

**Rajarshi Shahu Mahavidyalaya, Latur**  
**(Autonomous)**  
**Biotechnology**

**SEMESTER PATTERN**

**(w.e.f. Academic Year 2016-17)**



**SYLLABUS FOR**  
**B.Sc.II Year (Biotechnology)**

**JUNE -2016**

**Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)**  
**Department of Biotechnology**  
**Course Structure of B.Sc. Biotechnology Second Year (w.e.f. June 2016)**

**B. Sc. II [Biotechnology] Semester III**

Code No.	Title of the course	Hours/ Week	Marks (100)		Credits
			In Sem	End Sem	
U-COE-301	Communicative English III	04	20	30	02
U-APM-398	Applied Microbiology	04	20	30	02
U-IMV-399	Immunology and Virology	04	20	30	02
U-ENV-400	Environmental Biotechnology	04	20	30	02
U-MET-401	Metabolism	04	20	30	02
U-LAC-402	Lab Course IX (Pract.I Based on BTT 9 )	03	20	30	02
U-LAC-403	Lab Course X (Pract.I Based on BTT 10)	03	20	30	02
U-LAC-404	Lab Course XI (Pract.I Based on BTT 11)	03	20	30	02
U-LAC-405	Lab Course XII (Pract Based on BTT 12)	03	20	30	02
U-ADC-334	Add on Course – HED-Person Related	02	50		02
	<b>Total Credits</b>				20

**B.Sc. II [Biotechnology] Semester IV**

CodeNo.	Title of the course	Hours/ Week	Marks (100)		Credits
			In Sem	EndSem	
U-COE-401	Communicative English IV	04	20	30	02
U-PLB-497	Plant Biotechnology	04	20	30	02
U-ENZ-498	Enzymology	04	20	30	02
U-PRB-499	Process Biotechnology	04	20	30	02
U-FMB-500	Fundamentals of Molecular Biology	04	20	30	02
U-LAC-501	Lab Course XIII (Pract.. Based on BTT 13)	03	20	30	02
U-LAC-502	Lab Course XIV (Pract. Based on BTT 14)	03	20	30	02
U-LAC-503	Lab Course XV (Pract. Based on BTT 15 )	03	20	30	02
U-LAC-504	Lab Course XVI (Pract. Based on BTT 16)	03	20	30	02
U-SEM	Seminar	03		50	02
U-	Add on Course- Hands on – Mol.bio. techniques ( Ten days programme)	04	50		02
	<b>TOTAL</b>				22

**Rajarshi Shahu Mahavidyalaya, Latur**  
**(Autonomous College)**  
**B.Sc. Biotechnology (Semester Pattern)**  
**III Semester**

**Course Title: Communicative English –III**

**Course Code: U-COE-301**

**Marks 50**

**Hours 45**

**Credit:02**

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**Learning Objectives:**

- To enhance learner's communication skills by giving adequate exposure in reading and writing skills and the related sub-skills.
- To create learner's confidence in written and interpersonal communication by reinforcing the basics of reading and writing.
- To help learners to recognize and make use of sentence structures in English in written communication.

**Unit-I Reading Skill 1**

**(Lectures 12 Practical 07)**

**A. Features of Reading**

- I Introduction
- II The Qualities of a Good Reader
- III Bad Habits of Reading
- IV Sub skills of reading
- V Types of Reading

**Practical:** Two stories with glossary

**B. Reading Techniques**

- I Surveying the reading matters and Identifying the text type.
- II Skimming the text for identifying the general theme
- III Scanning the text to locate specific details
- IV Understanding meaning of words , phrases and sentences

**Practical:** Two stories with questions

**C. Reading Task**

1. Reading samples (*Rainbow* Page No 223-236)
2. Five passages with questions

**Practical**

Students should make a recording of the lessons learnt in a CD and submit it to the department as per the instructions given by the teacher.

## Unit II Writing Skill 1

(Lectures12 Practical 07)

### A. Features of Writing

- I Features of Writing
- II The Writing Process (Spelling and Capital Letters)
- III Paragraph Writing  
(*Rainbow* Page No 214 - 222)  
Two Stories
  - i. Bahut Kuch Hota Hai
  - ii. Honesty Comes from the Heart  
(*Rainbow* Page No 237 - 246)

### B. Writing Techniques

- I Note making and Note taking (*Prism* Page No 135 – 38)  
(Note making is the ability to listen and reduce information to point form and  
Note taking is the ability to read and reduce information to point form  
and to expand from points to paragraph)

### C. Writing Comprehension

- I Basic Cursive Writing  
Description  
(*Writing Task* by Agrawal)
  - 1. Situation I Page No. 240
  - 2. Situation II Page No. 241
  - 3. A Picnic I Enjoyed Page No. 244
  - 4. My Favourite Hero in History Page No. 245
  - 5. My Best Friend Page No. 251

## Unit III Written Communication 06)

(Lectures12 Practical

- I Letter Writing  
e-mail letter
- II Job Application with C V
  - a. Introduction
  - b. What is C V ?
  - c. Specimen Curriculum Vitae , Resume and Biodata
  - d. Guidelines for writing a good C V

(*Radiance* page No 117-119)

To be assessed through MCQ and short answers

## **Reference Books**

1. Patil Z N . 2003. English for Practical Purposes. Chennai: Macmillan
2. Dwivedi R K & Kumar A, 2002. Macmillan Foundation English . Chennai: Macmillan
3. Edt Jadhav B S. 2009 Radiance Communication Skills Prose and Poetry . Mumbai Orient Blackswan
4. Vanikar Ranu. 1995. Corridors to Communication . Bombay. Orient Longman
5. Krishna Mohan & Meera Banerji. 2006 Developing Communication Skills. New Delhi. Macmillan
6. Thorat A R, 2000. Enriching Your Competence in English Bombay. Chennai. Orient Longman
7. Narayanswami V R . 1993. Strengthen Your Writing. Madras. Orient Longman

