Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Biotechnology

Curriculum

For the Academic Year 2018-19

Under CBCS

Three Year Degree Programme in Biotechnology

(Six Semester Programme)

UG Second Year

Semester III and IV

Syllabus Approved by Board of Studies in Biotechnology

With effect from June, 2018

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
Department of Biotechnology
Course Structure of B. Sc. Biotechnology Second Year

B. Sc. II (Biotechnology)Semester III

Code No.	Title of the course	Hours/ Week	Marks (50)		Credits
			In Sem	End Sem	
U-COE-301	Communicative English III	04	**20**	**30**	02
U-APM-398	Applied Microbiology	04	**20**	**30**	03
U-IMV-399	Immunology and Virology	04	**20**	**30**	03
U-ENV-400	Environmental Biotechnology	04	**20**	**30**	03
U-MET-401	Metabolism	04	**20**	**30**	03
U-LAC-402	Lab Course IX (Pract. l Based on U-APM-)	03	**20**	**30**	02
U-LAC-403	Lab Course X (Pract.l Based on U-IMV-)	03	**20**	**30**	02
U-LAC-404	Lab Course XI (Pract.l Based on U-ENV-)	03	**20**	**30**	02
U-LAC-405	Lab Course XII (Pract Based on U-MET-)	03	**20**	**30**	02
U-ADC-334	Good Laboratory Practices/ Human Excellence Development	01+02			02
	Total Credits				24

B. Sc. II (Biotechnology) Semester IV

Code No.	Title of the course	Hours / Week	Marks (50)		Credits
			In Sem	End Sem	
U-COE-401	Communicative English IV	04	**20**	**30**	02
U-PLB-497	Plant Biotechnology	04	**20**	**30**	03
U-ENZ-498	Enzymology	04	**20**	**30**	03
U-PRB-499	Process Biotechnology	04	**20**	**30**	03
U-FMB-500	Fundamentals of Molecular Biology	04	**20**	**30**	03
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-ADC-434-A	Algal Cultivation Technology/ Mushroom Cultivation	01+02			02
	TOTAL				24

Rajarshi Shahu Mahavidyalaya, Latur
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B.Sc. Biotechnology
III Semester

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

Learning Objectives:

- To enhance learner's communication skills by giving adequate exposure (use of language lab) in listening and speaking skills and the related sub-skills.
- To create learner's confidence in oral and interpersonal communication by reinforcing the basic of pronunciation.
- To help learners to recognize and make use of sentence structures in English.
- To enable the student, speak with Fluency.

Course Outcomes:

On the successful completion of the course, student will be able to-

- 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.
- student become able to speak fluently.

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 lesson learnt in a CD and submit it to the Department as per the instruction 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
   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 (Lectures12 Practical 06)

I. Letter Writing
e-mail letter

II. Job Application with C V

a. Introduction
b. What is CV?
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

Recommended Reading

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.Enrichinhg Your Competence in English Bombay. Chennai. Orient Longman
7. Narayanswami V R. 1993.Strenghen Your Writing. Madras. Orient Longman

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B.Sc. Biotechnology
III Semester

Course Title: Applied Microbiology **Course Code: U-APM- 398**
Marks: 50 **Lectures: 45** **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 microorganism's 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:

On the successful completion of the course, student will be able to-

- acquaint the knowledge in the different areas of microbiology
- understand the significance of microorganism in biogeochemical cycling of nutrients,
- apply the knowledge of soil microbiology and significant biochemical processes of microbes to improve the agricultural practices.
- define the science of microbiology, its development and importance for human welfare.

Unit I: **(12L)**

Soil, Water and Air microbiology

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 andcontrols.

Unit II: **(10L)**

Food Microbiology and Preservation

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: **(13L)**

Introduction to Medical Microbiology

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: **(10L)**

Environmental and Agriculture 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.

Recommended Textbooks and References:

1. Soil Microbiology (1977) 2nd ed., Martin Alexander, John Wiley and Sons Ltd.
2. Food Microbiology (1995) 4 th ed.-Martin R. Adams, Moris O Moss., Peter MacClure Royal society of Chemistry.
3. Microbiology (1998). Pelczar Tata McGraw-Hill
4. Brock Biology of Microorganisms (2021).15 th ed. Michael T. Madigan., John M Martinko., Kelly S. Bendar. David A. Stahl Pearson Publications.

