Rajarshi Shahu Mahavidyalaya (Autonomous), Latur

Biotechnology

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

(w.e.f. Academic Year 2018-19)

SYLLABUS FOR

B.Sc. II Year (Biotechnology)

Revised in JUNE 2020

Rajarshi Shahu Mahavidyalaya (Autonomous), Latur

Biotechnology

1. Introduction:

Biotechnology is technology based on biology - biotechnology harnesses cellular and biomolecular processes to develop technologies and products that help to improve our lives and health of our planet. Taking into consideration of the importance of Biotechnology Rajarshi Shahu Mahavidyalaya, Latur, have taken an initiative to introduce a new emerging field as a post graduate Programme in biotechnology under the faculty of science. M.Sc. Biotechnology is a Two year post graduate degree program which is started in the academic year 2005-06.

The syllabus was designed according to employability in the field of biotechnology. After designing syllabus, we have taken online feedback on curriculum from the academia and Industry expert. The feedback is analyzed, recommendation is reviewed and necessary changes are made in the syllabus by members of BOS. The board of studies in biotechnology follows the systematic process in design and development of the curriculum. In the design and development of curriculum, the regulation and guidelines of curriculum frame work stipulated by apex bodies such as Parent University and UGC. Faculty members of the department actively participated in syllabus designing, workshop, seminars and conferences. The programme outcome is given in the curriculum display in college website so that students can look for it before taking admission. The learning objectives and course outcome of course are given in the syllabus of respective course and communicated to students on the beginning of course.

2. Title of the Programme: **B.Sc. Biotechnology**

3. Learning Objectives of the Programme:

The main objective is to create biologically and technologically skilled minds for the understanding theoretical and practical knowledge essential for implementation from LAB to LAND further it will useful to find the solutions of various interacting biological phenomenon. It helps effectively to inculcate scientific temper and social attitude to solve various problems in the field of science.

The member of Board of Studies from various organizations of repute has a strong recommendation for Job oriented syllabus is to be included. Accordingly, the necessary changes have been effectively implemented in Curriculum.

4. Programme Specific outcomes/ Programme Outcomes:

At the end of the program the student will be able to

- Students should be able to integrate basic principles of common analytical techniques of protein molecular structures to engage in hands-on practices for implementation of such techniques to facilitate the development of biopharmaceutical manufacturing
- Students should be able to integrate basic principles of protein chemistry and molecular interactions to engage in hands-on practices to facilitate the development and manufacturing of biopharmaceutical formulations suitable for use as human therapeutics
- Students should be able to integrate basic principles of process units operations of recombinant protein production in hands-on practices for implementation of such techniques to facilitate the development of biopharmaceutical manufacturing
- Students should be able to integrate fundamental concepts of leadership, entrepreneurship and innovation, financial decision making and marketing to business enterprises.
- Students should be able to integrate their didactic and practical knowledge of molecular biotechnology, protein expression, and structural biology to the development of new protein drugs.
- Plan, conduct and write-up a programme of original research Practical skills – able to:
- Plan and execute safely a series of experiments;
- Use laboratory methods to generate data;
- Analyze experimental results and determine their strength and validity; • Prepare technical reports;
- Give technical presentations;
- Use the scientific literature effectively;
- Use computational tools and packages. Transferable skills – able to:
- Communicate effectively through oral presentations, computer processing and presentations, and written reports;
- Work independently and as part of a team
- Integrate and evaluate information from a variety of sources;
- Use Information and Communications Technology;

- Manage resources and time;
- Learn independently with open-mindedness and critical enquiry;
- Learn effectively for the purpose of continuing professional development.

5. Local, Regional and Global relevance of Syllabus:

Curriculum developed and implemented have relevance to the local, regional and global developmental needs which is reflected in Programme Specific Outcomes/ Programme Outcomes and Course Outcomes of the Programmes offered by the College.

Global and local focus has slowly shifted to using knowledge of life Science for innovative technology development that is being used for betterment of human life. Many fundamental and advanced research fields come under the umbrella of Biotechnology e.g. Environmental Biotechnology, Plant Biotechnology and Enzymology etc.

6. Duration of the Course:	**Three years**
7. Eligibility of the Course:	**XII science**
8. Strength of the Students:	**160**
9. Fees for Course:	**As per University/College rules.**
10. Admission / Selection procedure:	**Admission by merit through Registration**
11. Teacher's qualifications:	As per UGC/University/College rules
12. Standard of Passing:	As per UGC/University/College rules
13. Nature of question paper with scheme of marking:	As per UGC/University/College rules
14. List of books recommended:	Included in syllabus

15. Laboratory Equipment's, Instruments, and Measurements etc.:

The department of biotechnology has well equipped laboratories with all necessary and advance instrumentation facility.

