SHIVAJI UNIVERSITY, KOLHAPUR.

Accredited By NAAC with 'A^{++}' Grade

Revised Syllabus For

B.Sc.II Biotechnology (Optional/Vocational)

(Faculty of Science & Technology)

Paper –V, VI - (Semester- III)

and

Paper -VII, VIII - (Semester- IV)

(NEP-2020) CBCS Syllabus to be implemented from June, 2023 onwards

ii) Structure of B.Sc. Programme (Semester III & IV)

SEMESTER–III (Duration–6 Months)																		
Sr. No.	Course (Subject) Title	TEACHING SCHEME						EXAMINATION SCHEME										
		THEORY			PRACTICAL			THEORY							PRACTICAL			
								Internal		University								
		Credits	No. of lectures	Hours	Credits	No. of lectures	Hours	Max Marks	Min Marks	Hours	Max Marks	Total Marks	Min Marks		Hours	Max Marks	Min Marks	
1	DSC-C	**2**	3	2.4	4	8	6.4	10	4	2	40	**80**	**28**		PRACTICAL EXAMINATION IS ANNUAL			
2	DSC-C	**2**	3	2.4				10	4	2	40							
3	DSC-C	**2**	3	2.4	4	8	6.4	10	4	2	40	**80**	**28**					
4	DSC-C	**2**	3	2.4				10	4	2	40							
5	DSC-C	**2**	3	2.4	4	8	6.4	10	4	2	40	**80**	**28**					
6	DSC-C	**2**	3	2.4				10	4	2	40							
7	AECC-C	**4**	4	3.2	---	---	---	---	---	---	---	---	---					
8	SEC-III	Any one from pool of courses			**2**	---	---	---	---	---	---	---	---		2	**50**	18	
	TOTAL	**16**	**22**	**17.6**	**14**	**24**	**19.2**	**60**			**240**	**350**	---			**50**		

SEMESTER–IV(Duration–6Months)																		
Sr. No.	Course (Subject) Title	TEACHING SCHEME						EXAMINATION SCHEME										
		THEORY			PRACTICAL			THEORY							PRACTICAL			
								Internal		University								
		Credits	No. of lectures	Hours	Credits	No. of lectures	Hours	Max Marks	Min Marks	Hours	Max Marks	Total Marks	Min Marks		Hours	Max Marks	Min Marks	
1	DSC-D	**2**	3	2.4	4	6.4	8	10	4	2	40	**80**	**28**		As per BOS Guide-lines	**100**	**35**	
2	DSC-D	**2**	3	2.4				10	4	2	40							
3	DSC-D	**2**	3	2.4	4	6.4	8	10	4	2	40	**80**	**28**			**100**	**35**	
4	DSC-D	**2**	3	2.4				10	4	2	40							
5	DSC-D	**2**	3	2.4	4	6.4	8	10	4	2	40	**80**	**28**			**100**	**35**	
6	DSC-D	**2**	3	2.4				10	4	2	40							
7	AECC-C AECC-D	---	---	---	---	---	---	---	---	3	70	**100**	**25**			---	---	
										Project	30		**10**					
8	SEC-IV	Any one from pool of courses			2	---	---								2	**50**	18	
	TOTAL	**12**	**18**	**14.4**	**14**	**19.2**	**24**					**400**	---			**350**		
		28	**40**	**32**	**28**	**38.4**	**48**					**750**	--		---			