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B.Sc. Biotechnology
III Semester

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

Learning Objectives

- To provide Hands-on Isolation of soil, water and air microbes by different methods
- To Provide Hands-on Isolation and Characterization of microbes used as organic fertilizers.
- To provide Hands-on Qualitative and quantitative analysis of Soil and water samples
- To provide solutions for Environment and Agriculture sustainability.

Course Outcomes

On the successful completion of the course, student will be able to-

- isolate the microbes from different reservoir
- check the notability of water samples.
- isolate nitrogen fixing and phosphate solubilizing organisms.
- perform and analyze the normal flora on skin, hair and throats etc.

Practicals:

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

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B.Sc. Biotechnology
III Semester

Course Title: Immunology and Virology **Course Code: U-IMV-399**
Marks: 50 **Lectures: 45** **Credit: 03**

Learning Objectives:

- The student will be made to understand basic concepts of Immunology and its historical background.
- To make the students understand the basic principles of Antigen-Antibody interactions and its applications in diagnosis.
- To make the students understand the basic concepts of virus structure, Nomenclature and its Classification.
- To make the students understand the life cycle of viruses and use of different antiviral drugs.

Course Outcomes:

On the successful completion of the course, student will be able to:

- understand the role of immune system in defense and the different mechanisms involved in it.
- acquaint the knowledge about antigen, antibody structure, interaction and their use in disease diagnosis.
- gain knowledge about the virus structure, its nomenclature and classification systems.
- understand the life cycle of viruses and study the different anti-viral agents and their mechanism.

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, Ka and Kd 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)**

Life cycle of Viruses

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

Recommended Textbooks and References:

1. Kuby Immunology (2000)4th Ed., Thomas J. Kindt Richard A. Goldsby,Barbara A. Osborne(W.H.Freeman & Company)
2. Kuby Immunology (2000)6th Ed., Thomas J. Kindt Richard A. Goldsby,Barbara A. Osborne(W.H.Freeman & Company)
3. Roitt's Essential Immunology (2017) 11th ed. Deives, Martin, Burton, Roitt. 11th ed. (Wiley Blackwell publications)
4. Virology Principles and Applications (2013) John B. Carter and Venetia A. Saunders, (John Wiley & Sons Ltd)
5. An introduction to viruses (1992) Amita Biswas (Vikas Publishing House)
6. Textbook of Microbiology (2017) 10th Ed.,R. Anantnarayan and J. Panikar (Universities Press Private Limited)

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B.Sc. Biotechnology
III Semester

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

Learning Objectives:

- To study tools and technical skills in the field of Immunology and Virology.
- To provide hands on approach for different immunodiagnostic techniques.
- To provide hands on approach on different basic techniques of virus isolation.
- To study antigen antibody interactions.

Course Outcome:

On the successful completion of the course, student will be able to-

- perform different immunodiagnostic techniques.
- handle instruments used in immunology.
- perform various methods of virus isolation.
- perform phage titration.

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.

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Course Title: Environmental Biotechnology **Course Code: U-ENB-400**
Marks 50 **Lectures: 45** **Credit: 03**

Learning Objectives:

- To impart the understanding of global environmental problems.
- To get deeper understanding of environment pollutions.
- To understand waste water treatment technology.
- To acquaint bioremediation techniques.

Course Outcomes

On the successful completion of the course, student will be able to-

- describe various components of environment.
- explain types of pollution and associated pollutants.
- describe waste water treatment process.
- discuss bioremediation technology and its global perspective.

Unit I: **(10L)**

Components of Environment and Global Environmental Problems

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 Effect, Ozone depletion, Biodiversity loss; chemical and radiation hazards.

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

Environmental pollution and Environmental Management

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 **(13L)**

Waste water treatment and management

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: up flow anaerobic sludge blanket (UASB) reactor, Fluidized bed reactor

Unit: IV **(10L)**

Biodegradation and Bioremediation

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.