16. Rules and regulations and ordinance if any:	As per UGC/University/College rules
17. Course duration:	Each theory course is of 50 Contact Lectures
18. Medium of the language:	English

Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)
Department of Biotechnology
Choice Based Credit System
Course Structure of B.Sc. Biotechnology Second Year (w.e.f. June 2018)

B. Sc. II [Biotechnology] Semester III

	Code No.	Title of the course	Lectures/ Week	Marks (50)		Credits
				In Sem	End Sem	
AECC1	U-COE-301	**Communicative English III**	04	**20**	**30**	02
CCT1	U-APM-398	**Applied Microbiology**	04	**20**	**30**	03
CCT2	U-IMV-399	**Immunology and Virology**	04	**20**	**30**	03
CCT3	U-ENV-400	**Environmental Biotechnology**	04	**20**	**30**	03
CCT4	U-MET-401	**Metabolism**	04	**20**	**30**	03
CCP1	U-LAC-402	**Lab Course IX**	03	**20**	**30**	02
CCP2	U-LAC-403	**Lab Course X**	03	**20**	**30**	02
CCP3	U-LAC-404	**Lab Course XI**	03	**20**	**30**	02
CCP4	U-LAC-405	**Lab Course XII**	03	**20**	**30**	02
SEC1	U-ADC-334	**Good Laboratory Practices/ Human Excellence Developement**	01+02			02
		Total Credits				24

B.Sc. II [Biotechnology] Semester IV

	Code No.	Title of the course	Lectures/ Week	Marks (50)		Credits
				In Sem	End Sem	
AECC1	U-COE-401	**Communicative English IV**	04	**20**	**30**	02
CCT1	U-PLB-497	**Plant Biotechnology**	04	**20**	**30**	03
CCT2	U-ENZ-498	**Enzymology**	04	**20**	**30**	03
CCT3	U-PRB-499	**Process Biotechnology**	04	**20**	**30**	03
CCT4	U-FMB-500	**Fundamentals of Molecular Biology**	04	**20**	**30**	03
CCP1	U-LAC-501	**Lab Course XIII**	03	**20**	**30**	02
CCP2	U-LAC-502	**Lab Course XIV**	03	**20**	**30**	02
CCP3	U-LAC-503	**Lab Course XV**	03	**20**	**30**	02
CCP4	U-LAC-504	**Lab Course XVI**	03	**20**	**30**	02
SEC2	U-ADC-434-A U-ADC-434-M	**Algal Cultivation Technology/** **Mushroom Cultivation**	01+02			02
		TOTAL				24

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

Course Title: Communicative English –III **Course Code: U-COE-301**
Marks: 50 **Lectures: 50** **Credit:02**

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.

Course Outcomes:

- Students will be aware of listening and speaking skills and the related sub-skills. They can focus a lot on listening style to be the better speaker of English language
- Students can realize the proper style of English for oral communication and can use words and sentences with proper accent and intonation.
- Students will speak English by using proper sentence structures

Unit-I: **(Lectures12 Practical 07)**

Reading Skill 1

A. Features of Reading

Introduction

The Qualities of a Good Reader

Bad Habits of Reading

Sub skills of reading

Types of Reading

Practical: Two stories with glossary

B. Reading Techniques

Surveying the reading matters and identifying the text type.

Skimming the text for identifying the general theme

Scanning the text to locate specific details

Understanding meaning of words, phrases and sentences

Practical: Two stories with questions

C. Reading Task

Reading samples (***Rainbow*** Page No 223-236)

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: (Lectures12 Practical 07)

Writing Skill 1

A. Features of Writing

Features of Writing

The Writing Process (Spelling and Capital Letters)

Paragraph Writing

(***Rainbow*** Page No 214 - 222)

Two Stories

Bahut Kuch Hota Hai

Honesty Comes from the Heart

(***Rainbow*** Page No 237 - 246)

B. Writing Techniques

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

Basic Cursive Writing

Description

(***Writing Task*** **by** Agrawal)

Situation I	Page No. 240
Situation II	Page No. 241
A Picnic I Enjoyed	Page No. 244
My Favorite Hero in History	Page No. 245
My Best Friend	Page No. 251

Unit-III: **(Lectures12 Practical 06)**

Written Communication

Letter Writing:

e-mail letter

Job Application with C V:

Introduction

What is C V?

Specimen Curriculum Vitae, Resume and Biodata

Guidelines for writing a good C V

(***Radiance page*** No 117-119)

To be assessed through MCQ and short answers

Text & References:

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

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

Course Title: Applied Microbiology **Course Code: U-APM-398**
Marks: 50 **Lectures: 50** **Credit: 03**

Learning Objectives:

- 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.
- To provide the information on new approaches in microorganisms exploitation.
- 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
- 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 students would be more aware about environment friendly and ecofriendly process should be applied in the research.

