Food Biotechnology” by Sinosh Skariyachan /Abhilash M.
2. Biotechnology in Food fermentation “Advances in food biotechnology“ By Ravishankar Rai

VSC –I (Credit-2) Biofertilizer

Exp No.	Title (CREDIT -02)	CREDIT - 02
CREDIT I	Study of Soil Sampling Tools, Collection of Representative Soil Sample, Its Processing and Storage	15
	Identification of Rocks	
	Soil Texture Determination by Feel Method	
	Determination of Bulk Density	
	Determination of Particle Density of Soil	
CREDIT II	Measurement of Soil Moisture Content by Gravimetric Method	15
	Determination of soil Ph	
	Determination of Soil Electrical Conductivity (EC)	
	Description of Soil Profile	
	Determination of Soil Organic Matter	

Learning Outcomes –

Students should be able to understand

- The concept of biofertilizers and develop the skills for handling microbial inoculants
- The growth and multiplication conditions of useful microbes and their role in mineral cycling and nutrition to plants

Books recommended for Practicals (References) –

1. Handbook of Microbial Biofertilizers - M. K. Rai
2. Production Technology of Bioagents And Biofertilizers - Mandal And Roy
3. Handbook of biofertilizer and biopesticide – Deshmukh, Khobragade and Dixit
4. Biofertilizers: Agricultural Uses, Management and Environmental Effects -Dr. P. Reddypriya
5. Biofertilizers in Agriculture - N.S. Subbarao

SEC I - Techniques in Nursery Development

Learning outcomes

Students after successful completion of the course will be able to

1. Understand different types of nurseries
2. Identify various facilities required to set up of a nursery
3. Understood expertise related to various practices in a nursery
4. Acquire skills to get an employment or to become an entrepreneur.

Topic No.	Techniques in Nursery Development	**Lectures 30**
1.	**Unit I:** **Introduction to Nursery** Definition, objectives and importance. Basic requirements for a nursery layout and components of a good nursery. Types of nurseries. Bureau of Indian standards (BIS - 2008) related to nursery. **Nursery inputs** Tools, implements and containers. Nursery media. Electricity, equipment and machinery management. Types of nursery beds and their preparations. Precautions and maintenance of nursery beds.	15
2.	**Unit II:** **Seeds and Propagules** Selection of seed and different sowing methods. Use of different plant parts for vegetative propagation to raise nursery. Different techniques of vegetative propagation. **Grafting techniques** Introduction to grafting, definition, types and tools for grafting. Steps involved in simple, splice graft, tongue graft, Whip graft, cleft graft and wedge graft. Grafting of horticultural & floricultural crops and applications.	15

Course Outcomes:

On successful completion of the course, student shall be able to

1. List out different types of nurseries and beds.
2. Identify the nursery tools, implements and containers.
3. Develop skill on potting media preparation and plant production.
4. Learn the technique of establishing cutting, layering, grafting etc

REFERENCES BOOKS:

1. Ratha Krishnan, M.,*et al.*(2014) Plant Nursery
2. Management: Principles and Practices, Central Arid Zone Research Institute – ICMR, Jodhpur, Rajasthan.
3. Vikas Kumar, Anjali Tiwari, Practical manual of Nursery management, Agri – biotech Press, New Delhi.
4. Tarai Ranjan Kumar, (2020) Plant propagation and nursery management, New India Publishers.
5. P.K.Ray,(2020)Essentials of plant nursery management.
6. P.K.Ray,(2012) How to start and operate a Plant Nursery

Semester III
Practical Course - Major P III (Credit-02)

Sr. No	Practical I Based on Major V and VI
1	Amylase assay by DNSA method (Major)
2	Effect of pH on amylase (Major)
3	Effect of temperature on amylase (Major)
4	Effect of inhibitor on amylase (HgCl2) (Minor)
5	Effect of activator on amylase (NaCl) (Minor)
6	Isolation of Chromosomal DNA from bacteria (Major)
7	Isolation of Plasmid (Major)
8	Restriction digestion (Major)
9	Separation of Plasmid DNA by Agarose Gel Electrophoresis (Minor)
10	Ligation (minor)
11	DNA sequencing by analysis of autoradiogram (Minor)