- Student contact hours per week: 36.8 Hours (Min.)
- Theory and Practical Lectures :48 Minutes Each
- Total Marks for B.Sc.-II (Including EVS) **1100**
- Total Credits for B.Sc.-II (Semester III & IV): **56**
- **DSC: -**Discipline Specific Core Course: Select any 3subject pairs, relevant to those opted at B. Sc. I, from DSC C1 to DSC C38 and / or DSC IC39 to DSC IC50 and DSC D1 to DSC D38 and/or DSC ID39 to DSC ID50.
- **AECC-** Ability Enhancement Compulsory Course (C): Environmental Studies: EVS Theory and AECC-D EVS Project (Theory:70 & Project:30 marks)
- ***There shall be separate passing for internal and University theory as well as practical / project examinations.***
- ***Practical Examination shall be conducted annually for 100 Marks per course (subject) and minimum 35 marks are required for passing.***
- ***Except Environmental Studies, there shall be combined passing for two theory papers of 40 marks each. i. e. minimum. 28 marks are required for passing out of 80.***
- ***Minimum 4 marks are required for passing out of 10 for Internal Examination of each paper.***
- ***Examination of SEC shall be either theory or practical depending upon type of SEC.***

Class	B. Sc. - I	B. Sc. - II	B. Sc. - III	Total
Marks	1200	1100	800	3100
No. of Credits	60	56	44	160

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)

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A] Ordinance and Regulations: (As applicable to Degree Course)

B] Shivaji University, Kolhapur

Revised syllabus for Bachelor of Science

1. TITLE: Subject-Biotechnology (Optional/Vocational)

Optional under the Faculty of Science

2. YEAR OF IMPLEMENTATION:-Revised Syllabi (As per NEP 2020) will be implemented from June 2023 onwards.

3. PREAMBLE:-

[Note: - The Board of Studies should briefly mention foundation, core and applied components of the course/paper. The student should get into the prime objectives and expected level of study with required outcome in terms of basic and advance knowledge at examination level.**]**

4. GENERAL OBJECTIVES OF THE COURSE:

(as applicable to the Degree concerned) Objectives:-

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.

5. DURATION

The course shall be a fulltime course.

6. PATTERN:-

Pattern of examination will be semester.

7. FEE STRUCTURE:-

As per Government / University rules

1) Refer brochure and prospectus of concern affiliated college/institute to Shivaji University, Kolhapur.
2) Other fee will be applicable as per rules and norms of Shivaji University, Kolhapur.

8. ELIGIBILITY FOR ADMISSION:

As per guidelines obtained from Shivaji University, Kolhapur by following rules and regarding reservations by Govt. of Maharashtra

9. MEDIUM OF INSTRUCTION:

The medium of instruction shall be in English.

10. STRUCTURE OF THE COURSE - B. Sc. II Biotechnology (Optional/Vocational)

SECOND YEAR (SEMESTER III / IV) (NO. 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-I			50
	Practical-II			50
Total				**300**

11. SCHEME OF TEACHING AND EXAMINATION:-

[The scheme of teaching and examination should be given as applicable to the course/paper concerned.]

SECOND YEAR-SEMESTER–III/IV:Biotechnology
(Optional/Vocational) Scheme of Teaching and Examination

Sr. No.	Subject/Paper	Teaching Scheme (Hrs/Week)				Examination Scheme (Marks)		
		L	T	P	Total	Theory	Term Work	Total
	Semester-III							
1	Paper-V	03	-	-	03	40	10	50
2	Paper-VI	03	-	-	03	40	10	50
	Semester-IV							
3	Paper-VII	03	-	-	03	40	10	50
4	Paper-VIII	03	-	-	03	40	10	50
	Practical- I (annual)	-	-	04	04	-	-	50
	Practical- II (annual)	-	-	04	04	-	-	50
	Total	06	-	08	14	-	-	300

12. SCHEME OF EXAMINATION :-

The examination shall be conducted at the end of each term for semester pattern.

- The theory paper shall carry 40 marks.
- The evaluation of the performance of the students in theory papers shall be on the basis of Semester Examination of 40 marks.
- The internal evaluation for each paper shall carry 10 marks. (Semester III: Group activity and Semester IV: Case study/Oral examination)
- Question paper will be set in the view of the /in accordance with the entire syllabus and preferably covering each unit of syllabi.