Unit-I: **(13 L)**

Introduction

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: **(13 L)**

Food Biotechnology

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: **(12 L)**

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 borne diseases and their causative agents from different reservoirs.

Unit-IV: **(12 L)**

Environmental microbiology

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.

Text & References:

1. Soil microbiology A.N. Alexander
2. Microbial ecology IV ed Tata McGra hill. Atlas and partha
3. Food microbiology Adams and Moss
4. Microbiology Pelzar
5. Biology of microorganism. Brock

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

Course Title: Lab Course IX **Course Code: U-LAC-402**
Marks: 50 **Credit: 02**

Learning Objective:

- Students will know the technical knowhow about the soil, water and air microorganism.
- Students will know the microbes which is disease causing and beneficial and their activities for recycling and sustainability

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 laboratory practices 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 (Autonomous), Latur
B.Sc. Biotechnology (Semester Pattern)
III Semester

Course Title: Immunology and Virology **Course Code: U-IMV-399**
Marks: 50 **Lectures: 50** **Credit: 03**

Learning Objectives:

- To make the students understand basic of immunology and Virology.
- To understand the concept of various immunological reactions.
- To make the student understand structural and functional aspects of viruses.

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: **(15 L)**

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: **(12 L)**

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, Ka and Kd with its importance, Affinity and avidity Immunological reactions: Precipitation and Agglutination reactions, ELISA.

Unit-III: **(12 L)**

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: **(11 L)**

Structure & Life Cylcles

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.
3. Roitt's Essential Immunology. Deives, Martin, Burton, Roitt. 11th ed. Blackwell publications.
4. Virology Principles and Applications, John B. CarterandVenetia 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 (Autonomous), Latur
B.Sc. Biotechnology (Semester Pattern)
III Semester

Course Title: Lab Course X **Course Code: U-LAC-403**
Marks: 50 **Credit: 02**

Learning Objectives:

- The student learns about molecular basis of antigen recognition, antigen antibody reactions.
- The course also develops an idea of application of immunological principles.

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.

Practicals:

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 immunodiagnostics.
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.

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

Course Title: Environmental Biotechnology Course Code: U-ENB-400
Marks: 50 Lectures: 50 Credit: 03

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: **(10 L)**

Components of Environment and Global Environmental Problems

Hydrosphere, lithosphere, atmosphere and biosphere

Environmental Studies as a multidisciplinary subject.

Green House Effect,

Acid rain, Ozone depletion,

Biodiversity loss

Unit-II: **(13 L)**

Environmental pollution and Environmental Management

Types of Pollution and Types of Pollutants.

Air Pollution- causes, effects & control Strategies.

Water Pollution- causes, effects & control Strategies.

Habitat Pollution

Environmental diseases – infectious (Water and air borne) and pollution related,

Unit-III: **(15 L)**

Waste water treatment and management

Domestic Waste Water Treatments: Preliminary, Primary, Secondary and Tertiary.

Aerobic Biological Treatments: Activated sludge process, Trickling filter, Rotating Biological Contactor

Anaerobic Biological Treatments: up flow anaerobic sludge blanket (UASB)

Unit-IV: **(12 L)**

Biodegradation and Bioremediation

Biodegradation of Hydrocarbon

Xenobiotics biodegradation

Bioremediation: Introduction, Definition and Concept,

Methods of Bioremediation (In Situ and Ex Situ Methods)

Phytoremediation: Concept and Types

Text & References:

1. Environmental Biotechnology: Theory and Applications, John Wiley and Sons Ltd., England.

EvanG.M.and Furlong J.C (2003)

2. Environment: Problems and Solutions, S.Chandand Company Ltd, New Delhi. Asthana D.K. and Asthana M. (2001)

3. Introduction to Environmental Biotechnology, Prentice Hall of India Pvt.Ltd, New Delhi Chatterji A.K. (2002)

4. Environmental Biotechnology,3rd Edi., Himalaya Publishing House, Mumbai Jogdand S.N. (2006)

5. Environmental Science and Biotechnology: Theroy and Techniques, MJP Publishers, Chennai. Murugesan A. G.andRajakumari C. (2005)

6. Environmental Biotechnology Principles and Applications, McGraw Hill, USA Rittmann B. E. And McCarty P. L. (2001)

7. Waste water engineering and management by Eddy and Metcalf

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

Course Title: Lab Course XI **Course Code: U-LAC-404**
Marks: 50 **Credit: 02**

Learning Objective:

- 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:

- To train the students about environmental parameter analysis like water analysis, soil analysis.
- Understanding of environmental problems and suggests the remedial measures.