Course Outcomes:

Students should be able to understand

- Enzyme and study its kinetics.
- Use techniques of an enzyme assay to characterize enzyme

Books recommended for Practicals- References

1. Laboratory manual in Biochemistry- J. Jayraman.
2. Practical Biochemistry- David T. Plummer.

Nature of Practical Question paper		**50M**
Q.1	Experiment	20M
Q.2	Experiment	10M
Q.3	Spotting- A, B, C, D & E	10M
Q.4	Journal	05M
Q.5	Viva	05M

Semester IV (Optional/Vocational)

Paper VII (Major VII): Molecular Biology
CREDITS: 2, LECTURE PERIOD: 2 PER WEEK
LECTURE HOURS: 2 PER WEEK, MARKS: 40

Paper-VII (Major VII) : Molecular Biology	Lectures 30
Objectives – • To understand molecular mechanisms • To study DNA replication and repair • To knowledge of molecular biology to research	
Credit-I	
1.1Central dogma of life 1.2 Structural organization of prokaryotic and eukaryotic gene 1.3 DNA replication- Semi conservative model of replication (Meselson &.Stahl Expt.) 1.4 Prerequisites of replication- Enzymes involved in replication 1.5 DNA replication in eukaryotes – Initiation, elongation and termination. 1.6 Mutation- Definition Types – A. Gene mutation – i) Base pair ii) Missense iii) Nonsense iv) Frame shift B. Spontanious mutation – Defination and basic concept C. Induced mutation – i) Base analogues – 5 bromo-uracil , 1.7 Mutagenes – i) Alkalyting agent ii) Acrydine dyes iii) Hydroxylamine 1.8 A. DNA damage by UV B. DNA Repair - Photoreactivation	15
Credit II	
2.1 Transcription Transcription in eukaryote - Initiation, elongation & termination 2.2 Translation Translation in eukaryotes - Activation of amino acids, initiation, elongation and termination. 2.3 Insertion elements and transposons - Properties and uses. 2.4 Modes of gene transfer in bacteria – a)Transformation b)Transduction c)Conjugation	15

Learning Outcomes –

Students should be able to understand

- Gene Expression
- Basic concept of mutation.
- Modes of gene transfer in bacteria

References:-

1) Molecular biology -Watson
2) Genetics -Strickbeger
3) Molecular Biology -Glickpastornack
4) Molecular Biology- GeraladCarph
5) Cell Biology - DeRobertis
6) Gene – Levin
7) Principles of Biochemistry-Albert L.Lehninger

Paper VIII :(Major VIII) Fermentation Technology

CREDITS: 2, LECTURE PERIOD: 2 PER WEEK
LECTURE HOURS: 2 PER WEEK, MARKS: 40

	Semester IV **Paper –VIII :(Major VIII): Fermentation Technology**	**Lectures 30**
	Objectives – • To understand fermentation principles • To learn fermentation equipments and design • To safety and regulatory considerations	
	Credit I	
	1.1 Basic design of fermenter 1.2 Construction material used for fermenter 1.4 Types of fermenters - Tube tower fermenter, Bubble cap fermenter, Fluidized bed fermenter, Air lift fermenter 1.5 Fermentation media 1.6 Sterilization of fermentation media, equipment and air 1.7 Screening of industrially important microorganisms 1.7.1 Primary screening 1.7.2 Secondary screening 1.8 Strain improvement by i. Mutation ii. Genetic engineering iii. genetic recombination 1.9 Preservation of industrially important microorganisms- Culture collection centers in India – NCIM	15

	Credit II	
	2.1 Scaleup Bench studies, pilot studies, industrial scale 2.2 Computer application in fermentation technology 2.4 Types of fermentations 2.4.1 Continuous fermentation 2.4.2 Batch fermentation 2.4.3 Solid state fermentation 2.5 Downstream processing - Centrifugation, Distillation, Solvent extraction, Filtration, Ultrafiltration, precipitation, Ion exchange chromatography, gel filtration, affinity chromatography, 2.6 Crystallization and drying Assays 2.6.1 Physico–chemicalassays-Gravimetric,spectrophotometric,Chromatographic 2.6.2 Microbiological assays – Diffusion assay.	15