Recommended Textbooks and References:

1. Environmental Biotechnology: Theory and Applications (2003), Evan G. M. and Furlong J.C, John Wiley and Sons Ltd., England.
2. Environment: Problems and Solutions (2001), Asthana D.K. and Asthana M., S. Chand and Company Ltd, New Delhi.
3. Introduction to Environmental Biotechnology (2004) Chatterji A.K. Prentice Hall of India Pvt. Ltd, New Delhi.
4. Environmental Biotechnology (2006),3rd Edi. Jogdand S.N., Himalaya Publishing House, Mumbai.
5. Environmental Science and Biotechnology: Theory and Techniques (2005). Murugesan A. G. and Rajkumari., C, MJP Publishers, Chennai.
6. Environmental Biotechnology Principles and Applications. (2001) Rittmann B. E. And McCarty P. L, McGraw Hill, USA
7. Waste water engineering and management (1972) Eddy and Metcalf Tata Mac Graw-Hill.

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III Semester

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

Learning Objectives

- To provide hands-on experience on water analysis.
- To provide practical experience on determination of presence of harmful microbes in environment.
- To identify hazardous pollutants and effect on human.

Course Outcomes

On the successful completion of the course, student will be able to-

- study effect of pollutants on environment.
- perform determination of DO, COD & BOD
- perform experiments for isolation of microbes from polluted water, soil & air
- analyze physico-chemical properties of water.

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 PH 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.

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III Semester

Course Title: Metabolism **Course Code: U-MET-401**
Marks: 50 **Lectures: 45** **Credit:03**

Learning Objectives

- To explain the role of catabolic and anabolic pathways in cellular metabolism.
- To understand the role of Biomolecules in providing the energy to the living system by its oxidation
- To distinguish between exergonic and endergonic reactions in terms of available energy change.
- To impart knowledge of structural and functional aspects of biomolecules in living systems

Course Outcomes

On the successful completion of the course, student will be able to-

- understand the relationship between the structure and function of specific biological molecules.
- compare and contrast anabolism and catabolism.
- understand the function of specific anabolic and catabolic pathways and how these pathways are controlled and interrelated.
- describe how current research has provided us with an understanding of the molecular basis of the control of metabolism.

Unit I **(11L)**

Respiration

Respiration, aerobic respiration – glycolysis and its regulation, Krebs cycles and its regulation, Substrate Level Phosphorylation, oxidative phosphorylation: ETC and its inhibitors, Electrochemical proton gradient, chemiosmotic theory, ATP synthase, P/O ratio, Pasteur effect, Warburg effect, respiratory quotient, Alcohol and Lactic acid Fermentation, Cori cycle.

Unit II **(11L)**

Photosynthesis

Photosynthesis: photosynthetic pigments, concept of photosynthetic unit, Hill reaction, oxygenic & anoxygenic photosynthesis, Light reaction: Cyclic and Non-Cyclic Photophosphorylation, Dark reaction: C_3, C_4, CAM, Photorespiration, Photophosphorylation.

Unit III **(12L)**

Carbohydrate and Lipid Metabolism

Glyoxylate PW. Pentose Phosphate Pathway, Entner-Doudoroff PW

Carbohydrate metabolism – Gluconeogenesis, Glycogenesis, Glycogenolysis.

Lipid Metabolism – Biosynthesis of FA, Fatty acid oxidation, alternative PW of fatty acid oxidation, Ketone bodies.

Unit IV **(11L)**

Amino acid and Nucleotide Metabolism

Amino acid Metabolism: Amino acid synthesis, Amino acid catabolism, urea cycle.

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

Recommended Textbooks and References:

1. Biochemistry by Donald Voet, Judith G. Voet, Publisher: John Wiley & Sons (2011), Fourth Edition
2. Fundamentals of Biochemistry by J. L. Jain, Nithin: Jain (2008), Publishers: S. Chand & Co Ltd
3. Lehninger, Principles of Biochemistry by Nelson, D. L., Lehninger; A. L. & Cox, M. M. (2008), 5th Edition, Publisher: W. H. Freeman and Company, New York,
4. 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.
5. 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),
6. Biochemistry Seventh Edition by Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, 74 Publisher: W. H. Freeman; Seventh Edition edition (December 24, 2010)
7. Biochemistry - J. Zubay

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III Semester

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

Learning Objectives

- To provide Hands-on Enzyme Assay
- To Provide Hands-on Quantitative analysis of biomolecules
- To provide Hands-on Qualitative analysis of biomolecules
- To provide solutions of Problems in Biochemistry and Metabolism

Course Outcomes

On the successful completion of the course, student will be able to-

- quantify different metabolites.
- perform enzyme assays
- perform quantitative and qualitative analysis of molecules
- solve problems in biochemistry and metabolism