Practicals:

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**.**
    i. Determination of Dissolved oxygen (D.O.)
    ii. Determination of carbon dioxide(co_2)
    iii. Determination of Biochemical oxygen demand (BOD).
    iv. Determination of Chemical Oxygen demand (COD)
    v. Determination of Hardness of given water sample.
    vi. Determination of P^H of given water sample
    vii. 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.

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

Course Title: Metabolism **Course Code: U-MET- 401**
Marks: 50 **Lectures: 50** **Credit: 03**

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:

- The relationship between the structure and function of specific biological molecules
- The main principles of metabolic concepts
- Compare and contrast anabolism and catabolism.
- Describe how enzymes control metabolic reactions.
- Explain how metabolic pathways are regulated.
- Explain how the reactions of cellular respiration release chemical energy.
- The function of specific anabolic and catabolic pathways and how these pathways are controlled and interrelated
- How current research has provided us with an understanding of the molecular basis of the control of metabolism

Unit-I: **(13 L)**

Metabolism

Introduction to Metabolism - Catabolism, anabolism, catabolic, anabolic and amphibolic pathways

Respiration**:** aerobic respiration, glycolysis and its regulation, Krebs cycles and its regulation, Anaplerotic reaction, Substrate Level Phosphorylation, oxidative phosphorylation: Electron Transport Chain and its inhibitors, Electrochemical proton gradient, chemiosmotic theory, ATP

synthase, shuttle systems, P/O ratio, pasteur effect, warburg effect, respiratory quotient, Anaerobic Respiration: Alcohol and Lactic acid Fermentation, cori cycle.

Unit-II: **(12 L)**

Photosynthesis

photosynthetic pigments, Absorption and action spectra, Fate of light energy absorbed by Photosynthetic Pigments, concept of photosynthetic unit and pigment system, Stages of Photosynthesis: oxygenic & anoxygenic photosynthesis, Light reaction: Cyclic and Non-Cyclic Photophosphorylation, Dark reaction: carbon reduction and fixation cycle. Starch and sucrose synthesis.

Unit-III: **(13 L)**

Metabolic pathways

Photorespiration C4 cycle, CAM Pathway

Glyoxylate PW. Pentose Phosphate Pathway, Entner-Doudoroff PW

Carbohydrate metabolism – Gluconeogenesis, Glycogen Metabolism.

Lipid Metabolism – Synthesis and storage of triacylglycerols, Biosynthesis of Fatty acid, Elongation of Fatty acid, Unsaturation of fatty acids, Fatty acid oxidation: Mitochondrial β - oxidation, alternative PW of fatty acid oxidation, Ketone bodies.

Unit-IV: **(12 L)**

Metabolism

Amino acid Metabolism: Biodegradation of amino acids – deamination, transamination, decarboxylation, urea cycle including its regulation. Biosynthesis of amino acids, Disorders of amino acid metabolism (phenylketonuria, alkaptonuria, biologically active amines)

Nucleotide Metabolism – Nucleotide synthesis: De-Novo and Salvage PW, Nucleotide degradation.

Text & References:

1. Biochemistry, 4th Edition, W.H. Freeman and Company, Lubert Stryer, 1995 Garrett & Grisham, Biochemistry, Saunders Publishing,
2. Biochemistry by Donald Voet, Judith G. Voet, Publisher: John Wiley & Sons (2011), Fourth Edition, ISBN-10: 0071737073, ISBN-13: 978-0071737074.
3. Fundamentals of Biochemistry by J. L. Jain, Sunjay Jain, Nithin· Jain (2008), Publishers: S. Chand & Co Ltd ISBN: 81-219-2453-7.
4. Lehninger, Principles of Biochemistry by Nelson, D. L., Lehninger, · A. L., & Cox, M. M. (2008), 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company, New York, p: 677-878.
5. A Text Book of Biochemistry by E.S. West, W.R. Todd, H.S. Mason and J.T. van Bruggen, Oxford and IBH Publishing Co., New Delhi, 1974.
6. Harper's Biochemistry by Robert K. Murray, Daryl K. Granner, Peter· A. Mayes and Victor W. Rodwell, Publisher: Appleton & Lange; 25th Revised edition (1 July 1999), ISBN-10: 0838536840, ISBN-13: 978-0838536841.
7. Biochemistry Seventh Edition by Jeremy M. Berg, John L. Tymoczko· and Lubert Stryer, 74 Publisher: W. H. Freeman; Seventh Edition edition (December 24, 2010)
8. Biochemistry J. Zubay.