**Rajarshi Shahu Mahavidyalaya, Latur**  
**(Autonomous)**  
**B.Sc. Biotechnology (Semester Pattern)**  
**IV Semester**

**Course Title: HED- Human Excellence Development**  
**Marks 50**

**Course Code: U-ADC-334**  
**Hours 45**  
**Credit: 02**

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**Objective** -To help Students:

1. To feel more confident
2. To enhance their potential for achievement
3. To develop creativity
4. To develop interpersonal relationship
5. To acquire life coping skills

**Course Outcomes:**

- Student will be able to feel confident
- Student will be able to enhance their potential for achievement
- Student will be able to develop creativity and interpersonal relationship
- will be able to acquire life coping skills

Related Audience	-	Students of B.Sc. II Year
01. Spoken English	-	Basics of Grammar
02. Communication Skills	-	Verbal / Non verbal
03. Influencing Skills	-	Attitude Management
04. Managerial Skills	-	Leadership Skills, - Managing Aggressiveness
05. Listening Skills	-	Paying attention to opponents, friends, seniors, teachers & parents
06. Social Skills	-	Extempore, Group Discussions
07. Presentation Skills	-	Seminars
08. Writing Skills	-	How to write effective Letter, Resume, E-mail Application, etc.
09. Paradigm Shift	-	Understanding challenges and try to accept them
10. Motivation	-	Self Motivation Making friends for Progress

11. Aptitude Skills - Understanding aptitude Role plays Small Test
12. Becoming better Student - Plan to become better student on daily basis
13. Preparing for Interview - Dress Code, Eye Contact, Killing nervousness, Building Confidence, Winning the interviewer

\*\* After all these classroom trainings mock interviews will be conducted of each and every student in an open environment.

**Rajarshi Shahu Mahavidyalaya, Latur  
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**B.Sc. Biotechnology (Semester Pattern)  
III Semester**

**Course Title: Applied Microbiology**

**Course Code: U-APM-398**

**Marks 50**

**Hours 45**

**Credit:02**

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**Learning Objectives:**

1. To create awareness about microorganism which is exploited in industrial process, product development it's beneficial as well as harmful aspect and study of applied areas.
2. To provide the information on new approaches in microorganisms exploitation.
3. To know the technical knowhow about the soil, water and air microorganism along with the microbe which is disease causing and beneficial and their activities for recycling and sustainability
4. To inculcate the new approaches to direct the issues related to research in applied microbiology.

**Course Outcomes:**

- The students would be more methodical and innovative while working with this area of research.
- By studying all these process student would be more aware about environment friendly and ecofriendly process should be applied in the research.

**Unit I:**

Soil, water and air microbiology:Biogeochemical cycles: Mineralization in Carbon, Nitrogen, Sulfur, Phosphorous etc.Bacteriological examinations of water; (Presumptive,

confirmative, complete test) MPN, SPC, IMVIC, significance of index organism, Significance of microorganism in Air; methods of enumeration and controls.

### **Unit II:**

Scope of Food microbiology: role of microorganism in food processes.

Spoilage of food, potential responsible microbes, bacteriological examination of foods.

Preservation of food: Different methods of preservation: High temperatures, chemical, irradiation and physical techniques and pasteurization.

Single cell protein: Process, production and its significance.

### **Unit III:**

Introduction to Medical microbiology

Normal flora of the body, Immune system and Immunity, Microbial and viral infections and diseases, Use of antibiotics its mechanism of action, broad spectrum, narrow spectrum and its respective mechanism Chemotherapy

Water born, air born, food born diseases and their causative agents from different reservoirs.

### **Unit IV:**

Environmental microbiology: Scope and concern

Agricultural microbiology: Scope and concern

Industrial effluents and Waste water Assessment;

Sewage treatment plants: Aerobic & anaerobic treatment processes

Integration of genetic engineering & application of genetically engineered

Microbes in Agriculture, Environmental and waste water treatments.

### **Reference Books:**

A.N. Alexander-soil microbiology

Atlas and partha-Microbial ecology IV ed Tata McGra hill.

Adams and Moss-Food microbiology

Pelzar-Microbiology

Brock biology of microorganism.



**Rajarshi Shahu Mahavidyalaya, Latur**  
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**B.Sc. Biotechnology (Semester Pattern)**  
**III Semester**

**Course Title: Lab Course IX**

**Course Code: U-LAC-402**

**Marks: 50M**

**Hours: 30**

**Credit: 02**

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**Course Outcomes:**

- Become proficient at laboratory skills and safety procedures.
- Learn to follow experimental procedures.
- Develop skills to formulate answerable questions/hypotheses, predict expected results.
- Learn how to make careful observations, collect and analyze data, and draw appropriate conclusions.
- Utilize active learning opportunity in the laboratories. Demonstrate good lab citizenry and the ability to work with others.

**Practicals:**

1. Isolation and enumeration of microbes from soil, water and food samples.
2. Isolation of cellulose degraders
3. Isolation of Rhizobium and Azatobactor
4. Isolation of microbes from air and their enumeration
5. MPN (bacteriological examination of water)
6. IMVIC (bacteriological examination of water)
7. Isolation of mycotoxin from infected food and vegetables.
8. visit to waste water plant (field visit)

**Rajarshi Shahu Mahavidyalaya, Latur**  
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**B.Sc. Biotechnology (Semester Pattern)**  
**III Semester**

**Course Title: Immunology and Virology**  
**Marks 50**

**Hours 45**

**Course Code: U-IMV-399**  
**Credit: 02**

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**Learning Objectives:**

The course involves a basic understanding of immunology and Virology.