13. STANDARD OF PASSING:-

As prescribed under rules and regulation for each degree.

14. NATURE OF THEORY QUESTION PAPER AND SCHEME OF MARKING:

Q.1. Multiple choices questions (8-questions) --- 8 Marks

Q. 2. Attempt **any two** of the following (out of three).

(Essay type / Broad answer questions)---- 16 Marks

Q. 3. Write short notes (**any four**) (out of six). 16 Marks

15. EQUIVALENCE IN ACCORDANCE WITH TITLES AND CONTENTS OF PAPERS- (FOR REVISED SYLLABUS)

(Introduced from June 2023 onwards)

Old Syllabus (Semester pattern)		**Revised Syllabus (Semester pattern)**		
Paper No.	**Title of Old Paper**	**Semester No.**	**Paper No.**	**Title of New Paper**
V	Biophysics and Enzyme technology	Semester- III	V	Biophysics and Enzyme technology
VI	Molecular Biology		VI	Molecular Biology
VII	Immunology	Semester- IV	VII	Immunology
VIII	r□DNA technology		VIII	r□DNA technology

16. SPECIAL INSTRUCTIONS, IF ANY

SEMESTER-III
Biotechnology(Optional/Vocational)

Paper V: DSC 17-C: Biophysics and Enzyme technology

CREDITS: 2, LECTURE PERIOD: 3 PER WEEK
LECTURE HOURS: 3 PER WEEK, MARKS: 50

		Lectures
	Semester III Paper-V: Biophysics and enzyme technology	
	Credit -1	30

	1.1Enzyme 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. 1.4Factors affecting enzyme activity – Temperature, pH, Substrate concentration, inhibitors, enzyme concentration, Activators. 1.5 Structure and function of Isozyme. 1.6 Concept of steady state kinetics, 1.7 Concept of activation energy 1.8 Derivation of Km., Significance of Km and Vmax Determination of km by Lineweaver Burk plot and Eadie Hofsteeplot. 1.9 Allosteric enzymes – Definition, properties, models explaining mechanism of action – Sequential model, Symmetry Model. 2.0 Regulation of enzyme activity Irreversible changes in covalent structure of enzyme, Reversible changes in covalent structure of enzyme, Feed back or end product inhibition.	15
	Credit -2	
	2.1Spectroscopy : Principle, working and applications of a) Principle, working and applications of Florescence spectroscopy b) Principle, working and applications of Infra red spectroscopy c) Principle, working and applications of Atomic absorption spectroscopy 2.2 concept of immobilization 2.3 Advantages of immobilization 2.4 Disadvantages of immobilization 2.5 Methods of immobilization 1. Physical adsorption 2. Covalent bonding 3. Cross-linking 4. Entrapment 5. Encapsulation 2.6 Applications of immobilized enzyme. 2.7 Biosensor-Types & applications	15

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: DSC 18-C: Molecular Biology

CREDITS: 2, LECTURE PERIOD: 3 PER WEEK
LECTURE HOURS: 3 PER WEEK, MARKS: 50

Semester III Paper-VI : Molecular Biology	Lectures
Credit-I	30
1.1Central dogma of life 1.2Structural organization of prokaryotic and eukaryotic gene 1.3 DNA replication-2.1Semi conservative model of replication (Meselson &.Stahl Expt.) 1.4 Prerequisites of replication- Enzymes involved in replication and their action, template DNA, Deoxyribonucleotides, primer 1.5 DNA replication in prokaryotes: Initiation , elongation and termination and Rolling circle model & θ model of replication. 1.6 DNA replication in eukaryotes – Initiation, elongation and termination. 1.7 Genetic code and its properties 1.8 Operon model Lactose operon, Structure and role of Lac repressor and inducer. 1.9 Mutation- Definition, Types-spontaneous & induced mutation, missense, nonsense, insertion, deletion, frame-shift mutations. Mechanism of mutagenesis. 2.0 A. DNA damage by UV B. DNA Repair - a) Photoreactivation b) Excision Repair Base excision and nucleotide excision repair c) SOS Repair system d) Mismatch repair	15
Credit II	
2.1 Transcription a) Transcription in prokaryotes: Initiation, elongation and termination. Post transcriptional processing - folding, modification of bases, removal of non-functioning sequences. b)Transcription in eukaryotes Initiation, elongation & termination, post transcriptional modifications/ processing. 2.2 Translation a) Translation in prokaryotes: Activation of amino acids, initiation, elongation and termination. b)Translation in eukaryotes: Activation of amino acids, initiation, elongation and termination, Post translational modifications. 2.3Insertion elements and transposons Properties and uses. 2.4Modes of gene transfer in bacteria – a)Transformation b)Transduction c)Conjugation	15