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

Course Title: Lab Course XII **Course Code: U-LAC- 405**
Marks: 50 **Credit: 02**

Learning Objectives:

- It helps the students in appreciating the integrated approach of interrelated pathways of catabolism and anabolism.
- To understand the basic metabolic reactions

Course Outcomes

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

Practicals:

1. Hydrolysis of Sucrose and Starch
2. Qualitative Test for Amino Acids
3. Qualitative Test for Proteins
4. To Perform Fatty acid Titration
5. Estimation of Ketone Bodies
6. Determination of Urinary Titrable acidity
7. Estimation of Urinary Creatinine
8. Estimation of Enzyme activity of Acid Phosphatase
9. Estimation of Enzyme activity of β-amylase
10. Estimation of Total Serum Cholesterol by Zak and Henley's method
11. Determination of Serum Bilirubin by Van de Bergh reaction
12. Solution of Problems in Biochemistry and Metabolism

Rajarshi Shahu Mahavidyalaya (Autonomous), Latur
B.Sc. Biotechnology (Semester Pattern)
III Semester
Skill Enhancement Course
Course Title: Good Laboratory Practices Course Code: U-ADC-334
Marks: 50 Lectures: 30 Credit: 02

Learning Objectives:

- Prepare students for practical study in life science laboratories.
- Students able to handle safely every laboratory facility and know troubleshoot measures
- During laboratory processes.
- Student able to keep, analyse laboratory data with accuracy.
- Objective in minimization of Errors related with handling of laboratory material and work
- becomes more accurate and precise.

Course outcomes:

- Students will be able to safely practice basic laboratory procedures and protocols in future lab situations.
- Maintain laboratory records compliant with current industry standards.

Unit-I: **(08 L)**

Introduction

Introduction to GLP, History, Scope, Fundamental points of GLP (Resources Characterization, Rules, Results, Quality assurance)

Practicals

Standard Operating Procedures

Unit-II: **(07 L)**

Lab Safety measures

General Rules/Protocols for Lab Safety measures, Precaution and Safety in handling of chemicals, Laboratory tools, Glasswares and instruments. Internal and External Audit,

Practicals

Preparation of Standard Solution and Buffers

Demo and Maintenance of Internal and External Audit

Unit-III: (08 L)

Basic SOPs

Levels of Laboratories, Log Book Maintenance, Basic SOPs for instrument handling and Maintenance

Practicals

Calibration of Instruments**:** PH meter, colorimeter, spectrophotometer, water bath, Distillation assembly, Burette, Pipette etc.

Unit-IV: (07 L)

Data records

Keeping data records, its analysis by using statistical and mathematical tools.

Result analysis and its interpretation.

Practicals

Use of Microsoft word, Excel. (For Data entry, calculation and graphical representation)

Use of internet and emails

Text & References:

1. Handbook Good Laboratory Practices-World health organization (WHO)

2. Life science protocol manual (2018)-DBT star college scheme

3. Guidelines for good laboratory practices-Indian council of medical research, New Delhi (2008)

Rajarshi Shahu Mahavidyalaya (Autonomous), Latur
B.Sc. Biotechnology (Semester Pattern)
III Semester
Skill Enhancement Course
Course Title: HED- Human Excellence Development
Course Code: U-ADC-334
Marks: 50 **Credit: 02**

Objective:

- To enhance student's potential for achievement
- To develop creativity
- To develop interpersonal relationship
- 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
- Students will be able to acquire life coping skills

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 (Autonomous), Latur
B.Sc. Biotechnology (Semester Pattern)
IV Semester

Course Title: Communicative English -IV **Course Code: U-COE-401**
Marks: 50 **Lectures: 50** **Credit: 02**

Course Outcomes:

- Students will be aware of listening and speaking skills and the related sub-skills.
- They can focus a lot on listening style to be the better speaker of English language
- Students can realize the proper style of English for oral communication and can use words and sentences with proper accent and intonation.
- Students will speak English by using proper sentence structures

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: **(Lectures12 Practical 07)**

Reading Skill 2

Applied Reading Skills:

Silent Reading

Loud Reading

Skimming

Scanning

Check your reading-speed

Increasing the Eye Span

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

Applied Reading Comprehension:

Summary Writing

Notemaking:

Arts Stream	Geographical Journals
Commerce Stream	Business Journals
Science Stream	Scientific Journals

Preparing summary notes from given texts

Preparing notes on given texts in graphic forms, charts, flow-charts, tables, tree diagrams, bubble maps etc.

