**"Education for Knowledge, Science and Culture"**

**- Dr Bapuji Salunkhe**

# Department of Biotechnology(Optional)

## B.Sc. Part II

## Semester III & IV

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

## CBCS Syllabus to be implemented from June 2019 onwards

# CHOICE BASED CREDIT SYSTEM SYLLABUS
# For Bachelor of Science Part - II
# BIOTECHNOLOGY (Optional)

**1. TITLE: Biotechnology-Optional**

**2. YEAR OF IMPLEMENTATION** :- CBCS Syllabus will be implemented from June, 2019 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 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.

**4. GENERAL OBJECTIVES OF THE COURSE / PAPER:**

1) To make the students knowledgeable with respect to the subject and it's practicable applicability.
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.

**3) OTHER FEATURES:**

(A) LIBRARY:

Reference and Text Books, Journals and Periodicals, Reference Books – List Attached

(B) LABORATORY SAFETY EQUIPMENT:

1) Fire extinguisher
2) First aid kit
3) Fumigation chamber
4) Stabilized power supply
5) Insulated wiring for electric supply.
6) Good valves & regulators for gas supply.
7) Operational manuals for instruments.
8) Emergency exits.

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

  **This syllabus is framed to give sound knowledge with understanding of Biotechnology to undergraduate students of B. Sc. Biotechnology Optional Program.**
- **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<br>Paper III- Enzyme Technology &Molecular Biology | Lectures |
|---|---|---|
| 1. | **Credit I**<br>**Enzyme**- Definition,<br>IUB Classification of Enzymes.<br>Active site of enzyme, Mechanism of action of enzyme -Lock and Key hypothesis , Induced-fit hypothesis.<br>Factors affecting enzyme activity – Temperature, pH, Substrate concentration, enzyme concentration.<br>Structure and function of Isozyme.<br>Concept of steady state kinetics,<br>Concept of activation energy<br>Derivation of Km.<br>Determination of km by Lineweaver Burk plot and Eadie Hofstee plot.<br>Allosteric enzymes – Definition, properties, models explaining mechanism of action – Sequential model, Symmetry Model.<br>Regulation of enzyme activity- Irreversible changes in covalent structure of enzyme, Reversible changes in covalent structure of enzyme, (competitive inhibition, Non-competitive, Un-competitive inhibition) Feed back or end product inhibition. | 15 |
| | **Credit II** | |
| 2. | **Biosensors**- Definition , Components,Features.<br>Types-1)Enzyme electrodes (glucose oxidase)<br>2)Bacterial Electrodes/Cell Based Electrodes<br>3)Enzyme Immuno sensors<br>4)Environmental Biosensor<br>Bioreports<br>**concept of immobilization**<br>Properties of immobilized Enzymes<br>Advantages of immobilization<br>Disadvantages of immobilization<br>Methods of immobilization 1. Physical adsorption 2. Covalent bonding 3. Cross linking 4. Entrapment 5. Encapsulation<br>Applications of immobilized enzyme. | 15 |
| | **Section II** | |
| | **Credit III** | 15 |

| | | |
|---|---|---|
| **3.** | Historical and conceptual background<br>Structure of DNA, RNA & Protein.<br>Structure of prokaryotic and eukaryotic genome<br>DNA replication in prokaryotes:- Rolling circle model & θ- model of replication.<br>DNA replication in eukaryotes – Mechanism of replication,<br>Inhibitors of replication<br>Genetic code and its properties<br>Transcription-<br>a) Transcription in Prokaryotes: -Initiation, elongation and termination.<br>b)Transcription in eukaryotes- Initiation, elongation & termination,<br>Post - transcriptional modification.<br>c) Inhibitors of transcription. | |
| | **Credit IV** | |
| 4. | Translation in Eukaryotes: - Activation of amino acids, initiation, elongation and termination, Post-translational modification.<br>Inhibitors of translation.<br>Gene regulation and Expression in Prokaryotes & eukaryotes.<br>Operon model - Lactose operon, Structure and role of Lac repressor and inducer.<br>DNA Damage & Repair Mechanisms-DNA damage- physical, chemical & biological.<br>DNA Repair Mechanisms-<br>a) Photoreactivation<br>b) Excision Repair- Base excision and nucleotide excision repair.<br>c)SOS Repair system | 15 |