**Course Outcomes**

- The basic replication strategies of viruses and the fundamentals of interactions between viruses and the host;
- The role and importance of innate and adaptive immunity to host defense against micro-organisms;
- The functions and properties of different cell types and organs that comprise the immune system;
- The cellular interactions and activation of immune cells in response to foreign antigen and cytokines;
- Antibody structure and how this relates to antibody functions;

**UNIT I**

**15L**

**Overview of Immunology**

Historical perspective

Innate and Adaptive Immune response.

Hematopoiesis, Cells of Immune system and their biological role.

Humoral and cell mediated Immunity.

The Primary and secondary lymphoid organs.

**UNIT II**

**10L**

**Basics of Immunology**

**Antigen:** Antigens- General properties, types, Factors that influence antigenicity, Epitopes, Paratopes, Haptens, adjuvant and its types.

**Antibody:** General Structure of antibody molecule,

Antibodies- variation in structure of antibody and their biological significance.

**Antibody Antigen interactions:** Strength of Antigen-Antibody Interactions,  $K_a$  and  $K_d$  with its importance, Affinity and avidity

**Immunological reactions:** Precipitation and Agglutination reactions, ELISA.

**UNIT III**

**10L**

**Introduction to viruses**

Viruses and their importance.

Discovery of viruses.  
Structure of virus: viral nucleic acid, nucleocapsid, envelope.  
Variation in structure of viruses.  
Viroids and Prions.  
Nomenclature and Classification of viruses.

#### **UNIT IV**

**10L**

Structure of animal virus (HIV) and plant virus (TMV).  
Life cycle and replication of DNA virus, RNA virus, Retrovirus, Bacteriophages (lytic and lysogenic)  
Vaccines, antiviral drugs.

#### **Text and References:**

1. Kuby Immunology. Goldsby, Kindt, Osborne. 4th ed. W, H Freeman & Company, New York
2. Kuby Immunology. Goldsby, Kindt, Osborne. 6th ed. W, H Freeman & Company, New York.
3. Roitt's Essential Immunology. Deives, Martin, Burton, Roitt. 11th ed. Blackwell publications.
4. Virology Principles and Applications, John B. Carter and Venetia A. Saunders, John Wiley & Sons Ltd.
5. An introduction to viruses, Amita Biswas
6. Textbook of Microbiology – R. Anantnarayan and J. Panikar

**Rajarshi Shahu Mahavidyalaya, Latur**  
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**B.Sc. Biotechnology (Semester Pattern)**  
**III Semester**

**Course Title: Lab Course X**

**Course Code: U-LAC-403**

**Marks: 50M**

**Hours: 30**

**Credit: 02**

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**Course Outcomes**

- Recall advanced knowledge of the underlying principles of immunology and its application in solving problems in biological systems.
  - Have an awareness of some current research activities in the field and possible applications of this knowledge.
1. Agglutination reaction.
  2. Latex agglutination.
  3. Immunoprecipitation.
  4. Immunodiffusion.
  5. Blood film preparation and identification of cells.
  6. Differential leucocyte count.
  7. Microscopic observation of lymphoid organs.
  8. Widal.
  9. VDRL.
  10. Demonstration of immunodiagnosics.
  11. Demonstration of ELISA.
  12. Isolation of Bacteriophages from sewage.
  13. Titration of phage.
  14. Isolation of plant virus.
  15. Demonstration of one step growth curve of Bacteriophages.
  16. Cultivation of virus in embryonated eggs.

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**B.Sc. Biotechnology (Semester Pattern)  
III Semester**

**Course Title: Environmental Biotechnology**  
**Marks 50**

**Hours 45**

**Course Code: U-ENB-400**

**Credit: 02**

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**Learning Objectives:** The main objective of this course is to impart students an understanding of pollution of environment by air, water and soil responsible for degradation of natural resources and degradation of biodiversity. It also familiarizes them with various remediation techniques, non-Polluting technologies viz. bioenergy and biomining.

**Course Outcome:-**

- Aware the students about environmental, its current status and sustainable development concerned with environment.
- To train the students about environmental parameter analysis like water analysis, soil analysis.
- Understanding of environmental problems and suggests the remedial measures.

**UNIT I: Components of Environment and Global Environmental Problems** **08**

Hydrosphere, lithosphere, atmosphere and biosphere – definitions with examples; Interaction of man and environment; Environmental Studies as a multidisciplinary subject. Green House Effect, Acid rain, El Nino, Ozone depletion, deforestation, desertification, salination, biodiversity loss; chemical and radiation hazards.

**UNIT: II: Environmental pollution and Environmental Management** **10**

Pollution of air, water and land with reference to their causes, nature of pollutions, impact and control strategies; noise pollution; environmental damage by agriculture, perspectives of pollution in urban, industrial and rural areas.

Habitat Pollution by Chlorinated Hydrocarbons (DDT, PCBs, Dioxin etc), Organophosphates, Heavy Metals, Die-offs, Endocrine disrupting chemicals, Nutrient pollution.

Environmental Management – Concept of health and sanitation, environmental diseases – infectious (Water and air borne) and pollution related, spread and control of these diseases, health hazards due to Pesticide and metal pollution, waste treatment, solid waste management, environmental standards and quality monitoring.

**UNIT: III-Waste water treatment and management**

**15**

Domestic Waste Water Treatments: Primary, Secondary and Tertiary.

