SYLLABUS

B.Sc II

(Implemented from June 2022 onwards)

“Education for Knowledge, Science and Culture”

-Dr. Bapuji Salunkhe

Department of Biotechnology (Optional) B.Sc. Part II

Semester III & IV

Semester	Course code	Paper No.	Course title	No. of Credits
III	DSC 1009C	Paper V	Enzyme Technology	4
		Paper VI	Molecular Biology	
IV	DSC-1009D	Paper VII	Immunology	4
		Paper VIII	rDNA Technology	

CBCS Syllabus to be implemented from June 2022 onwards

CHOICE BASED CREDIT SYSTEM SYLLABUS

For Bachelor of Science Part –
IIBiotechnology (Optional)

1. Title -: Biotechnology Optional

2. Year of implementation -: CBCS Syllabus will be implemented from June, 2022 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. II. 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 membersof 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.

4. GENERAL OBJECTIVES OF THE COURSE / PAPER:

1. To make the students knowledgeable with respect to the subject and it's practicableapplicability.
2. To promote understanding of basic and advanced concepts in Biotechnology.
3. To expose the students to various emerging areas of Biotechnology.
4. To prepare students for further studies, helping in their bright career in the subject.
5. To expose the students to different processes used in industries and in research field.
6. To prepare the students to accept the challenges in life sciences.
7. To develop skills required in various industries, research labs and in the field of Human - health.

5. Duration

The course shall be three year full time course.

6. PATTERN:-

Pattern of theory Examination will be Semester. Practical examination will be annual.

7. MEDIUM OF INSTRUCTION:

The medium of instruction shall be English.

Guidelines shall be as per B.Sc Regular Program.

- Rules and Regulations shall be as per B. Sc. Regular Program except CBCS B.Sc II Structure of Program and List of Courses.

- This syllabus is framed to give sound knowledge with understanding of Biotechnology to undergraduate students of B. Sc. Biotechnology Entire Program. Students learn Biotechnology as a separate course (Subject) from B. Sc II.

- The goal of the syllabus is to make the study of Biotechnology popular, Interesting and encouraging students for higher studies including Research.

- Structure of Program and List of Courses are as follows:

Index

	Semester III	**Lectures (30)**
	DSC-1009C Enzyme Technology & Molecular Biology	
	Section I- Enzyme Technology	
	Credit I	
	1. Enzyme--- a. Introduction and definition and history b. Enzyme classification – According to international Union of Biochemistry (IUB) and its feature c. Active site of enzyme—Mechanism of action by Lock and key and Induced fit hypothesis d. Concept of Coenzyme, Cofactor, Haloenzyme, Apoenzyme e. Types of Enzymes (Intracellular, Extracellular) , (Inducible, constitutive) **2. Factors affecting enzyme activity-** Temperature, pH, Enzyme concentration , Substrate concentration **3. Enzyme kinetics** 1. Concept of Activation energy 2. Concept of steady state kinetics 3. Michelis Menten equation 4. Determination of Km by Linewever Burk plot and Eadie Hofstee plot **4..Regulation of enzyme activity** Inhibition – type a. .Reversible inhibition – Competitive, Non-compitive, Un-competitive b. Irreversible Inhibition) c. Feedback inhibition	**15**
	Credit II	

	A. Types of enzyme— 1. Allosteric enzyme— Mode of action by Symmetry and Sequential model 2. Ribozyme Structure and function 3. Isozyme- Example Lactate dehydrogenase structure and function Other examples of Isoenzyme **B. Immobilization of enzyme** 1. Advantage and disadvantages of immobilization of enzyme 2. Application of immobilized enzyme 3. Methods of immobilization--Physical adsorption , Covalent bonding, Entrapment, Encapsulation, Cross-linking **C. Biosensor-** Definition, Components, Features Types of Biosensor- 1) Enzyme electrode(glucose oxidase) 2) Bacterial electrode / Cell based electrode 3) Enzyme immunosensor 4) Environmental Biosensor 5)Bioreporter	**15**