## References:


**[Enzyme Technology]**

1. Fundamentals of Biochemistry -J.L. Jain
2. Enzyme technology - S. Shanmugam and T. Sathishkumar
3. Biotechnology - R.C. Dubey
4. Enzymes – Trevar Palmer
5. Biochemistry- U. Satynarayanan
6. Bioinstrumentation- L. Veerakumari

**[Molecular Biology]**

1) Molecular biology -Watson
2) Genetics -Strickbeger
3) Molecular Biology -Glickpastornack
4) Molecular Biology- Geralad Carph
5) Cell Biology - DeRobertis

| | | |
|---|---|---|
| | **Semester IV** | |
| | **Paper IV -Immunology & rDNA technology** | Lecture 45 |
| | **Credit I** | |
| 1. | Introduction<br>1.2.Types of immunity-<br>i) Innate immunity - Types, Factors influencing innate immunity<br>ii) Acquired immunity - Active and Passive<br>1.3. Types of Defense –<br>A) Nonspecific -<br>a) First line of defense- (Physico-chemical barriers)<br>b)Second line of defense- (phagocytes and mechanism of phagocytosis)<br>B) Specific defense mechanism-Third line of defense<br>2.1. Organs of immune system-Structure and role of primary and secondary lymphoid organs.<br>2.2. Cells of immune system- monocytes and macrophages, granulocytes, mast cells,dentritic cells, NK cells, B and T lymphocytes. | 15 |
| | **Credit II** | 15 |
| | 4.1. Antigen- definition , chemical l nature, types of antigen, factors affecting antigenicity.<br>Antibodies- defination,chemical nature,basic structure of immunoglobulin,properties and functions of major human immunoglobulin classes, theories of antibody production.<br>4.2.Immune response-Primary and secondary immune response<br>4.3.Antigen-antibody reactions-Principle, mechanism and applications of-<br>a) Agglutination b) Precipitation<br>c) Complement fixation d)ELISA (Sandwich)<br><br>4.4. Hypersensitivity- definition, types<br>Immediate hypersensitivity – Anaphylaxis<br>Delayed hypersensitivity – Homograft rejection | |
| | **Section II** | |
| | **Credit III** | 15 |
| | 1.3. Introduction to r-DNA technology:-<br>1.4. A)Nucleases (Types & Uses), | |

| | | |
|---|---|---|
| | B)Restriction Enzymes-Types (I ,II,III,), Recognition sequences, cleavage patterns.<br>1.4.Enzymes to modify ends of DNA – Alkaline phosphatase, S1 nuclease ,DNA ligase Terminal transferase Adaptors, Linkers.<br>1.5.Cloning vectors:- Plasmids(Pbr322,pUC18), Bacteriophages(λphage), cosmids, phagemids(pEMBL8), Animal vectors, Plant vectors(Ti & Ri), Shuttle vectors(YAC & BAC).<br>Construction of c-DNA and genomic library | |
| | **Credit IV** | 15 |
| | Techniques in r-DNA technology<br>A)Probes- Preparation , Labeling and Applications<br>B)Blotting techniques :- a)Southern Blotting, b)Northern Blotting,<br>c) Western Blotting .<br>C)PCR- concept , types(Reverse Transcriptase-PCR, Real time PCR, Nested PCR, Hot start PCR, Multiplex PCR, Colony PCR), applications.<br>D)DNA sequencing techniques- a) Maxam and Gilbert's method<br>b) Sanger's method<br>c)Automated Sequencing<br>Selection of transformed cells:- Colony hybridization, immunological screening, Blue-White Screening, Insertional inactivation.<br>Applications of gene cloning<br>1)Production of r-Insulin<br>2)Production of r-Somatostatin<br>Safety measures and biological risk for r-DNA work<br>-Hazards in genetic engineering. | |
| | **References:**<br>**[Immunology]**<br>1. Essential Immunology- Riott<br>2. Immunology- Kuby<br>3. General Microbiology- Stanier<br>4. Immunology An Introduction –Tizzard 4th Edition<br>5. Medical Bacteriology – Dey & Dey<br>6. Immunology & Serology – Ashim Chakravar<br>**[rDNA Technology]**<br>1. Biotechnology -U. Satynarayan<br>2. Biotechnology - R.C. Dubey<br>3. Gene technology- S.N.Jogdand<br>4. Fundamentals of Biotechnology- H.S.Chawala<br>5. Introduction to Biotechnology- B.D.Singh<br>6. Principle of gene manipulation- Old and Primrose<br>7. Genome by T.A. Brown | |