Learning Outcomes –

Students should be able to understand

- Describe the history and fundamental knowledge of food fermentation technology
- Basic concept of fermentation technology
- Overview of fermentor design and operation

References:

1. Comprehensive Biotechnology volume 3 – Murray Moo-Young
2. Basic Biotechnology – Colin Ratledge & BijonKritinsen, Cambridge university press, UK
3. Industrial Microbiology – casida
4. Principles of Fermentation technology – Whittekar
5. Industrial Microbiology – Prescott & dunns
6. Industrial Microbiology - A. H. Patel
7. Industrial Microbiology – Pepler & Perlman

OE - 4: Food Biotechnology II CREDIT - 02

Topic No.	OE - 4 : Food Biotechnology	Lectures
CREDIT 1	1. Production of Tempeh. 2. Production of Yoghurt. 3. Extraction and purification of Juice 4. Microbial Analysis of foods 5. Study of Genetically Modified Food.	15
CREDIT 1I	6. Determination of chemical constituents of foods 7.Determination of protein 8. Determination of carbohydrate 9.Good Manufacturing Practices for foods 10.Food Preservation Techniques	15

Course Outcomes:

After successful completion of the course the students will be able to:

1. Factors influencing the development of microbes in food
2. Application of newer techniques in food processing.

Books:

1. Food Biotechnology. "Introduction to Food Biotechnology" by Sinosh Skariyachan /Abhilash M.
2. Biotechnology in Food fermentation "Advances in food biotechnology" By Ravishankar Rai

SEC II - Organic Farming

Learning outcomes

Students after successful completion of the course will be able to

1. Understand the soil profile and nutrients in soil

2. Appreciate the importance of organic manure and bio fertilizers

3. Produce vermi compost, farmyard manure from bio waste

4. Acquire skill on isolation and maintenance of bio fertilizers

Topic No.	Organic Farming	Lectures 30
1.	**Unit I:** **Soil** Definition, soil formation, composition and characteristics. Types of soils. Distribution of soil groups in India. Acidic, Alkaline and heavy metal contaminated soil. Methods of reclamation. Effects of chemical dependent farming on yield and soil health. **Plant Nutrition** Macro and micro nutrients, functions of nutrients in plant growth and development. Nutrient uptake and utilization by plant. Types of fertilizers. Organic, inorganic and bio fertilizers. Chemical fertilizer. Advantages & disadvantages of their use. Importance of organic and bio fertilizers.	15
2.	**Unit II:** **Organic Farming** Definition, concept, benefits. Integrated farming system (combination of organic and inorganic). Mixed farming system. Concept of different cropping systems in relation to organic farming, Inter cropping, crop rotation. Organic farming process. Organic fertilizers, crop nutrients and effective microorganisms in Organic farming. **Organic compost** Definition, types of compost, farm yard compost, green leaf compost, animal husbandry, animal housing, animal feeding, animal health, breeding goals. Vermi compost: Introduction, vermi composting material, species of earthworms, small scale, large scale composting process. Vermi castings, harvesting, processing and drying. Nutrient content of vermi compost. Field application methods.	15

Course Outcomes:

On successful completion of the practical course, student shall be able to

1. Learn about estimation of NPK levels in the soil
2. Demonstrate the collection and processing of raw material
3. Develop skill of vermi compost production
4. Learn the technique of establishing organic farms

References:

1. Principles of Organic Farming: by E Somasundaram,D Udhaya Nandhini,M Meyyappan ;2021

2. Organic farming in India:: by Arpita Mukherjee; 2017

3. Biofertizer and biocontrol agents for agriculture;; by AM Pirttilä · 2021

4. Trends in Organic Farming in India;; by S. S. Purohit, 2006

5. Biofertilizers for Sustainable Agriculture and Environment;; by Bhoopander Giri Ram Prasad, Qiang-Sheng Wu, Ajit Varma; 2019

Semester IV
Practicals Course - Major P IV (Credit-02)