Important microorganisms in waste water treatment, Microbial kinetics

**Waste water treatment Reactors:** Introduction and types in brief

**Aerobic Biological Treatments:** Activated sludge process, Lagoons

Aerobic biofilm processes- Trickling filter and biological towers, Rotating Biological Contactors, fluidized-bed and circulating –bed biofilm reactors

**Anaerobic Biological Treatments:** upflow anaerobic sludge blanket (UASB) reactor, Fluidized and expanded beds.

**UNIT IV Biodegradation and Bioremediation**

**12**

**Biodegradation:** Definition and Concept, Aerobic and Anaerobic degradation pathways in Microbes.

**Biodegradation of Hydrocarbon** with Suitable Examples,

**Xenobiotics biodegradation**-pesticide biodegradation with suitable example

**Bioremediation:** Introduction, Definition and Concept, Methods of Bioremediation (In Situ and Ex Situ Methods)

**Phytoremediation:** Concept and Types.

**Reference books:**

1. Evan G.M. and Furlong J.C (2003), Environmental Biotechnology: Theory and Applications, John Wiley and Sons Ltd., England.
2. Asthana D.K. and Asthana M. (2001), Environment: Problems and Solutions, S.Chand and Company Ltd, New Delhi.
3. Chatterji A.K. (2002), Introduction to Environmental Biotechnology, Prentice Hall of India Pvt.Ltd, New Delhi
4. Jogdand S.N.(2006), Environmental Biotechnology, 3rd Edi., Himalaya Publishing House, Mumbai
5. Murugesan A. G. and Rajakumari C. (2005), Environmental Science and Biotechnology: Theory and Techniques, MJP Publishers, Chennai.
6. Rittmann B. E. And McCarty P. L. (2001), Environmental Biotechnology Principles And Applications, McGraw Hill, USA
7. Waste water engineering and management by Eddy and Metcalf

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**B.Sc. Biotechnology (Semester Pattern)**  
**III Semester**

**Course Title: Lab Course XI**

**Course Code: U-LAC-404**

**Marks: 50M**

**Hours: 30**

**Credit: 02**

**Course Outcome:-**

- To train the students about environmental parameter analysis like water analysis, soil analysis.
  - Understanding of environmental problems and suggests the remedial measures.
1. Visit and Observe any two pollutant sights and write a short report on cause, effects and Remedial measures through biotechnology.
  2. Waste water analysis for pollution and compare it with drinking water standards.
    1. Determination of Dissolved oxygen(D.O.)
    2. Determination of carbon dioxide( $\text{CO}_2$ )
    3. Determination of Biochemical oxygen demand (BOD).
    4. Determination of Chemical Oxygen demand(COD)
    5. Determination of Hardness of given water sample.
    6. Determination of  $\text{P}^{\text{H}}$  of given water sample
    7. Determination of alkalinity and chlorinity of given water sample.
  3. Detection of potability of water through Bacterial Examination of Water by MPN Test: Presumptive and Confirmed Coliform test.
  4. Isolation of hydrocarbon degrading bacteria and test it for degradation of aromatic hydrocarbons.
  5. To observe effects of air pollutants on plants and note the nature of pollution in your Surrounding and suggest remedial measures.

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**B.Sc. Biotechnology (Semester Pattern)  
III Semester**

**Course Title: Metabolism**  
**Marks 50**

**Hours 45**

**Course Code: U-ENB-401**

**Credit: 02**

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**Learning Objectives**

- To explain the role of catabolic and anabolic pathways in cellular metabolism.
- To distinguish between kinetic and potential energy.
- To distinguish between exergonic and endergonic reactions in terms of available energy change.
- To describe the structure of ATP and identify the major class of macromolecules to which ATP belongs.
- To explain how ATP performs cellular work.

**Course Outcomes**

- Describe the linked pathways of metabolism.
- Compare and contrast anabolism and catabolism.
- Describe how enzymes control metabolic reactions.
- Explain how metabolic pathways are regulated.
- Explain how ATP stores chemical energy and makes it available to a cell.
- Explain how the reactions of cellular respiration release chemical energy.
- Describe the general metabolic pathways of carbohydrate metabolism.

**UNIT I**

**13 lectures**

General scheme of metabolism, Glycolysis - aerobic and anaerobic, regulation of glycolysis, Krebs cycle and its regulation; Hexose monophosphate shunt, phosphoketolase pathway, EntnerDudroff pathway, glyoxylate and glucuronate pathways, Cori cycle, Regulation of blood glucose and homeostasis, glycogenolysis and its regulation, Bacterial fermentation- alcohol fermentation, Pasteur effect, Lactate fermentation- homofermentation and Heterofermentation Mixed acid fermentation, Fermentation without substrate level phosphorylation.

**UNIT II**

**10 lectures**

Hormone triggered mobilization of triglycerols, activation and transport of fatty acids-Role of acyl carnitine in fatty acyl transport, Beta oxidation - pathway and regulation, degradation of unsaturated fatty acids, oxidation of odd number fatty acids, peroxysomes and  $\beta$ - oxidation, Ketone bodies - formation and utilization  
Amino acid Oxidation and production of Urea- aminotransferase in amino group transfer to pyruvate and  $\alpha$  ketoglutarate, Urea cycle, pathways of amino acid degradation, degradation of purine and pyrimidine nucleotides



### UNIT III

13 lectures

Oxidative phosphorylation- Mitochondrial inner membrane, electron transport chain and its component, ATP and ATP synthesis, regulation of oxidative phosphorylation, Photosynthesis- energy production and CO<sub>2</sub> assimilation, oxygenic and anoxygenic photosynthesis, Chlorophylls and bacteriochlorophylls, reaction centres and antenna pigments, carotenoids and phycobilins, Anoxygenic photosynthesis in purple, green and heliobacter, Oxygenic photosynthesis in lower and higher eukaryotes, Chemolithotrophic-Hydrogen Oxidation, Oxidation of reduced sulphur compounds, Iron oxidation, Nitrification, Nitrogen Fixation, nitrogenase and alternative nitrogenase, Autotrophy- Calvin cycle, carboxysomes, reverse citric acid cycle, hydroxypropionate pathway, Photorespiration and salvage of phosphoglycolate, CO<sub>2</sub> Fixation in C<sub>4</sub> and CAM Plants. Gluconeogenesis, Biosynthesis of sucrose, starch and glycogen, biosynthesis of peptidoglycan