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 VII: DSC 17-D: Immunology

CREDITS: 2, LECTURE PERIOD: 3 PER WEEK
LECTURE HOURS: 3 PER WEEK, MARKS: 50

Topic No.	Semester IV Paper –VII :Immunology	Lectures
	Credit- I	30
1.	1.1 Introduction 1.2 Types of immunity- i) Innate - types, factors influencing innate immunity ii) Acquired - Active and Passive 1.3 Types of Defense- A) Nonspecific- a) First line of defense - physical and chemical barriers b) Second line of defense - chemical and biological barriers B) Specific - a) Third line of defense -specific defense mechanism 1.4 Organs of immune system-primary and secondary lymphoid organs - structure and their role 1.5 cells of immune system-monocytes and macrophages, granulocytes, mast cells, dendritic cells, NK cells, B and T lymphocytes and types	15
	Credit-II	
2.	2.1 Antigen- definition, nature, types of antigen, factors affecting on antigenicity 2.2 Antibody-definition, chemical nature, basic structure of immunoglobulin, major human immunoglobulin classes (their properties and functions), theories of antibody production. 2.3Immune response -Primary and secondary immune Response 2.4 Antigen - Antibody reactions-Principle, mechanism and applications of - a)Agglutination b) Precipitation c) Complement fixation d) ELISA e) Fluorescent antibody test 2.5 Hypersensitivity – definition, types – a) Immediate - Anaphylaxis a) Delayed – homograft rejection	15

References:

1. "Essential Immunology"-11th edition- Delves, Martin, Burton &Roitt
2. "Immunology"-6th edition-Kuby , Kindt, Goldsby & Osborne
3. ''Immunology and Serology''- Ashim Chakravar
4. Immunology-An Introduction - 4th edition-Tizzard
5. Essentials of Immunology- S.K.Gupta
6. Immunology- M.P.Arora

Paper VIII: DSC 18-D: r-DNA technology

CREDITS: 2, LECTURE PERIOD: 3 PER WEEK
LECTURE HOURS: 3 PER WEEK, MARKS: 50

	Semester IV Paper –VIII :r-DNA technology	Lectures
	Credit I	30
	1.1.Isolation and purification of nucleic acids-DNA, RNA and plasmids 1.2.Methods of purification of DNA-Electro-elution from the gel, Agarose gel electrophoresis, PAGE 1.3.Probes-Preparation, Labelling and Applications 1.4 Introduction to r-DNA technology-Restriction enzymes (Exonuclease and Endonuclease) and their types. 1.5 Enzymes to modify ends of DNA-Alkaline phosphatase,S1 nuclease, DNA ligase Terminal transferase, Adaptors, Linkers 1.6.Cloning vectors-Plasmids(pBR 322 and pUC18), Bacteriophages- λ phage vector –(λ insertional e.gλgt 10) cosmids, phagemids (e.gpBlue script II KS/SK), Animal vectors(Retroviral), Plant vectors(Ti plasmid) Shuttle vectors (e.gpJBD 219) 1.7. Construction of c-DNA and genomic library	15
	Credit II	
	2.1. Techniques in r-DNA technology a) Blotting techniques-Southern, Northern , Western blotting techniques b) PCR-Types(RT-PCR, real time PCR, touch down PCR, hot start PCR, colony PCR) and applications c) DNA sequencing techniques- i)Maxam and Gilbert's method ii) Sanger's method iii)Automated DNA sequencing 2.2. Selection of transformed cells-Replica plate technique, colony hybridization, Hybrid arrested translation and Hybrid selection translation. 2.3 Applications of r-DNA technology a) Novel protein generation- r-Insulin b) r-Vaccines- r-vector vaccines 2.4. Safety measures and biological risk for r-DNA work –Hazards in genetic engineering. 2.5. Gene Silencing- Introduction, Principle of Si-RNA and Si- RNA technology	15