	Semester III	**Lectures (30)**
	DSC-1009C Enzyme Technology & Molecular Biology	
	Section II - Molecular Biology	
	Credit I	
	A. Historical and Connectional background Structure of DNA , RNA, Protein B. Structure of Prokaryotic genome Structure of Eukaryotic genome C. DNA replication in prokaryotes – Rolling circle model and θ mode ofreplication D. DNA replication in eukaryotes – Mechanism of replication and inhibitors of replication E. Genetic Code and its properties F. Transcription a. Prokaryotic transcription – Initiation, elongation, termination b. Eukaryotic transcription - Initiation, elongation, termination and post transcriptional modification c. Inhibitors of transcription	**15**
	Credit II	
	A. Translation a. Translation in Prokaryotes – Initiation, elongation, termination b. Translation in Eukaryotes- Initiation , elongation, termination c. post translational modification d. Inhibitors of translation **B. Gene regulation and Expression in prokaryotes and Eukaryotes** **a. Operon Model- Lactose operon** Structure and role of Lac repressor and inducer. **C. DNA damage and repair Mechanism-** a. DNA damage by Physical , chemical amd biological agent b. DNA repair mechanism by 1. Photoreactivation 2. Excision Repair- Base excision and nucleotide excision repair 3. SOS repair system	**15**

References

1. Fundamentals of Biochemistry by –J.L.Jain

2. Biotechnology – R.C. Duby

3.Enzyme technology- S. Shanmugam and T, Satishkumar

4. Bioinstumentation – L. Veerakumari

5. Biochemistry – U. Sattyanarayan

6. Principles of biochemistry – Lehninger

7. Biochemistry – Lubert Stryer

8. Fundamentals of Enzymology- Price abd Stevens

9. Enzymes – Trevor Palmer

10. Enzymes Biotechnology- N. Gray .M. Calvin. SC Bhatia

11. Molecular biology- Watson

12. Molecular biology- Glickpastornack

13. Molecular Biology- Geralad Carph

14. Genetics- Strickbeger

15. Cell biology , Genetics, Molecular Biology Evolution and Ecology- S.Chand

	Semester IV	**Lectures (30)**
	DSC-1009D Immunology and r-DNA technology	
	Section I – Immunology	
	Credit I	
	Introduction 1. Immunology introduction 2. Immunity- Types of immunity a. Innate immunity- Types, Factors influencing innate immunity b. Acquired Immunity- Active and Passive 3. Types of Defense- A. Nonspecific- a. First line of defense- (Physico-chemical- barriers) b. Second line defense- (Phagocytes and mechanism of phagocytosis) B. Specific defense mechanism - Third line of defense 3. Organs of immune system- Structure and role of primary lymphoid organs & secondarylymphoid organs 4. Cell of immune system – monocytes and macrophages, granulocytes, Mastcells, dendtritic cells, NK cells, B and T lymphocytes	**15**
	Credit II	
	1. Antigen- definition, chemical nature, types of antigen, factors affecting antigenicity. 2. Antibodies- definition, chemical nature , basic structure of immunoglobulin, properties and function of major human immunoglobulinclasses, theories of antibody production 3. Immune response- Primary and secondary immune response 4. Antigen-antibody reaction - principle, mechanism, application of a. agglutination b. Precipitation c. Complement fixation d. ELISA(Sandwich) 5. Introduction to some disease causing pathogens- Enteric fever- *Salmonella typhi* Urinary tract infection-(UTI)- *Escheria coli , Pseudomonas aerogenosa*	**15**

	Semester IV	**Lectures (30)**
	DSC-1009D Immunology and r-DNA technology	
	Section II - r-DNA technology	
	Credit I	
	1. Introduction to r-DNA technology- **2.** Nucleases – types and uses **3.** Restriction enzymes- Types- I,II III Recognition sequences, cleavage patterns **4.** Enzymes to modify ends of DNA- Alkaline phosphatase , S1 nuclease, DNA ligase, terminal transferase Adaptors , Linkers **5.** Cloning Vectors- Plasmids (pBR322, pUC 18) Bacteriophages (λ phage) cosmids, phgemids (pEMBL8), Animal vectors, plant vectors (Ti and Ri) , Shuttle vectors (YAC and BAC) **6.** Construction of c-DNA genomic library	**15**
	Credit II	
	Techniques in r-DNA technology A. Probes-Preparation , Labeling, and Applications B. Blotting techniques- a. Southern Blotting b. Northern Blotting c. Western Blotting C. PCR- Concept types (Reverse Transcriptase- PCR, Real time PCR, Nested PCR, Hot start PCR, Multiple PCR, Colony PCR) application D. DNA sequencing techniques- a. Maxam Gilbert method b. Sanger's method c. Automated sequencer E. Selection of transformed cells- Colony hybridization , immunological screening, blue –white screening . Insertional activation F. Applications of gene cloning 1. Production of r- Insulin 2. Production of r- Somatostatin Safety measures and biological risk for r-DNA work- Hazards in genetic engineering	**15**