Unit-II: **(Lectures12 Practical 07)**

Applied Writing Skills

Essay Writing

Newspaper Report Writing

Unit-III: **(Lectures12 Practical 06)**

Written Communication

Writing Review

Book Review

Film/ Serial Review

Preparing Questionnaire

Survey

Interview

Project

Anchoring, Welcoming, Introducing the guest

To be assessed through MCQ and short answers

Text & References:

1. English for Practical Purposes. Chennai: Macmillan Patil Z N. 2003.

2. Macmillan Foundation English. Chennai: Macmillan Dwivedi R K & Kumar A, 2002.

3. Radiance Communication Skills Prose and Poetry. Mumbai Orient Blackswan EdtJadhav B S. 2009

4. Corridors to Communication. Bomby.Orient Longman VanikarRanu. 1995.

5. Developing Communication Skills. New Delhi. Macmillan Krishna Mohan &Meera Banerji. 2006

6. Enriching Your Competence in English Bomby. Chennai. Orient Longman Thorat A R, 2000.

7. Strengthen your Writing. Madras. Orient Longman Narayanswami V R. 1993.

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

Course Title: Plant Biotechnology **Course Code: U-PLB-497**
Marks: 50 **Lectures: 50** **Credit: 03**

Learning Objectives:

- To know the basic infrastructural facilities to establish the plant tissue culture labs.
- To educate about the basic technique related with aseptic manipulation and in vitro propagation.
- To know and aware about the technique which is very potential and establish the commercial propagation of cash and ornamental crops.
- 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 students 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: **(12 L)**

Introduction

Traditional agriculture: Domestication of plant and centers of origin. Introduction to Plant breeding and Breeding methods: Advantages and disadvantages, green revolution: aims and objectives, current achievement, applications and organizations involved. Need of emergence of new techniques.

New Breeding Technology – Biotechnological Approaches

Unit-II: **(11 L)**

Plant Tissue Culture

Introduction to Plant Tissue Culture:Introductory History – Concepts of Cell theory & Cellular Totipotency. Milestones in plant tissue culture, scientist and their concepts Infrastructure & Organization of plant tissue culture laboratory: Design, laboratory structure – General & aseptic laboratory, different work areas, equipment's & instruments required.

Unit-III **(12 L)**

Laboratory Techniques

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 **(15 L)**

Invitro Techniques

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.

Text & References:

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 (Autonomous), Latur
B.Sc. Biotechnology (Semester Pattern)
IV Semester

Course Title: Lab Course XIII **Course Code: U-LAC-501**
Marks: 50 **Credit: 02**

Learning Objectives:

- To know the basic infrastructural facilities to establish the plant tissue culture labs.
- To educate about the basic technique related with aseptic manipulation and in vitro propagation.
- To know and aware about the technique which is very potential and establish the commercial propagation of cash and ornamental crops.
- 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 students 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 (Autonomous), Latur
B.Sc. Biotechnology (Semester Pattern)
IV Semester

Course Title: Enzymology **Course Code: U-ENZ- 498**
Marks: 50 **Lectures: 50** **Credit: 03**

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.
- To 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 L)**

Enzymes & Enzyme Catalysis:

General Features of enzymes, Classification: IUB system, rationale, overview and specific examples, Characteristics of enzymes, enzyme substrate complex, Concept of active center, 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: **(10 L)**

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: **(13 L)**

Enzyme Kinetics:

Michaelis - Menten Equation - form and derivation, steady state enzyme kinetics, Significance of Vmax and Km, 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: **(12 L)**

Enzyme Regulation & Immobilized Enzymes

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 Km) 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.

Text & References:

1. Fundamentals of Enzymology: Price and Stevens
2. Enzymes: Dixon and Webb Lehninger, Principles of Biochemistry by Nelson, D. L., Lehninger, · A. L., & Cox, M. M. (2008), 5thEdition, ISBN: 978-0-230-22699-9, Publisher: W. H. Freeman and Company, New York, p: 677-878.
3. Isoenzymes: D. W. Moss
4. Immobilized Biocatalysts: W. Hartneir
5. Enzymes: Trevor palmer

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

Course Title: Lab Course XIV **Course Code: U-LAC- 502**
Marks: 50 **Credit: 02**

Learning Objective

- It helps students to learn the significant features of the biochemical catalyst.
- It also helps the students to learn the methodology involved in assessing the enzyme activity and Mechanism of enzyme action.

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

Practicals:

1. To Study Effect of amylase activity on Starch
2. Determination of α-amylase activity
3. Effect of substrate concentration on enzyme activity
4. Effect of Salt concentration on enzyme activity
5. Effect of P^H, Temperature, Time on enzyme activity
6. Effect of different metal ions on enzyme activity,
7. Immobilization of enzyme in sodium alginate matrix
8. Hydrolysis of sucrose by β-fructofuranoside
9. Determination of Hydrolyzed sucrose solution by Benedict's method
10. Indirect estimation of lactate dehydrogenase
11. Purification of enzyme
12. Problems based on MM equation and Lineweaver burk plot

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

Course Title: Process Biotechnology Course Code: U-PRB- 499
Marks: 50 Lectures: 50 Credit: 03

Learning Objectives:

- This paper aims to improve the students with various designs of fermenters
- To study the growth kinetics and process kinetics of fermentation processes.
- 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 equipment
- Awareness of career options, potential job functions, contemporary and professional issues.
- Familiarity with computer applications in process industries.