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
13. Hills reaction
14. Assay of nitrogenase by acetylene reduction

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III Semester

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

Learning Objectives

- To provide Hands-on Enzyme Assay
- To Provide Hands-on Quantitative analysis of biomolecules
- To provide Hands-on Qualitative analysis of biomolecules
- To provide solutions of Problems in Biochemistry and Metabolism

Course Outcomes

On the successful completion of the course, student will be able to-

- quantify different metabolites.
- perform enzyme assays
- perform quantitative and qualitative analysis of molecules
- solve problems in biochemistry and metabolism

Practicals:

15. Hydrolysis of Sucrose and Starch
16. Qualitative Test for Amino Acids
17. Qualitative Test for Proteins
18. To Perform Fatty Acid Titration
19. Estimation of Ketone Bodies
20. Determination of Urinary Titrable acidity
21. Estimation of Urinary Creatinine
22. Estimation of Enzyme activity of Acid Phosphatase
23. Estimation of Enzyme activity of β-amylase
24. Estimation of Total Serum Cholesterol by Zak and Henley's method
25. Determination of Serum Bilirubin by Van de Bergh reaction
26. Solution of Problems in Biochemistry and Metabolism
27. Hills reaction
28. Assay of nitrogenase by acetylene reduction

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III Semester
Skill Enhancement Course

Course Title: Good Laboratory Practices **Course Code: U-ADC-334**

Marks: 50M **Hours: 30** **Credit: 02**

Learning Objectives:

- To teach the students safety handling and regulation laboratory facility.
- To learn how to record, keep and analyze laboratory data with accuracy.
- To practice minimization of Errors related with handling of laboratory accessories and equipment's.
- To learn Standard Operating Procedures (SOPs) Laboratory equipment's.

Course outcomes

On the successful completion of the course, student will be able to-

- understand the basic calibration and handling of instrumentation in laboratory.
- safely practice, basic laboratory procedures and protocols in on job laboratory situations.
- maintain laboratory records, complaints with current industry standards.
- maintain audit record

Unit I: **(8L)**

Introduction to GLP

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

Practicals

Standard Operating Procedures

Unit II: **(8L)**

Laboratory rules and Protocols

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

Practicals

- Preparation of Standard Solution and Buffers
- Demo and Maintenance of Internal and External Audit

Unit III: (8L)

Laboratory hierarchy and SOP

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: (6L)

Record Keeping and Interpretation

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

Practicals

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

Recommended Textbooks and 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)

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B.Sc. Biotechnology
III Semester
Skill Enhancement Course

Course Title: HED- Human Excellence Development **Course Code: U-ADC-334**
Marks 50 **Hours 30** **Credit: 02**

Learning Objectives:

- To sharpen the intellect through analytical thinking and discussion
- To teach the students about various interview skills.
- To boost self-confidence among students.
- To make the students to understand etiquette and moral values.

Course outcomes:

On the successful completion of the course, student will be able to-

- Get self-confidence.
- enhance their potential for higher achievement
- develop creativity and interpersonal skills
- 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.

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B.Sc. Biotechnology
IV Semester

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

Learning Objectives:

- To enhance learner's communication skills by giving adequate exposure in reading, 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.
- Enabled students to read properly.

Course Outcomes:

On the successful completion of the course, student will be able to-

- by giving adequate exposure in reading and writing skills and the related sub skills the students enhanced the communication skills.
- the learners increased their confidence in written and interpersonal communication.
- the learners recognized and used the sentence structures in English in written communication.
- the student will be able to read properly.

Unit-I Reading Skill 2 **(Lectures12 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. Note making

3. Arts Stream
4. Geographical Journals
5. Commerce Stream
6. Business Journals
7. Science Stream
8. 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: (Lectures 12 Practicals 07)

Applied Writing Skills

A. Essay Writing
B. Newspaper Report Writing

Unit-III (Lectures 12 Practicals 07)

Written Communication

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.