References-

1 . Biotechnology-U.Satyanarayan
2. Biotechnology-R.C.Dubey
3. Gene Technology-S.N.Jogdand
4. Immunology Kuby
5. Introduction to Biotechnology B.D.Singh
6. Principle of gene manipulation Old and Primrose
7. Genome by T.A. Brown
8. Fundamentals of Biotechnology H.S.Chawala

Laboratory exercise

Sr. No	**Practical 1. Based on paper V and VI**
	Techniques in Enzymology
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 ($HgCl_2$) (Minor)
5	Effect of activator on amylase (NaCl) (Minor)
	Techniques in Molecular Biology
1	UV survival curve (Major)
2	Isolation of lac negative mutants of E.coli by visual detection method.(Major)
3	Subcellular fractionation of mitochondria, nucleus (Major)
	Practical- II Based on paper VII and VIII **Techniques in Immunology**
1	Dot ELISA test (Minor)
2	Qualitative & Quantitative Widal test (Major)
3	Radial immunodiffusion-Single & double diffusion (Major)
4	RPR test (Minor)
	Techniques in r-DNA technology
1	Isolation of chromosomal DNA from bacteria (Major)
2	Isolation of plasmid DNA(Major)
3	Resriction digestion (Major)
4	Separation of plasmid DNA by Agarose Gel electrophoresis (Minor)
5	Ligation(Minor)
6	DNA sequencing by analysis of autoradiogram (Minor)

(Note:-Practical examination will be Annual)

Books recommended for Practicals- References

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

Nature of Practical Question paper 100M

Q.1 Major experiment 20M

Q.2 Minor experiment 15M

Q.3 Major experiment 20M

Q.4 Minor experiment 15M

Q.5 Spotting- A,B,C,D.E 10M

Q.6 Journal 10M

Q.7 Viva 10M

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)

Practical Examination

(A) The practical examination will be conducted on two consecutive days for four hours per day per batch of the practical examination.

(B) 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.

Course Outcomes:

Paper V:

After successful completion of the course, the students will be able

1. To know the scope and importance of the enzyme technology.
2. To understand enzyme definition, classification, nomenclature.
3. To understand the derivation of Km and its significant.
4. To understand principal application of spectroscopy.

Paper VI:

After successful completion of the course, the students will be able

1. To understand ability to evaluate the impact of structure or part modification on biological system.
2. To understand differentiate between transcription and translation.
3. To understand modes of gene transfer in bacteria.
4. To know DNA replication in prokaryotes and eukaryotes.
5. To summarize concept of central dogma and genetic code.

Paper VII:

After successful completion of the course, the students will be able

1. To understand types of immunity and defense mechanism.
2. To understand organs of human system.
3. To know definitions and structure of antibody.
4. To evaluate antibody antigen reactions.

Paper VIII:

After successful completion of the course, the students will be able

1. To illustrate creative use of modern tools and techniques for analysis of genomic sequences.
2. To understand application of r-DNA technology.
3. To know the methods of purification of DNA.
4. To understand the cloning vectors and probes.
5. To understand PCR and its applications.