Unit-I: (12 L)

Introduction to Concepts of Bioprocess engineering:

Definition of Bioprocesses engineering. Introduction to Simple engineering calculations, Mass & Energy Balances. Oxygen uptake rate (OUR), KLa, Viscosity & its control.

Design of Fermenters: Construction, Design & Operation, Materials of Constructions, Welding, Surface treatment Components of the fermenters & their specifications

Unit-II: (13 L)

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: **(13 L)**

Bioprocess Techniques

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: Feedback 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: **(12 L)**

Measurement & Control of Bioprocesses Parameters

Cell growth. pH, temperature, Substrate consumption, product formation, Measurement of O2/CO2 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 & Stan bury, Pergamon Press
2. Bioprocess Engineering Principles - Pauline Doran, Academic Press 1995
3. Operational Modes of Bioreactors, BIOTOL series - Butter worth, Heinemann 1992
4. Bioreactor Design & Product Yield, BIOTOL series - Butter worth 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, Butter worth Heinemann 1992
8. Bioseparation : Downstraem Processing for Biotechnology - Paul A. Belter, E.L Cussler, Wei-Shou Hu, Academic Press
9. Solvent Extraction in Biotechnology - Larl Schuger, Spinger Verlag,1994

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

Course Title: Lab Course XV **Course Code: U-LAC- 503**
Marks: 50 **Credit: 02**

Learning Objectives:

- To study the growth kinetics and process kinetics of fermentation processes.
- The course aims to provide fundamental insights to exploit microbes for manufacturing of products which have huge industrial significance.

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.

Practicals:

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 (Autonomous), Latur
B.Sc. Biotechnology (Semester Pattern)
IV Semester

Course Title: Fundamentals of Molecular Biology

Course Code: U-FMB-500

Marks: 50 **Lectures: 50** **Credit: 03**

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: **(12 L)**

The beginnings of molecular biology

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

Introduction: Eukaryotic genome, bacterial genome

DNA replication and Telomere maintenance

Introduction DNA polymerases and other enzymes that catalyze DNA synthesis, DNA replication- In prokaryotes and brief introduction to eukaryotes, telomere maintenance: the role of telomerase in DNA replication, aging, and cancer

Unit-II: **(13 L)**

From gene to protein

Introduction The central dogma, The genetic code

The versatility of RNA: Introduction, Secondary structure of RNA, 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-III: (10 L)

Prokaryotic Transcription

Brief introduction to Eukaryotic Transcription, Post Transcriptional Modifications in Eukaryotes

Translation

Protein structure, Protein function

Prokaryotic Translation: Brief introduction to Eukaryotic Translation, Post Translational Modifications in Eukaryotes

Unit-IV: (15 L)

Introduction to mutation

Types of mutations and their phenotypic consequences, General classes of DNA damage, Repair of single Base excision repair, Mismatch repair: Nucleotide excision repair

Disease: Hereditary nonpolyposis colorectal cancer: a defect in mismatch repair Base changes and structural distortions by removal of DNA damage, Double-strand break repair by removal of DNA damage: Homologous recombination, Nonhomologous end-joining, Disease: *Xeroderma pigmentosum* and related disorders: defects in nucleotide excision repair

Disease: Hereditary breast cancer syndromes: mutations in *BRCA1* and *BRCA2,* SOS repair

Prokaryotic gene expression and regulation, Operon concept-Lac operon, Tryptophan operon, Arabinose operon, Eukaryotic gene expression and regulation (in brief)

Text & References:

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, Archana Ayyagari 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 (Autonomous), Latur
B.Sc. Biotechnology (Semester Pattern)
IV Semester

Course Title: Lab Course XVI **Course Code: U-LAC-504**
Marks: 50 **Credit: 02**

Learning Objectives:

- It majorly emphasizes the concepts of central dogma of molecular biology spanning from DNA Replication till Protein Synthesis and Reverse Transcriptase.
- To make the students understand the methods of qualitative and quantitative estimations of nucleic acids.

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.

Practicals:

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.

Rajarshi Shahu Mahavidyalaya (Autonomous), Latur
B.Sc. Biotechnology (Semester Pattern)
IV Semester
Skill Enhancement Course

Course Title: Algal Cultivation Technology

Course Code: U-ADC-434-A
Marks: 50 **Credit: 02**

Learning objective:

- To make the students learn collection, maintenance and preservation of algal culture.
- This course would be beneficial for the study of basic and applied area concerning with this micro-creature.

Course outcome:

- Students would be more learned and would develop skills and would enhance the attitude about the study of existing biodiversity and its utility to present demand areas.
- To understand business economics for algal cultivation.

Unit-I: **(10 L)**

Theory:

Introduction to Algae, Life cycle of Algae, Role Algae in Ecosystem.