### UNIT IV

9 lectures

Biosynthesis of fatty acids- malonyl CoA synthesis, fatty acid synthase complex, desaturation of fatty acids, Biosynthesis of Phospholipids, cholesterol biosynthesis, Amino acids biosynthesis families, *denovo* and salvage pathway for purine and pyrimidine synthesis,

#### Reference:

1. Garrett & Grisham, Biochemistry, Saunders Publishing,
2. Voet and Voet. Biochemistry, second edition, Prentice-Hall,
3. Lehninger, Nelson and Cox. Principles of Biochemistry
4. J. Zubay. Biochemistry
5. Mathews, van Holde and Ahern. Biochemistry
6. Stryer, Biochemistry

**Rajarshi Shahu Mahavidyalaya, Latur  
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**B.Sc. Biotechnology (Semester Pattern)  
III Semester**

**Course Title: Lab Course XII**

**Course Code: U-LAC-405**

**Marks: 50M**

**Hours: 30**

**Credit: 02**

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**Course Outcomes**

- Compare and contrast anabolism and catabolism.
- Describe how enzymes control metabolic reactions.
- Explain how metabolic pathways are regulated.

1. Hills reaction
2. Assay of nitrogenase by acetylene reduction
3. Study of respiration
4. Study of enzyme activity of tissue extracts
5. Estimation of total carbohydrates, protein, and fats of tissue extracts/serum
6. Estimation of cholesterol from blood
7. Estimation of urea from urine and blood
8. In vitro photosynthesis
9. Estimation of ketone bodies
10. Saponification value of oils and fats

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**B.Sc. Biotechnology (Semester Pattern)  
IV Semester**

**Course Title: Communicative English -IV**  
**Marks 50**

**Hours 45**

**Course Code: U-COE-401**

**Credit: 02**

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**Learning Objectives:**

- To enhance learner's communication skills by giving adequate exposure in reading and writing skills and the related sub-skills.
- To create learner's confidence in written and interpersonal communication by reinforcing the basics of reading and writing.
- To help learners to recognize and make use of sentence structures in English in written communication.

**Unit-I Reading Skill 2**

**(Lectures 12 Practical 07)**

**A. Applied Reading Skills**

- I Silent Reading
- II Loud Reading
- III Skimming
- IV Scanning
- V Check your reading-speed
- VI Increasing the Eye Span

Short para from stories, article, news, autobiography (refer *Wisdom*)

**B. Applied Reading Comprehension**

1. Summary Writing
  2. Notemaking
    - Arts Stream                      Geographical Journals
    - Commerce Stream          Business Journals
    - Science Stream                Scientific Journals
- i. Preparing summary notes from given texts
  - ii. Preparing notes on given texts in graphic forms, charts, flow-charts, tables, tree diagrams, bubble maps etc.

**Unit II Applied Writing Skills**

**(Lectures 12 Practical 07)**

**A. Essay Writing**

**B. Newspaper Report Writing**

### **Unit III Written Communication**

**(Lectures12 Practical 06)**

- A. Writing Review
  - I Book Review
  - II Film/ Serial Review
- B. Preparing Questionnaire
  - I Survey
  - II Interview
  - III Project
- C. Anchoring , Welcoming, Introducing the guest

To be assessed through MCQ and short answers

### **Reference Books**

1. Patil Z N . 2003. English for Practical Purposes. Chennai: Macmillan
2. Dwivedi R K & Kumar A, 2002. Macmillan Foundation English . Chennai: Macmillan
3. EdtJadhav B S. 2009 Radiance Communication Skills Prose and Poetry .Mombai Orient Blackswan
4. VanikarRanu. 1995.Corridors to Communication . Bomby.Orient Longman
5. Krishna Mohan &Meera Banerji. 2006 Developing Communication Skills. New Delhi. Macmillan
- 6.Thorat A R, 2000.Enrichinhg Your Competence in English Bomby.Chennai. Orient Longman
7. Narayanswami V R . 1993.Strengthen Your Writing. Madras. Orient Longman

**Rajarshi Shahu Mahavidyalaya, Latur  
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**B.Sc. Biotechnology (Semester Pattern)  
IV Semester**

**Course Title: Plant Biotechnology**  
**Marks 50**

**Course Code: U-PLB-497**

**Hours 45**

**Credit: 02**

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**Learning Objectives:**

1. To know the basic infrastructural facilities to establish the plant tissue culture labs..
2. To educate about the basic technique related with aseptic manipulation and in vitro propagation.
3. To know and aware about the technique which is very potential and establish the commercial propagation of cash and ornamental crops.
4. To educate and aware about application regarding every technique of PTC and their utilities.

**Course Outcomes:**

- Students would be more aware about PTC technique and lab organization with necessary explanations.
- By studying all these student would be more empower with the special skills of PTC to establish own business and create employment in the field of seed and processing and related technique in various research organizations.

**Unit I:**

Traditional agriculture: Development of civilization

Breeding methods : Advantages and disadvantages,

Introduction to plant Breeding: Historical and traditional development for multiplication of agricultural produce.

Green revolution: its implication and applications.

Need of emergence of new techniques.

New Breeding Technology – Biotechnological Approaches

**Unit II:**

Introduction to Plant Tissue Culture:

Introductory History – Concepts of Cell theory & Cellular Totipotency.