	Practical- II **Based on paper VII and VIII**
1	Effect of UV on growth of bacteria (Major)
2	Isolation of lac negative mutants of *E.coli* by visual detection method.(Major)
3	Sub-cellular fractionation of mitochondria, nucleus (Major)
4	Bioassay of penicillin
5	Screening of antibiotic producers
6	Immobilization of yeast (*Saccharomyce scerevisiae*) cells, production of ethanol by using immobilized yeast cells and determination of Alcohol content by specific gravity method
7	Screening of Amylase Producers from Soil, Production of bacterial amylase by submerged culture method & estimation of amylase by DNSA method
8	Isolation and identification of fungi Aspergillus, Penicillium

Course Outcomes:

Students should be able to understand

- Understanding the effects of UV on bacterial growth
- Isolation of mutants in E-coli

Books recommended for Practicals- References

1. Laboratory manual in Biochemistry- J. Jayraman.
2. Practical Biochemistry- David T. Plummer.

Practical Examination

(A) The practical Examination is of semester type.
(B) The practical examination will be conducted on two consecutive days for four hours per day per
batch of the practical examination.
(C) Each candidate must produce a certificate from the Head of the Department in her/his college, stating that he/she has completed in a satisfactory manner the practical course on lines laid down from time to time by Academic Council on the recommendations of Board of Studies and that the journal has been properly maintained. Every candidate must have recorded his/her observations in the laboratory journal and have written a report on each exercise performed. Every journal is to be checked and signed periodically by a member of teaching staff and certified by the Head of the Department at the end of the year. Candidates must produce their journals at the time of practical examinations.

Note: - At least 80% Practicals should be covered in practical examination.

Nature of Practical Question paper		**50M**
Q.1	Experiment	20M
Q.2	Experiment	10M
Q.3	Spotting- A, B, C, D.E	10M
Q.4	Journal	05M
Q.5	Viva	05M

List of minimum equipments-

1. Hot air oven – 1
2. Incubator – 1
3. Autoclave – 1
4. Refrigerator – 1
5. Medical microscopes - 10 nos. for one batch
6. Chemical balance – 2
7. pH meter – 1
8. Cooling Centrifuge – 1
9. Colorimeter – 1
10. Distilled Water Plant – 1
11. Laminar air flow cabinet – 1
12. Colony counter – 1
13. Water bath – 1

14. Arrangements for gas supply and fitting of two burners per table.
15. One working table of 6’ x 2½’ for two students.
16. One separate sterilization room attach to the laboratory (10’ x 15’)
17. At least one wash basin for a group of five students
18. One separate instrument room attached to lab (10’ x 15’)
19. One laboratory for one batch including working tables (6’ x 2½’) per two students for one batch.
20. Store room (10’ x 15’)
21. Electrophoresis assembly
22. UV transilluminator
23. Micropipettes (0.5-10 µl, 2-20 µl, 5-10 µl , 200-1000 µl)

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SHIVAJI UNIVERSITY, KOLHAPUR

Accredited By NAAC with A^{++} Grade

Structure and Syllabus in Accordance with

National Education Policy - 2020 (NEP 2.0)

with Multiple Entry and Multiple Exit

Syllabus For B.Sc. Part II Biotechnology - Minor

Optional / Vocational

(Faculty of Science and Technology)

SEMESTER III AND IV

(To Be Implemented from Academic Year 2025-26)

SHIVAJI UNIVERSITY,KOLHAPUR

NEP-2020(2.0): Credit Framework for UG (B.Sc.) Programme under Faculty of Science and Technology