| Sr. No. | Name of Practical<br>**Techniques in (Molecular Biology rDNA Technology)** | Practicals |
|---|---|---|
| 1 | Isolation of Genomic DNA from Bacteria | 2 |
| 2 | Isolation of Plasmid DNA from Bacteria | 2 |
| 3 | Separation of plasmid DNA by Gel Electrophoresis | 1 |
| 4 | Restriction Digestion of DNA | 2 |
| 5 | Ligation of DNA | 2 |
| 6 | Demonstration of DNA amplification by PCR. | 1 |
| 7 | DNA sequencing by Analysis of Autoradiogram. | 1 |
| | **Techniques in ( Enzymology )** | |
| 8 | Amylase Assay | 2 |
| 9 | Effect of Temperature on Amylase Assay | 2 |
| 10 | Effect of Activator on Invertase | 1 |
| 11 | Effect of Inhibitor on Invertase | 1 |
| 12 | Determination of nitrate reductase activity from Plant Material | 1 |
| 13 | Separation of amino acid from mixture by Thin Layer Chromatography | 1 |
| 14 | Separation Macro & Micro molecules by Dialysis | 1 |
| 15 | Isolation of Mitochondria/Nucleus from goat Liver. | 2 |
| 16 | Estimation of Fructose by Resorcinol method | 1 |
| | **Techniques in ( Immunology )** | |
| 17 | Dot ELISA | 1 |
| 18 | Quantitative Widal test | 2 |
| 19 | Radial Immuno Diffusion Assay | 2 |
| 20 | Rapid Plasma Reagan test | 1 |
| 21 | Measurement of Cell Size by Micrometry | 1 |

# Course Outcome

## rDNA Technology:

- In the past century, the recombinant DNA technology was just an imagination that desirable characteristics can be improved in the 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 pathogens and 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

## Enzyme Technology:

- Enzyme Technology deals with study of detailed structure & function of Enzymes.
- The course will give opportunity to understand following concepts;

a) IUB classification of Enzyme
b) Steady state kinetics
c) Allosteric Enzyme
d) Biosensor
e) Immobilization

## Molecular Biology

- Molecular Biology gives knowledge about structure and function of the macromolecules, essential to life. Molecular Biology gives detailed knowledge of biological and/or medicinal processes through the investigation of the underlying molecular mechanisms.
- Students will gain an understanding of chemical and molecular processes that occur in and between cells. Students understanding will become such that they will able to describe and explain processes and their meaning for the characteristics of living organisms.
- Students will gain insight into the most significant molecular and 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

## 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 in a 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 | 80 | Semester wise | Two sections, each of 40 marks | As per instruction | 35% (28 marks) |
| 2 | DSC-1009D | 80 | Semester wise | Two sections, each of 40 marks | As per instruction | 35% (28 marks) |

## SCHEME OF MARKING (CIE) Continues Internal Evaluation

| Sem | Core Course | Marks | Evaluation | Sections | Answer Books | Standard of passing |
|---|---|---|---|---|---|---|
| 1 | DSC-1009C | 20 | Semester wise | One | As per instruction | 35% (7marks) |
| 2 | DSC-1009D | 20 | Semester wise | One | As per instruction | 35% ( 7marks) |

## SCHEME OF MARKING (PRACTICAL)

| Sem | Course | Marks | Evaluation | Section | Standard of passing |
|---|---|---|---|---|---|
| III & IV | 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**: **40**

**Q. 1. Rewrite the sentences by selecting correct alternative from the following. (8 Marks)**

i.)

a) b) c) d)

**As above (i) to (viii.)**

**Q. 2. Attempt any two. (16 Marks)**

i.
ii.
iii..

**Q. 3. Attempt any four. (16 Marks)**

i.
ii.
iii..
iv.
v.
vi.

## SECTION II
## (Same as above)

**PRACTICAL EXAMINATION**

**First day**

Q.1 Major Experiment 20
Q.2 Minor Experiment 10
Q.3 Spotting 10
Q.4 Viva-voce 10

**Second day**

Q.5 Major Experiment 20
Q.6 Minor Experiment 10
Q.7 Minor Experiment 10
Q.8 Journal 10

**TOTAL** **100 marks**

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