Recommended Textbooks and References:

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. Mombai Orient Blackswan
4. Vanikar Ranu. 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.Strenghen You're Writing. Madras. Orient Longman

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Course Title: Plant Biotechnology **Course Code: U-PLB-497**
Marks: 50 **Lectures: 45** **Credit:03**

Learning Objectives:

- To Familiarize the students with the key developments in the sphere of Plant Biotechnology.
- To Train students with the techniques associated with the invitro propagation of plants and their maintenance.
- To Create awareness on the importance of plant diversity and its conservation both insitu and exsitu.
- To Train students on basic molecular biology techniques used in genetically modified plants.

Course outcomes

On the successful completion of the course, student will be able to-

- understand the importance of plant diversity and their conservation through invitro propagation and maintenance.
- describe methods for obtaining and application of genetically modified plants
- define regulatory issues for genetically modified plant production
- critically discuss and understand the uses of plants for novel biotechnological applications

Unit: I **(11L)**

Traditional Agriculture

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 **(11L)**

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, equipment's & instruments required other requirements.

Unit: III **(11L)**

Aseptic 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 & there *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 **(12L)**

Callus Culture Technique

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.

Recommended Textbooks and 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

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

Learning Objectives:

- To teach the students safety handling and regulation laboratory facility.
- To learn how to record, keep and analyze laboratory data with accuracy.
- To practice minimization of Errors related with handling of laboratory accessories and equipment's.
- To learn Standard Operating Procedures (SOPs) Laboratory equipment's.

Course outcomes

On the successful completion of the course, student will be able to-

- understand the basic calibration and handling of instrumentation in laboratory.
- safely practice, basic laboratory procedures and protocols in on job laboratory situations.
- maintain laboratory records, complaints with current industry standards.
- maintain audit record

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.

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IV Semester

Course Title: Enzymology **Course Code: U-ENZ-498**
Marks: 50 **Lectures: 45** **Credit: 03**

Learning Objectives:

- To provide a deeper insight into the fundamentals of enzyme structure and function.
- To outline the diverse applications of enzymes in disease diagnosis and therapy as well as in industry.
- To develop an understanding of Enzyme Kinetics and Enzyme Inhibition.
- To understand Mechanism of enzyme action and their regulation.

Course Outcomes:

On the successful completion of the course, student will be able to-

- describe structure, functions and the mechanisms of action of enzymes.
- get exposure of wide applications of enzymes and their future potential in research .and medicine as well as in industry, which will bolster their foray into industrial and biomedical research.
- learn kinetics of enzyme catalyzed reactions and enzyme inhibitory and regulatory process.
- know the applications of Biosensor in Industry and Research.

Unit I **(14L)**

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 **(8L)**

Application And Characterization 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 **(12L)**

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 **(10L)**

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.

Recommended Textbooks and References:

1. Fundamentals of Enzymology (2000) ed 3rd: Price and Stevens
2. Enzymes: Dixon and Webb (2014), 2nd Edition, Publisher: Elsevier
3. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York),
4. Immobilized Biocatalysts: W. Hartneir (2018). Springer-Verlag publication.
5. Isoenzymes: D. W. Moss
6. Enzymes: Trevor palmer

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

Learning Objectives:

- To Provide Hands-on Enzyme Assays.
- To Provide Hands-on factors affecting enzyme rate of reaction.
- To Provide Hands on Immobilization Techniques.
- To Provide Hands-on Purification Techniques

Course Outcomes:

On the successful completion of the course, student will be able to-

- perform Enzymes Assays
- study effect of different factors on enzyme rate.
- perform immobilization of enzymes.
- perform experiments on purification of enzymes

Practicals:

1. Laboratory Calculations
2. Effect of substrate concentration on enzyme activity
3. Effect of P^H, Temperature, Time on enzyme activity
4. Effect of different metal ions on enzyme activity,
5. Study of kinetics of enzyme calculation of Km and Vmax
6. Effect of different inhibitors on enzyme activity
7. Immobilization of enzyme in sodium alginate matrix
8. Effect of P^H and temperature on immobilized enzyme activity
9. Kinetic study of immobilized enzymes
10. Purification and calculation of specific activity and turnover number

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Course Title: Process Biotechnology **Course Code: U-PRB-499**

Marks: 50 **Lectures: 45** **Credit: 03**

Learning Objectives:

- To explain the role of fermenter in Industrial Biotechnology
- To improve knowledge of students with designs of various fermenters.
- To study the process kinetics of fermentation.
- To make the student to understand bioreactor design, upstream processing, downstream processing, and operation.