SEM (Level)	COURSES			OE	VSC/SEC	AEC/VEC/IKS	OJT/FP/CEP /CC/RP	Total Credits	Degree/Cum.Cr. MEME
	Course-1	**Course-2**	**Course-3**						
SEM I(4.5)	DSC-I(2) DSC-II(2) DSCP-I(2)	DSC-I(2) DSC-II(2) DSCP-I(2)	DSC-I(2) DSC-II(2) DSCP-I(2)	OE-1(2)(T/P)		IKS-I(2)		**22**	**UG Certificate 44**
SEMI I(4.5)	DSC-III(2) DSC-IV(2) DSCP-II(2)	DSC-III(2) DSC-IV(2) DSCP-II(2)	DSC-III(2) DSC-IV(2) DSCP-II(2)	OE-2(2)(T/P)		VEC-I(2) (Democracy, Election and Constitution)		**22**	
Credits	**8(T)+4(P)=12**	**8(T)+4(P)=12**	**8(T)+4(P)=12**	**2+2=4 (T/P)**	**--**	**2+2=4**	**--**	**44**	**ExitOption:4credits NSQF/Internship/Skillcourses**
	MAJOR		**MINOR**						
SEMIII(5.0)	Major V (2) Major VI (2) Major PIII (2)	--	Minor V(2) Minor VI (2) Minor PIII (2)	OE-3(2)(T/P)	VSCI(2)(P) (Major specific) SECI(2)(T/P)	AECI(2) (English)	CC-I(2)	**22**	**UG Diploma 88**
SEMIV (5.0)	Major VII(2) Major VIII(2) Major P IV(2)	--	Minor VII(2) Minor VIII(2) Minor PIV (2)	OE-4(2)(T/P)	SEC-II(2)(T/P)	AEC-II(2) (English) VEC-II(2) (Environmental studies)	CEP-I(2)	**22**	
Credits	**8(T)+4(P)=12**		**8(T)+4(P)=12**	**2+2=4(T/P)**	**4(T/P)+2(P)=6**	**2+4=6**	**2+2=4**	**44**	**ExitOption:4credits NSQF/Internship/Skillcourses**
SEM V(5.5)	Major IX(2) Major X (2) MajorPV(4)	MajorI (ELEC)(2) MajorP-I (ELEC)(2)	-	OE-5(2)(T/P)	VSCII(2) (Majorspecific)(P)	AECIII(2) (English)	**OJT(04)**	**22**	**UG Degree 132**
SEMVI(5.5)	Major XI(2) Major XII (2) MajorPVI(4)	MajorII (ELEC)(2) MajorP-II(2) (ELEC)	-		VSCIII(2) (Major specific) (P) SECIII(2) (T/P)	AECIV(2) (English) IKS2(Major specific)(2)	**FP-(02)**	**22**	
Credits	**8(T)+8(P)=16**	**4(T)+4(P)=8**	**-**	**2(T/P)**	**2(T/P)+4(P)=6**	**4+2=6**	**4+2=6**	**44**	
Total Credits	**40+20=60**		**24**	**10**	**12**	**16**	**10**	**132**	**ExitOption**

SEMVII (6.0)	Major -XIII(4) Major -XIV(4) Major(P).-VII(4) Major(P).-VIII(2)	MAJORIII (4)(ELEC)	RM-I(4)	-	-	-		**22**	**UG Honours Degree 176**
SEMVIII (6.0)	Major -XV(4) Major -XVI(4) Major(P)-IX(4) Major(P).-X(2)	MAJORIV (4)(ELEC)	-	-	-	-	**OJT(04)**	**22**	
Credits	**16(T)+12(P)=28**	**8(T)**	**4**	**-**	**-**	**-**	**04**	**44**	
									ExitOption
Total Credits	**68+28=96**		**28**	**10**	**12**	**16**	**14**	**176**	
SEMVII (6.0)	Major-XIII(4) Major-XIV(4) Major(P).-VII(2)	MAJOR(4) (ELEC)	RM-I(4)	-		-	**RP-4**	**22**	**UG Honours withResearchDegree176**
SEMVIII (6.0)	Major-XV(4) Major-XVI(4) Major(P)-VIII(2)	MAJOR(4) (ELEC)		-		-	**RP-8**	**22**	
Credits	**16(T)+4(P)=20**	**8(T)**	**4**	**-**	**-**	**-**	**12**	**44**	
Total Credits	**60+28=88**		**28**	**10**	**12**	**16**	**22**	**176**	

Nature of Question Paper for B.Sc. Part – I, II & III (40 + 10 Pattern) according to Revised Structure as Per NEP – 2020 to be implemented from academic year 2022-23

Maximum Marks: 40
Duration: 2 hrs

Q. 1 Select the most correct alternate from the following **[8]**

i) to viii) MCQ one mark each with four options
A)
B)
C)
D)

Q.2 Attempt any TWO of the following **[16]**
A)
B)
C)

Q. 3 Attempt any FOUR of the following **[16]**
a)
b)
c)
d)
e)
f)

---xxx---

SEMESTER-III
Biotechnology (Optional/Vocational)
Paper-V (Minor-V): Metabolic Pathways