Milestones in plant tissue culture, with respective scientist and their concepts

Infrastructure & Organization of plant tissue culture: Design of laboratory – General & aseptic laboratory, different work areas, equipments & instruments required other requirements.

### **Unit III**

Aseptic techniques – Washing & preparation of glassware, packing & sterilization, media sterilization, surface sterilization, aseptic work station, precautions to maintain aseptic conditions.

Culture Medium – Nutritional requirements of the explants, PGR's & their *in vitro* roles.

Media preparation. Preparations of stock solutions and their sterilization 'Explants' for plant tissue culture – histological and/or cellular characteristics

Dedifferentiation and dedifferentiation, Organogenesis, Embryogenesis

### **Unit IV**

Callus culture technique – Introduction, principle, Suspension culture technique – Introduction, principle, Growth & growth measurement, synchronization

Organ culture technique – Introduction, principle, Different routes of multiplication *in vitro* – a) auxiliary bud proliferation, Micropropagation b) somatic embryogenesis,

Embryo rescue, anther and pollen culture, Protoplast isolation, regeneration and fusion.

Plant secondary metabolites and its applications.

Germplasm conservation and cryopreservation.

Application of plant tissue culture technology and their commercialization.

### **Reference Books:**

1. Introduction to Plant Tissue culture : M.K. Razdan
2. Plant Tissue Culture : Theory & Practice : S.S. Bhojwani & M.K. Razdan
3. Micropropagation: Debergh & Zimmermann
4. Laboratory manual of plant tissue culture - H.S.Chawla.

**Rajarshi Shahu Mahavidyalaya, Latur  
(Autonomous)**

**B.Sc. Biotechnology (Semester Pattern)  
IV Semester**

**Course Title: Lab Course XIII  
Marks 50**

**Course Code: U-LAC-501  
Hours 45**

**Credit: 02**

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**Course Outcomes:**

- Students would be more aware about PTC technique and lab organization with necessary explanations.
- By studying all these student would be more empower with the special skills of PTC to establish own business and create employment in the field of seed and processing and related technique in various research organizations

**Practicals:**

1. General laboratory design for establishing plant tissue culture.
2. Collection of explants, washing of explants and sterilization of explants
3. Surface sterilization and aseptic manipulations
4. Media preparation, sterilization and subculture
5. Callus culture
6. Cell suspension culture
7. Anther and pollen culture
8. Embryo culture
9. Artificial seed production
10. Field visit-National research laboratories
11. Visit to commercial Plant tissue culture laboratory.

**Rajarshi Shahu Mahavidyalaya, Latur  
(Autonomous)**

**B.Sc. Biotechnology (Semester Pattern)  
IV Semester**

**Course Title: Enzymology**  
**Marks 50**

**Hours 45**

**Course Code: U-ENZ-498**

**Credit: 02**

**Learning Objective**

The objective of the course is to provide a deeper insight into the fundamentals of enzyme structure and function and kinetics of soluble and immobilized enzymes. Also it deals with current applications and future potential of enzymes.

**Course Outcome**

- The student will be able to describe structure, functions and the mechanisms of action of enzymes.
- The student will learn kinetics of enzyme catalyzed reactions and enzyme inhibitory and regulatory process.
- The student will be able to perform immobilization of enzymes.
- The student will get exposure of wide applications of enzymes and their future potential

**UNIT I**

**(15)**

**ENZYMES & ENZYME CATALYSIS:**

General Features of enzymes, Classification - IUB system, rationale, overview and specific examples, Characteristics of enzymes, enzyme substrate complex, Concept of active centre, binding sites, Types of Specificity and ES complex formation Effect of different factors on reaction rate, Factors affecting catalytic efficiency - proximity and orientation effects, distortion or strain, acid - base and nucleophilic catalysis, Methods for studying fast reactions, Chemical modification of enzymes, Isoenzymes and multiple forms of enzymes. Examples of Enzymatic Reactions: Lysozyme and Chymotrypsin, Zymogen, Ribozyme.

**UNIT II**

**(8)**

**APPLICATION AND CHARACTERISATION OF ENZYMES**

Commercial application of enzymes in food, pharmaceutical and other industries; Enzymes for analytical and diagnostic applications, Production and Purification of Crude Enzyme extracts from plant, animal and microbial sources-some case studies; methods of characterization of enzyme; development of enzymatic assays.

**UNIT III**

**(12)**

**ENZYME KINETICS:**

Michaelis - Menten Equation - form and derivation, steady state enzyme kinetics, Significance of  $V_{max}$  and  $K_m$ , Bisubstrate reactions, Graphical procedures in enzymology - advantages and disadvantages of alternate plotting, Enzyme inhibition - types of inhibitors - competitive, non-competitive and uncompetitive, their mode of action and experimental determination. Enzyme activity, international units, specific activity, turnover number, end point kinetic assay



## **UNIT IV**

### **ENZYME REGULATION & IMMOBILIZED ENZYMES**

**(10)**

Product inhibition, feedback control, enzyme induction and repression and covalent modification, Allosteric regulation, Relative practical and economic advantage for industrial use, effect of partition on kinetics and performance with particular emphasis on charge and hydrophobicity (pH, temperature and  $K_m$ ) Various methods of immobilization - ionic bonding, adsorption, covalent bonding (based on R groups of amino acids), microencapsulation and gel entrapment. Immobilized multienzyme systems Biosensors - glucose oxidase, cholesterol oxidase, urease and antibodies as biosensors

#### **Reference:-**

1. Fundamentals of Enzymology Price and Stevens
2. Enzymes Dixon and Webb
3. Isoenzymes By D. W. Moss
4. Immobilized Biocatalysts W. Hartneir
5. Enzymes by Trevor palmer