Course Outcome:

On the successful completion of the course, student will be able to-

- understand bioprocess engineering and its relation to other disciplines.
- interpret the Bioprocess Engineering and product formulation.
- create awareness of job functions in bioprocess industries, professional issues and entrepreneurship.
- get familiar with computer applications in bioprocess industries.

Unit I: (11L)

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: (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 Equipment's used in sterilization; Constituents of media, Media Optimization their estimation & quantification. Design of media. Costing of media

Unit-III: (11L)

Types of Bioprocesses, Screening and Strain Improvement of Microorganism

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 **(12L)**

Measurement & Control of Bioprocesses Parameters:

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.

Recommended Textbooks and References:

1. Principles of Fermentation Technology (2016) ed 3rd - Whittaker & Stan bury, Pergamon Press ISBN: 9780444634085.
2. Bioprocess Engineering Principles (1995) - Pauline Doran, Academic Press
3. Operational Modes of Bioreactors, BIOTOL series (1992) - Butter worth, Heinemann
4. Bioreactor Design & Product Yield, BIOTOL series (1992) - Butter worth Heinemann
5. Bioprocess Engineering: Systems, Equipment & Facilities (1993) - Ed. B. Lydersen, N.A. Delia & K.M. Nelson, John Wiley & Sons Inc,
6. Bio separation & Bioprocessing (1998) - Ed. G. Subramaniam, Wiley –VCH,
7. Product Recovery in Bioprocess Technology, 'BIOTOL series (1992) Butter worth Heinemann
8. Bio separation: Downstream Processing for Biotechnology (1988) - Paul A. Belter, E.L Cussler, Wei-Shou Hu, Academic Press.
9. Solvent Extraction in Biotechnology (1994) - Larl Schuger, Spinger Verlag,

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IV Semester

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

Learning Objectives:

- To get deeper understanding of fermentation technology
- To provide hands-on experience on sterilization techniques
- To Aquent the effect of various factors on growth Kinetics.
- To provide hands-on knowledge on isolation of microorganisms for production of industrially important products

Course Outcomes:

On the successful completion of the course, student will be able to-

- describe how effective sterilization techniques control the contamination.
- perform qualitative analysis of fermentative products
- perform quantitative analysis of fermentative products
- solve problems encountered during fermentation process.

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

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IV Semester

Course Title: Fundamentals of Molecular Biology **Course Code: U- FMB-500**

Marks 50 **Lecture: 45** **Credit: 03**

Learning Objectives:

The main objectives of this course:

- To provide comprehensive background of Salient features of Nucleic Acids and DNA model.
- To impart detailed understanding of key events of molecular biology comprising of mechanism of DNA Replication, Transcription and Translation in Prokaryotes and Eukaryotes.
- To provide adequate knowledge about Post Transcriptional Modifications and Processing of Eukaryotic RNA.
- To develop comprehensive understanding regarding DNA Repair Mechanisms and gene expression regulation.

Course Outcomes:

On the successful completion of the course, student will be able to:

- understand the structure, and function of nucleic acids in prokaryotes and eukaryotes.
- get knowledge about the mechanism of DNA replication, transcription and translation in prokaryotes and eukaryotes
- understand post transcriptional modifications and processing of eukaryotic rna.
- understand different DNA repair mechanisms and transcriptional regulation with examples of lac operon and tryptophan operon in prokaryotic as well as eukaryotic organisms

Unit I: **(10L)**

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

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: (12L)

From gene to protein

Introduction; The central dogma; 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: (8L)

DNA replication and Telomere maintenance

Introduction; DNA polymerases are the enzymes that catalyze DNA synthesis Historical Perspective Semi discontinuous DNA replication- In prokaryotes and eukaryotes Telomere maintenance: the role of telomerase in DNA replication, aging, and cancer

Unit IV: (15L)

DNA repair, recombination and gene expression

Introduction; 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 – *Xerodermapigmentosum* 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)

Recommended Textbooks and References:

1. Molecular Biology of the Gene (2013) 7th ed. James Watson, Tania Baker, Stephen Bell, Alexander Gann, Michael Levine, Richard Losick (Pearson)
2. Molecular Biology (2004) David Freifelder (Narosa)
3. Molecular Biology (2011)5th ed., Robert F. Weaver (McGraw Hill Education)
4. Concepts Of Genetics (1999) 6th Ed., William S. Klug, Michael R. Cummings, et al. (Prentice Hall)
5. Genetics (1995)3rd Ed., M.W., Strick Berger, Prentice Hall India.
6. Concepts of Genetics (2000)2nd Ed., P.J. Russell (Benjamin Cummings)
7. Principles of Genetics (2006)8th Ed., E.J. Gardner (Wiley)
8. Lab manual in biochemistry, immunology and biotechnology (2007) Arti Nigam, Archana Ayyagari Tata McGraw-Hill Publications.