CREDITS: 2, LECTURE: 2 PER WEEK
LECTURE HOURS: 2 PER WEEK, MARKS: 40

	Semester III **Paper –V: (Minor V) : Metabolic Pathways**	**Lectures 30**
	Objectives – • To learn basic concept of metabolism • To understand the fundamental biochemical pathways involved in metabolism.	
	Credit I	
	Metabolism:- Introduction to metabolism, anabolism & catabolism Bioenergetics : ATP,NADH,FADH2,as energy currencies Enzymes: Role in metabolic reactions Laws of thermodynamics in biological systems **Carbohydrates Metabolism:-**Reactions and energetics of Glycolysis, Glucon Shuttle system- Malate Aspartate shuttle system, TCA cycle	15
	Credit II	
	. **Respiration:-** Aerobic:-Flow of electrons in ETC, Redox potential components of ETC, Mechanism of ATP generation- Chemiosmotic hypothesis, ATP synthase complex. Inhibitors of ETC **Anaerobic Respiration:-** Alcoholic and Lactic acid fermentation**.**	15

At the end of this course students will be able to:
CO 1. compare different biochemical reactions in cell
CO 2. Explain different methods to study metabolism.
CO 3. Conclude the stoichiometry of metabolic pathways.
CO 4. To analyze the relation between ATP generation and Electron transport Chain.

References:-
1) Biochemistry- Lubert Stryer
2) Biochemistry- Nelson and Cox
3) Practical Biochemistry- Wilson and Walker

4) Fundamentals of Biochemistry – J. L. Jain
5) Principals of Biochemistry- Voet and Voet
6) Fundamentals of Plant Physiology- V. K. Jain

Paper VI (Minor VI): Microbial Genetics

CREDITS: 2, LECTURE PERIOD: 2 PER WEEK
LECTURE HOURS: 2 PER WEEK, MARKS: 40

Topic No.	Paper –VI (Minor VI): Genetics	Lectures
	Objectives – • To understanding genetic principles • To learn genetic recombination in bacteria	30
	Credit- I	
1.	**Mendel's law of Inheritance** – Mendel's Experiment, Dominant and recessive characters, Principle of segregation, independent assortment, back and test cross. Deviations of Mendel laws - Incomplete dominance, co-dominance, multiple alleles. Modifiers, suppressors, pleiotropic gene. **Interaction of gene**-Dominant and Recessive Epistasis **Linkage -** Definition, coupling and repulsion hypothesis, linkage groups. **Crossing over**-Mechanism and theory. **Structural and numerical changes in chromosomes**.	15
	Credit-II	
2.	**Mutation:** Definition, Types (spontaneous and Induced) Mechanism of Mutagenesis- Base analogue, Nitrous acid, hydroxyl amine, alkylation agent, Acridine dyes, U.V. Light. **Plasmid**- Types, Structure, properties and applications. **Genetic recombination in bacteria-** Definition, fate of exogenote in recipient cell, transformation, conjugation, transduction. **Genetics Disease:** Autosomal and Sex Linked	15

At the end of this course students will be able to:
CO 1. Outline of Mendelian inheritance.
CO2. Demonstrate the chromosome structure, chromatin organization and variation using model.
CO 3. Perceive knowledge about the genetic disease.

References:

1. Strickberger "Genetics"

2. Freifelder “Genetics”
5. Stanier “General Microbiology”
6. P. K. Gupta “Genetics”
7. C. Sarin “Genetics”
8. Larry Snyder Wendy Champness “Molecular Genetics of Bacteria”

Practicals Semester III
Minor P III (Credit-02)

	Practical- II **Based on Minor paper V and VI**
1	Problems based on Mendelian Inheritance, linkage and crossing over.
2	Testing of Carcinogenicity of substance by Ame’s Test.
3	Estimation of fructose by Resorcinol method
4	Estimation of DNA by Diphenylamine method
5	Isolation of Amylase from germinating seed and determination of its activity.
6	Estimation of Total Phenolic Content of Plant Extract of by Folin - Ciocalteau Method
7	Estimation of Indole-3 Acetic Acid by (Salkowaski reagent) Colorimetric method.
8	Determination of Antioxidant activity of Plant extract by suitable method