References

1. Essential immunology – Riott
2. Immunology - Kuby
3. General Microbiology- Stainer
4. Immunology an introduction – Tizzard 4th edition
5. Medical Bacteriology – Dey and Dey
6. Immunology and serology- Ashim Charkravar
7. Immunology - Nandini Shetty
8. Biotechnology – U.Styanarayanan
9. Biotechnology – R.C. Dubey
10. Gene Biotechnology – S.N. Jogdan
11. Fundamentals of Biotechnology- H.S. Chawala
12. Introduction to Biotechnology – B.D. Singh
13. Principle of gene manipulation – Old and primrose
14. Genome- T.A. Brown

PRACTICAL SYLLABUS

	Name of Practical	Credits
	Techniques in Enzymology and Biochemical analysis	
1.	Introduction to Enzymology concepts	
2.	Amylase assay	
3	Effect of temperature on amylase	
4	Effect of Activator on Invertase	
5	Effect of Inhibitor on Invertase	
6	Determination of nitrate reductase activity from plant material	
7	Separation of amino acid from mixture by thin layer chromatography	
8	Separation of macro and micro molecules by dialysis	
9	Estimation of fructose by Resorcinol method	
10	Effect of substrate concentration on enzyme activity	
	Techniques in molecular biology and r- DNA technology	
11.	Isolation of genomic DNA from Bacteria	
12.	Isolation of plasmid DNA from Bacteria	**30**
13	Separation of plasmid DNA by gel electrophoresis	
14	Restriction digestion of DNA	
15	Ligation of DNA	
16	DNA sequencing analysis by Autoradiogram	
17	Demonstration of DNA amplification by PCR	
	Techniques in Immunology	
18	Dot ELISA	
19	Quantitative Widal test	
20	Radial immuno diffusion assay	
21	Rapid plasma Reagen test	
22	Measurement of Cell micrometry	
23	Isolation and cultivation of pathogens causing Enteric fever to study its morphological and culture characters	

	Semester III and IV (Optional) Biotechnology	**Lectures (30)**
	Skill Enhancement Course	
	Introduction to Molecular Diagnostics	
	Credit I	
	Comparison of enzymes available for immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogenous and heterogeneous enzyme immunoassays, Enzyme immunoassay after Immunoblotting. Enzyme immuno histochemical techniques. Use of polyclonal or monoclonal antibodies in enzyme immuno assays. Applications of enzyme immunoassays in diagnostic microbiology	**15**
	Credit II	
	Molecular methods in clinical microbiology; Application of PCR , RFLP, Nuclear hybridization methods (Southern, Northern, Western) GLC, HPLC, Electron microscopy, flow Cytometry and cell sorting, Transgenic animals	**15**
	Prcticals	
1	Demonstrate RFLP	1
2	Kirby- Bauyer method (disc- diffusion method) to study antibiotic sensitivity of a bacterial culture	1
3	A kit based detection of microbial infection (Widal test)	1
4.	Immuno diagnostic test (Typhoid)	1

Reference

1.Practical biochemistry, Principles and techniques, Keith Wilson and John Walkar

2.Bioinstrumentation, Webster

3.Advanced instrumentation - J.F. Van Impe, Kluwer Academic

4.Textbook of Microbiology- Anantnarayanan R. and Paniker

Course Outcome

Enzyme Technology
1. Enzyme Technology deals with study of detailed structure & function ofEnzymes. 2.The course will give opportunity to understand following concepts; 1. IUB classification of Enzyme 2. Steady state kinetics 3. Allosteric Enzyme 4. Biosensor and Immobilization