Practical:

1. Collection & Microscopic observation of algae.
2. Quantification of collected algae.

Unit-II: **(08 L)**

Theory:

Techniques for cultivation of Algae in laboratory, seed culture & its maintenance. Designing of photobioreactor and Raceway Ponds for algal cultivation & its application.

Practical:

1.Isolation, Identification of economic important algae.

2.Inoculam development pilot scale production.

Unit-III: **(07 L)**

Theory:

Algal Biotechnology – potential of microalgae for SCP, carotene, Biofertilizer, Biodiesel; Principles of mass cultivation of microalgae and its Economic Importance.

Practical:

1. Qualitative estimation of protein from algae.

2.Chromatographic separation of essential biomolecules from algae.

Unit-IV: **(05 L)**

Theory

Business economics for algal cultivation, production and processing and Futuristic approaches in algal biotechnology.

Practical

1.Visit to industry actively engaged in algal technology.

2.Project report on algal technology.

3. Study of Spirulina production and its products.

Rajarshi Shahu Mahavidyalaya (Autonomous), Latur
B.Sc. Biotechnology (Semester Pattern)
IV Semester
Skill Enhancement Course

Course Title: Mushroom Cultivation **Course Code: U-ADC-434-A**
Marks: 50 **Credit: 02**

Learning Objectives:

- This Course will provide an adequate hand on experience for the students towards an independent handling and Culture capability of edible mushrooms.
- This course-built students as a trainer for farmer or entrepreneur in the area of mushroom cultivation.

Course outcome:

- Student would be more learned about the crop management, its method of isolation to identification, screening of concerned products.
- Students would be more learned and would develop skills and would enhance the attitude about the study of existing biodiversity and its utility to present demand areas.

Unit-I: **(10 L)**

Cultivation System & Farm design:

Fundamentals of cultivation system- small village unit & larger commercial unit. Principles of mushroom farm layout-location of building plot, design of farm, bulk chamber, composting platform, equipments & facilities, Pasteurization room & growing rooms.

Practical: Practical approaches in composting of biomass

Unit-II: **(08 L)**

Compost & Composting:

Principles of composting, machinery required for compost making, materials for compost preparation. Methods of Composting-Long method of composting (LMC) & Short method of composting (SMC).

Practicals:

1. Equipment and sterilization techniques for culture media
2. Preparation of culture, mother spawn production, multiplication of spawn,

Unit-III: **(07 L)**

Spawn & Spawning:

Facilities required for spawn preparation, Preparation of spawn substrate, preparation of pure culture, media used in raising pure culture, culture maintenance, and storage of spawn.

Practicals:

1. Cultivation techniques, harvesting, packing and storage;
2. Problems in cultivation --- diseases, pests and nematodes, weed moulds and their management strategies.

Unit-IV: **(05 L)**

Casting materials & Case running:

Importance of casing mixture, Quality parameters of casing soil, different types of casing mixtures, commonly used materials.

Cultivation of Button, Oyster and Straw Mushrooms:

Collection of raw materials, compost & composting, spawn & spawning, casing & case run, cropping & crop management, picking & packing. Visit to relevant Labs/Field Visits

Practicals:

Maintenance of mushroom beds of oyster mushroom, and *Agaricus.* Processing and preservation of mushrooms, economics of spawn and mushroom production.

Text & References:

1. Mushroom Cultivation, Tripathi, D.P. (2005) Oxford & IBH Publishing Co. PVT.LTD, New Delhi.
2. Mushroom Production and Processing Technology, Pathak Yadav Gour (2010) Published by Agrobios (India).
3 A hand book of edible mushroom, S.Kannaiyan& K.Ramasamy (1980). Today & Tomorrow's printers &
Publishers, New Delhi
4. Handbook on Mushrooms, Nita Bahl, oxford & IBH Publishing Co

Summary of cross cutting issues:

Biotechnology is a collective term for a group of technologies that use biological matter or processes to generate new and useful products and processes. As such, it ranges in complexity and maturity from ancient brewing and bread-making techniques to genetic modification through hybridization and interbreeding of plants and animals, as well as the manipulation of individual genes in humans, animals, plants and micro-organisms. Biotechnology is a key technology for the new millennium. It has an immense range of applications in agriculture, medicine, food processing, environmental protection, mining, and even nanoelectronics

It is expected to cover some critical issues in the designed curriculum for the development of Students. In our syllabus we tried to include following cross cutting issues.

Sr. No.	Cross Cutting Issues	Related course
1.	**Gender Sensitization**	_
2.	**Environment & Sustainability**	Environmental Biotechnology Plant Biotechnology
3.	**Human Values**	Human Excellence Development
4.	**Professional Ethics**	Communicative English

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