Semester IV (Optional/Vocational)

Paper VII (Minor VII): Immunology
CREDITS: 2, LECTURE PERIOD: 2 PER WEEK
LECTURE HOURS: 2 PER WEEK, MARKS: 40

Paper-VII (Minor VII) : Immunology	Lectures 30
Objectives – • To understand immune system function. • To study cells and organs of immune system	
Credit-I	
Introduction- **Types of immunity**-i)Innate (specific and non-specific) ii) Acquired (Active and Passive), **Types of Defense-** a) first line of defense (barriers at the portal of entry, physical and chemical barriers) b) second line of defense (Phagocytosis– oxygen dependent and independent) **Introduction to cells and organs of immune system-** Organs of immune system- primary and secondary lymphoid organs- structure and their role. Cells of immune system- a) B-lymphocytes b) T-cells-subsets c) other cells (APC, Null, NK)	15
Credit II	
Antigen and Antibody **Antigen-** definition, nature, types of antigen, factors affecting antigenicity. **Antibody-** definition, nature, basic structure of immunoglobulin molecule, major human immunoglobulin classes, properties and functions. Theories of antibody production. **Immune response**-primary and secondary immune response, **Antigen Antibody reactions**-Principle and applications of a)agglutination b) Precipitation c) complement fixation d) ELISA.	15

At the end of this course students will be able to:

CO 1. Differentiate between different types of immunity.
CO 2. Classify cells of immune system.
CO 3. Construct models demonstrating antigen-antibody interaction.
CO 4. Perform various serological tests for diagnosis of various types' diseases.

References:

1. Riott "Essential Immunology"
2. Kuby "Immunology"

3. Ashim Chakravar "Immunology and Serology"
4. Tizzard "Immunology-An Introduction"-4th Edition
5. S. K. Gupta "Essentials of Immunology"
6. M. P. Arora "Immunology"

Paper VIII (Minor VIII): Environmental Microbiology

CREDITS: 2, LECTURE PERIOD: 2 PER WEEK
LECTURE HOURS: 2 PER WEEK, MARKS: 40

Paper-VII (Minor VII) : Environmental Microbiology	Lectures 30
Objectives – • To introduce students to the role of microorganism in the environment • To explore microbial interactions in soil, water and air.	
Credit-I	
Water Pollution -Definition, Sources and Types- Physical, Chemical and Biological, Hardness [Mechanism, Determination, Types], Water softening methods [Clark's method, Use of cation and anion exchange resins Purification of water (Physical Methods-UV Treatment, Distillation, Chemical Methods-Chlorination, Ozonization) **Air Pollution** -Definition, Sources, London and LA Smog (Mechanisms of Formation), Greenhouse Effect, Ozone Depletion (Role of CFCs, Control) **Soil Pollution** -Definition, Sources, Role of pesticide in soil pollution, control Measures.	15
Credit II	
Environmental Toxicology Definition, classification and concept, Pesticide Toxicity –Classification (Organic and Inorganic), Mode of action of toxicants (Metals, organophosphates, carbamates and mutagens), Bioconcentration, Bioaccumulation, Biomagnification, Control of Toxic effects-Biotransformation and excretion **Environmental Impact Assessment-** Introduction, History, Process, salient features and Importance	15

At the end of this course students will be able to:

CO 1. Classify different kinds of pollution
CO 2. Describe the concept of toxicity.
CO 3. Describe sources of bioethanol production
CO4. Discover the different way of Bioremediation

References:-

1. Applied and environmental Microbiology; Amann, R.I Stromely,J.Stahl.
2. Enviornmental Biotechnology, Chattergy.
3. Enviornmental Biology,Verma Agerwal
4. Enviornmental pollution, Peavy and Rowe.
5. Enviornmental problems and solution. and Enviornmental Science., Saigo

Practicals Semester IV
Minor P IV (Credit-02)

	Practical- II **Based on Minor paper VII and VIII**
1	Blood group detection
2	Widal test – Qualitative
3	RPR card test.
4	ELISA-dot ELISA.
5	Radial immune diffusion Assay
6	IMViC Test
7	Determination of TDS of water sample.
8	Determination of moisture content of given soil sample