Molecular Biology
Molecular Biology gives knowledge about structure and functionof the macromolecules, essential to life. Molecular Biology givesdetailed knowledge of biological and/or medicinal processes through the investigation of the underlying molecular mechanisms. Students will gain an understanding of chemical and molecularprocesses that occur in and between cells. Students understanding will become such that they will able to describeand explain processes and their meaning for the characteristicsof living organisms. Students will gain insight into the most significant molecularand cell-based methods used today to expand our understanding of biology. After completion of this course students will understand following techniques; a) Gel Electrophoresis b) Blotting Techniques c) Polymerase Chain Reaction d) Genetic Engineering

rDNA technology

In the past century, the recombinant DNA technology was just an imagination that desirable characteristics can be improved inthe living bodies by controlling the expressions of target genes. However, in recent era, this field has demonstrated unique impacts in bringing advancement in human life.

By virtue of this technology, crucial proteins required for health problems and dietary purposes can be produced safely, affordably, and sufficiently.

After completion of this course students will understand following Concepts;

a) Restriction Digestion
b) Ligation
c) Plasmid Construction
d) Gene Transfer Methods
e) Recombinant Insulin
f) Recombinant Vaccines

Immunology:

The immune system governs defense against pathogensand is of importance for development of autoimmune diseases, allergy and cancer.

The course discusses basic immunology including cellular and molecular processes that represents the human immune system.

This subject offers detailed study of following concepts;

a) Immunological processes at a cellular and molecular level
b) Defense mechanism (Physico-chemical barriers)
c) Innate & Acquired Immunity
d) Antigen & Antibody (Reactions)
e) Hypersensitivity

List of minimum equipment's-for Biotechnology

1) Hot air oven - 1
2) Incubator - 1
3) Autoclave - 1
4) Refrigerator - 1
5) Students microscopes (oil immersion) - 10 nos. for one batch
6) Digital balance - 2
7) pH meter - 1
8) 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')

Practical Examination

(A) The practical examination will be conducted on two consecutive days for three 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 satisfactory manner the practical course online 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 90% Practical's should be covered in practical examination

SCHEME OF MARKING FOR (THEORY)

Sem	Core Course	Marks	Evaluation	Sections	Answer Books	Standard of passing
1	DSC-1009C	70	Semester wise	Two sections, each of 35 marks	As per instruction	35% (25 marks)
2	DSC-1009D	70	Semester wise	Two sections, each of 35 marks	As per instruction	35% (25marks)

SCHEME OF MARKING (CIE) Continues Internal Evaluation

Sem	Core Course	Marks	Evaluation	Sections	Answer Books	Standard of passing
1	DSC-1009C	30	Semester wise	One	As per instruction	35% (10marks)
2	DSC-1009D	30	Semester wise	One	As per instruction	35% (10marks)

SCHEME OF MARKING (PRACTICAL)

Sem	Course	Marks	Evaluation	Section	Standard of passing
I & II	DSC 1009C & DSC 1009D	100	Annual	As per instruction	35% (35marks)

***Separate passing is mandatory**

Nature of Question Paper (Theory)
SECTION I

Instructions

1. All the questions are compulsory.
2. Figures to the right indicate full marks.
3. Draw neat labeled diagram wherever necessary.

Time: 2 Hrs **Total Marks**: **35**

Q. 1. a) **Rewrite the sentences by selecting correct alternative from the following. (5 Marks)**

i.)

a) b) c) d)

(i) to (v)- Same as above

Q.1 b Fill in the blanks (2 Marks)

i

ii.

Q. 2. Attempt any two. (14 Marks)

A.

B.

C.

Q.3 Attempt any four out of Six (14 Marks)

i.

ii.

iii

iv

v

vi

SECTION II

(Same as SECTION I)

PRACTICAL EXAMINATION PAPER NATURE

First day

Major Experiment 20
Minor Experiment 10
Spotting 10
Viva-voce 10

Second day

Major Experiment 20
Minor Experiment 10
Minor Experiment 10
Journal 10

TOTAL 100 marks