**Rajarshi Shahu Mahavidyalaya, Latur  
(Autonomous)**

**B.Sc. Biotechnology (Semester Pattern)  
IV Semester**

**Course Title: Lab Course XIV  
Marks 50**

**Hours 45**

**Course Code: U-LAC-502**

**Credit: 02**

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**Course Outcome**

- The student will be able to describe structure, functions and the mechanisms of action of enzymes.
- The student will learn kinetics of enzyme catalyzed reactions and enzyme inhibitory and regulatory process.
- The student will be able to perform immobilization of enzymes.
- The student will get exposure of wide applications of enzymes and their future potential

1. Laboratory calculations
2. Effect of substrate concentration on enzyme activity
3. Effect of P<sup>H</sup>, Temperature on enzyme activity
4. Effect of different metal ions on enzyme activity,
5. Study of kinetics of enzyme calculation of K<sub>m</sub> and V<sub>max</sub>
6. Effect of different inhibitors on enzyme activity
7. Immobilization of enzyme in sodium alginate matrix
8. Effect of P<sup>H</sup> and temperature on immobilized enzyme activity
9. Kinetic study of immobilized enzymes
10. Purification and calculation of specific activity and turnover number

**Rajarshi Shahu Mahavidyalaya, Latur**  
**(Autonomous)**  
**B.Sc. Biotechnology (Semester Pattern)**  
**IV Semester**

**Course Title: Process Biotechnology**  
**Marks 50**

**Course Code: U-PRB-499**  
**Hours 45**

**Credit: 02**

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**Learning Objectives**

1. This paper aims to improve the students with various designs of fermenters
2. To study the growth kinetics and process kinetics of fermentation processes.
3. To explain the role of fermenter in Industrial Biotechnology.

**Course Outcome**

- Understanding of bioprocess engineering and its relation to other disciplines
- Ability to list bioprocess engineering processes, units, and the corresponding equipments
- Awareness of career options, potential job functions, contemporary and professional issues. • Familiarity with computer applications in process industries.

**UNIT-I:**

**12L**

**Introduction to Concepts of Bioprocess engineering:**

Definition of Bioprocesses engineering. Introduction to Simple engineering calculations, Mass & Energy Balances. Oxygen uptake rate (OUR), K<sub>L</sub>a, Viscosity & its control. **Design of Fermenters:** Construction, Design & Operation, Materials of Constructions, Welding, Surface treatment Components of the fermenters & their specifications

**UNIT-II:**

**11L**

**Air & Media sterilization:** Air Sterilization Principles, Mechanisms of capture of particles in Air, Depth & Screen Filters, Sizing, Testing & validation of filters for air Sterilization. Principles of Media Sterilization, Decimal reduction, Design of sterilization, Cycle using kinetics of thermal death of microbes Equipments used in sterilization; Constituents of media, Media Optimization their estimation & quantification. Design of media. Costing of media

**UNIT-III:**

**11L**

**Types of Bioprocesses:** Biotransformation (enzyme, whole cell), Batch, Fed-batch, continuous.

**Screening:** Primary and Secondary Screening, Preservation and Maintenance methods for Microbial culture.

**Strain Improvement:** Feed back Mechanism, Isolation of mutants which do not produce feedback inhibitors or repressors. Isolation of mutants which do not recognize presence of inhibitors or repressors. Modification of Permeability.

**UNIT-IV:**

**11L**

**Measurement & Control of Bioprocesses Parameters:** Cell growth. pH, temperature, Substrate consumption, product formation, Measurement of O<sub>2</sub>/CO<sub>2</sub> uptake, evolution. Specific rates of consumption substrate & formation of product. Strategies for fermentation

control. Foam & its control. Computer controlled fermentations. Scale up in Bioprocesses fermentations, Factors used in scale up.

**Text & References:**

1. Principles of Fermentation Technology - Whittaker & Stanbury, Pergamon Press
2. Bioprocess Engineering Principles - Pauline Doran, Academic Press 1995
3. Operational Modes of Bioreactors, BIOTOL series - Butterworth, Heinemann 1992
4. Bioreactor Design & Product Yield, BIOTOL series - Butterworth Heinemann 1992
5. Bioprocess Engineering: Systems, Equipment & Facilities - Ed. B. Lydersen, N.A. Delia & K.M. Nelson, John Wiley & Sons Inc, 1993
6. Bioseparation & Bioprocessing - Ed. G. Subramaniam, Wiley-VCH, 1998
7. Product Recovery in Bioprocess Technology, 'BIOTOL series, Butterworth Heinemann 1992
8. Bioseparation : Downstream Processing for Biotechnology - Paul A. Belter, E.L. Cussler, Wei-Shou Hu, Academic Press
9. Solvent Extraction in Biotechnology - Larl Schuger, Springer Verlag, 1994

**Rajarshi Shahu Mahavidyalaya, Latur  
(Autonomous)**

**B.Sc. Biotechnology (Semester Pattern)  
IV Semester**

**Course Title: Lab Course XV  
Marks 50**

**Course Code: U-LAC-503  
Hours 45**

**Credit: 02**

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**Course Outcomes**

- Understanding of bioprocess engineering and its relation to other disciplines
- Ability to list bioprocess engineering processes, units, and the corresponding equipments .
- Awareness of career options, potential job functions, contemporary and professional issues.
- Familiarity with computer applications in process industries.