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IV Semester

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

Learning Objectives:

- To provides hands-on tools and techniques in Molecular Biology.
- To inculcate and augment the hands-on expertise on isolation of nucleic acid from different sources.
- To study qualitative and quantitative analysis of Nucleic Acids.
- To study purity of Nucleic acid

Course Outcomes:

On the successful completion of the course, student will be able to:

- isolates nucleic acids from different sources.
- perform analysis of DNA and RNA qualitatively and quantitatively
- check purity of nucleic acid
- check effect of mutagens on bacterial growth.

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.

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IV Semester

Course Title: Algal Cultivation Technology **Course Code: U-ADC-434-A**

Marks 50 **Hours: 30** **Credit: 02**

Learning objectives:

- To learn collection, maintenance and preservation of algal culture.
- To study of basic and applied science behind the production of mass culture.
- To teach students about current applications and future potential of algae.
- To educate students on the commercial production of algae.

Course outcome:

On the successful completion of the course, student will be able to-

- acquire the knowledge of Algal culturing techniques.
- learn laboratory skill, lab organization & nutritional importance of different algae.
- understand about the algal isolation, identification, screening and cultivation, method.
- describe structure, functions and the economic importance of algae.

Unit: I **(8L)**

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 **(8L)**

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. Inoculum development pilot scale production.

Unit III **(6L)**

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 **(8L)**

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.

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IV Semester

Course Title: Mushroom Cultivation **Course Code: U-ADC-434-A**

Marks 50 **Hours: 30** **Credit: 02**

Learning Objectives:

- To teach the student about various cultivation method of mushroom.
- To make the student to understand about commercial & medicinal importance of mushroom.
- To learn seed culture preparation and preservation methods.
- To help the learners to practice a means of self-employment and income generation.

Course Outcomes:

On the successful completion of the course, student will be able to-

- distinguish the principle of various cultivation methods of mushroom.
- grow various varieties of Mushroom in-house.
- standardize protocol for commercial production of Mushroom.
- Knowledge of harvesting and post harvesting processes of mushroom.

Unit: I **(6L)**

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, equipment's & facilities, Pasteurization room & growing rooms.

Unit: II **(6L)**

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).

Unit: III **(6L)**

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.

Unit: IV **(6L)**

Casting materials & Case running:

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

Unit: V **(6L)**

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

Recommended Textbooks and 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 & Tomorrows printers & Publishers, New Delhi
4. Handbook on Mushrooms, Nita Bahl, oxford & IBH Publishing Co

Practicals:

1. Introduction to mushroom fungi, nutritional value, edible and poisonous type, edible mushrooms - *Pleurotus*, *Agaricus*, medicinal value of mushrooms,
2. Equipment and sterilization techniques for culture media
3. Preparation of culture, mother spawn production, multiplication of spawn,
4. Cultivation techniques, harvesting, packing and storage;
5. Problems in cultivation --- diseases, pests and nematodes, weed moulds and their management strategies.
6. Maintenance of mushroom beds of oyster mushroom, and *Agaricus.* Processing and preservation of mushrooms, economics of spawn and mushroom production.

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.

Cross-cutting issues relevant to Professional Ethics, Gender, Environment and Sustainability, and Human Values into the curriculum:

Sr. No.	Course Name	Code	Relevant to Professional Ethics	Description
1	Applied Microbiology	U-APM-398	Professional Ethics	Students will enable as an expert in role of microorganism in biogeocycles
2	Immunology and Virology	U-IMV-399	Professional Ethics	Student will be skilled in Immunotechniques
3	Metabolism	U-MET-401	Professional Ethics	Skilled in Metabolomics
4	Good Laboratory Practices	U-ADC-334	Professional Ethics	Expertise in Practical skills
5	Plant Biotechnology	U-PLB-497	Professional Ethics	Students will be skilled and expertise in plant tissue culture
6	Enzymology	U-ENZ-498	Professional Ethics	Expertise in Enzyme Technology
7	Process Biotechnology	U-PRB-499	Professional Ethics	Expertise in Upstream and Downstream processing of industrial products
8	Fundamentals of	U-FMB-	Professional	Expertise in Molecular