1. Isolation and Screening of Industrially important Microbes-Acid, Antibiotics, Enzymes
2. Strain improvement
3. Sterilization Techniques
4. Maintenance of pure Culture
5. Growth Curve
6. Growth kinetics: Effect of pH & Temp
7. Media Formulation
8. Sterilizer Design- TDP, TDT
9. Cell and Enzyme immobilization
10. Visit to Fermentation Industry

**Rajarshi Shahu Mahavidyalaya, Latur**  
**(Autonomous)**  
**B.Sc. Biotechnology (Semester Pattern)**  
**IV Semester**

**Course Title: Fundamentals of Molecular Biology**  
**Marks 50**

**Course Code: U-FMB-500**  
**Hours 45**

**Credit: 02**

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**Learning Objective**

To understand core aspects of molecular biology from basics to advanced.

To know Scope and achieve molecular biology study skills theoretically and practically.

**Course Outcome**

- Understand the synthesis, structure, and function of nucleic acids and proteins in prokaryotes and eukaryotes.
- Understand the principles of inheritance from molecular mechanisms to population consequences.
- Understand the flow of genetic information in populations and the relationship between genetics and evolutionary theory.

**UNIT I: The beginnings of molecular biology      10 L**

1. Introduction

Historical perspective

The structure of DNA-Primary structure: the components of nucleic acids, Secondary structure of DNA, Tertiary structure of DNA

Genome organization: from nucleotides to chromatin

1 .Introduction

2 .Eukaryotic genome

3. Bacterial genome

The versatility of RNA

1. Introduction

2. Secondary structure of RNA

3. Tertiary structure of RNA

Roles -RNA is involved in a wide range of cellular processes

Unique function: The discovery of RNA catalysis and Ribozymes catalyze a variety  
Of chemical reactions

**UNIT II: From gene to protein**

**12**

1.Introduction

2.The central dogma

3.The genetic code

Protein structure, Protein function

Prokaryotic Transcription and Translation

Eukaryotic Transcription and Translation

Post Transcriptional and Post Translational Modifications in Eukaryotes

### **UNIT III: DNA replication and Telomere maintenance**

**08**

1. Introduction
2. DNA polymerases are the enzymes that catalyze DNA synthesis Historical Perspective
3. Semidiscontinuous DNA replication- In prokaryotes and eukaryotes
4. Telomere maintenance: the role of telomerase in DNA replication, aging, and cancer

### **UNIT IV: DNA repair, recombination and gene expression**

**15**

1. Introduction
2. Types of mutations and their phenotypic consequences
3. General classes of DNA damage
4. Repair of single Base excision repair
  - Mismatch repair
  - Nucleotide excision repairDisease - Hereditary nonpolyposis colorectal cancer: a defect in mismatch repair Base changes and structural distortions by removal of DNA damage
5. Double-strand break repair by removal of DNA damage
  - Homologous recombination
  - Nonhomologous end-joiningDisease - *Xerodermapigmentosum* and related disorders: defects in nucleotide excision repair  
Disease - Hereditary breast cancer syndromes: mutations in *BRCA1* and *BRCA2*
6. SOS repair
7. Prokaryotic gene expression and regulation
  - Operon concept-Lac operon, Tryptophan operon, Arabinose operon
8. Eukaryotic gene expression and regulation (in brief)

### **REFERANCES**

1. Text Molecular Biology of the gene “by Watson et.al Pearson
2. Molecular biology by - David Friefelder
3. Molecular biology by weaver
4. Lab Manual in biochemistry, immunology and Biotechnology by Arti Nigam, ArchanaAyyagari Tata mac graw hill publication
5. Concepts of genetics (Sixth Edition), William S. Klug & Michael R, Cummings, Person
6. Genetics, M.W., Strickberger, Prentice Hall College Division.
7. Concepts of Genetics, P.J. Russell, Benjamin/Cummings.
8. Principles of Genetics, E.J. Gardner, John W.H. Sons Inc.

**Rajarshi Shahu Mahavidyalaya, Latur**  
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**B.Sc. Biotechnology (Semester Pattern)**  
**IV Semester**

**Course Title: Lab Course XVI**  
**Marks 50**

**Course Code: U-LAC-504**  
**Hours 45**                      **Credit: 02**

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**Course Outcome**

- Understand the synthesis, structure, and function of nucleic acids and proteins in prokaryotes and eukaryotes.
- Understand the principles of inheritance from molecular mechanisms to population consequences.
- Understand the flow of genetic information in populations and the relationship between genetics and evolutionary theory.

**1. The study of fundamental laboratory techniques in molecular biology, includes**

- a) Essentials of practical work-Basic requirements-Laboratory notebook for recording Practical results, calculators and other requirements for presenting more advanced Practical work.
  - b) Understanding bioethics including ethical principles.
  - c) Understanding health and safety in molecular biology in relation with risk assessment, Basic rules for laboratory work.
  - d) Working with liquids-Measuring and dispensing liquids, Holding and storing liquids,
  - e) Understanding principles of solution chemistry like concentration in molarity, molality, per cent composition (% w/w), Per cent concentration (% w/v and % v/v), Parts per million (ppm) and parts per billion (ppb) concentration, Normality, preparing Dilutions, Preparation of  $P^H$  and buffer solutions.
2. Isolation of DNA from Bacterial cells.
  3. Isolation of DNA from Animal and plant cells.
  4. Quantification of DNA by using Diphenylamine (DPA) method.
  5. To resolve the given DNA sample by using agarose gel electrophoresis.
  6. Spectroscopic determination of nucleic acid purity and concentration.
  7. Isolation of total RNA from yeast cells and plant tissues.
  8. To estimate RNA quantitatively using orcinol reagent.



9. To estimate protein in the plant and animal sources by using Folin-Lowry's method.
10. To carry out ammonium sulphate precipitation of amylase enzyme present in the crude Protein extract.
11. To carry out dialysis for desalting ammonium sulphate precipitated enzyme.
12. To determine the molecular weight of the given protein by SDS-PAGE.
13. To Prepare a survival curve for the given bacterial culture using germicidal ultraviolet Radiation as a mutagen.