	Molecular Biology	500	Ethics	Techniques (Lab Technician)
9	Algal Cultivation Technology/ Mushroom Cultivation	U-ADC-434	Professional Ethics	Skilled in algal production/mushroom cultivation

Environment and Sustainability

Sr. No.	**Course Name**	**Code**	**Relevant to Environment and Sustainability**	**Description**
1	Environmental Biotechnology	U-ENV-500	Environment and Sustainability	The significant benefits of environmental biotechnology are that it helps us to make our environment safer and cleaner for further use.

Human Values

Sr. No.	**Course Name**	**Code**	**Relevant to Human values**	**Description**
1	Human Excellence Development	**U-ADC-334**	Human values	inculcate Human Values and Ethics

Curricula developed and implemented have relevance to the local, national, regional and global developmental needs

Sr. No	**Course Code**	**Course Name**	**Linkage wit Local/National/Regional/Global development**
1.	U-APM-398	Applied Microbiology	Solution to Environmental Problems
2.	U-IMV-399	Immunology and Virology	Basic Immuno techniques
3.	U-ENV-400	Environmental Biotechnology	Global Environmental issues, Solution t Environment Problems
4.	U-MET-401	Metabolism	Qualitative and Quantitative Analysis o Metabolites
5.	U-ADC-334	Good Laborator Practices/Human Excellence Development	GLP (Practices in Industry and Research)

6.	U-PLB-497	Plant Biotechnology	Tissue Culture
7.	U-ENZ-498	Enzymology	Quantitative Analysis, Production Purification techniques
8.	U-PRB-499	Process Biotechnology	Quality Control, Upstream an Downstream Processing in Industry
9.	U-FMB-500	Fundamentals of Molecula Biology	Molecular Techniques
10.	U-ADC-434	Algal Cultivatio Technology/ Mushroom Cultivation	SCP Production, Purification, Marketing

Courses having focus on employability/ entrepreneurship/ skill development

Sr. No.	Name of the Course	Course Code	Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development			Year of introduction
			Employability	Entrepreneurship	Skill development	
1	Applied Microbiology	U-APM-398	Job opportunities as Lab technician/principal investigator		Students will expert be expertise in role of microorganism in biogeocycles/Bioremediation	2018-2019
2	Immunology and Virology	U-IMV-399	Expertise in immunological techniques will create employability in Pathology Labs, Clinical and Research Institutes		Student will be skilled in Immuno techniques	2018-2019
3.	Environmental Biotechnology	U-ENV-400	Job opportunity as Environment officer/Public Health officer	Knowledge of waste management helps the student to become good Entrepreneur	Students will be skilled in water analysis /soil analysis/waste management	2018-2019

4	Metabolism	U-MET-401			Skilled in Metabolomics	2018-19
5	Good Laboratory Practices/Human Excellence Development	U-ADC-334			Expertise in Practical skills/inculcate Human Values and Ethics	
6	Plant Biotechnology	U-PLB-497	Students will get job in different agricultural and seed companies as well as students will be worked as consultant and may set up their own business	Students will be a successful entrepreneur in the field of plant tissue culture and nursery development	Students will be skilled and expertise in plant tissue culture	2018-2019
7	Enzymology	U-ENZ-498			Student will get exposure of wide applications of enzymes and their future potential	2018-2019
8	Process Biotechnology	U-PRB-499	Students will get job in Fermentation Industries. Wineries		Student will understand the Upstream and Downstream processing of Industrial Products	2018-2019
9	Fundamentals of Molecular Biology	U-FMB-500	Job opportunities as Lab technician/principal investigator		basics and advance molecular tools and techniques which helps in diagnosis of disease at molecular level	2018-2019
10	Algal Cultivation Technology/ Mushroom Cultivation	U-ADC-434	Job opportunity in Production Lab	Set Up Algal Production Lab/mushroom Cultivation Plant	Students will be able to understand the collection and processing of algae/mushroom cultivation	2018-19