

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
Biotechnology

CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER PATTERN

(Revised Syllabus 2020 -21)



SYLLABUS FOR
B.Sc. II Year (Biotechnology)

Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)

Department of Biotechnology

Choice Based Credit System

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.I Based on U-APM-)	03	20	30	02
U-LAC-403	Lab Course X (Pract.I Based on U-IMV-)	03	20	30	02
U-LAC-404	Lab Course XI (Pract.I 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

CodeNo.	Title of the course	Hours / Week	Marks (50)		Credits
			In Sem	EndSem	
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
(Autonomous College)**

**CHOICE BASED CREDIT SYSTEM
B.Sc. Biotechnology (Semester Pattern)
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 in reading and writing skills and the related sub-skills.

To create learner's confidence in written and interpersonal communication by reinforcing the basics of reading and writing.

To help learners to recognize and make use of sentence structures in English in written communication.

Unit-I Reading Skill 1

(Lectures 12 Practical 07)

A. Features of Reading

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

Practical: Two stories with glossary

B. Reading Techniques

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

Practical: Two stories with questions

C. Reading Task

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

Practical

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

Unit II Writing Skill 1

(Lectures12 Practical 07)

A. Features of Writing

- I Features of Writing
- II The Writing Process (Spelling and Capital Letters)
- III Paragraph Writing
(*Rainbow* Page No 214 - 222)

Two Stories

- i. Bahut Kuch Hota Hai
- ii. Honesty Comes from the Heart
(*Rainbow* Page No 237 - 246)

B. Writing Techniques

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

C. Writing Comprehension

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

Unit III Written Communication 06)

(Lectures12 Practical

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

d. Guidelines for writing a good C V

(*Radiance* page No 117-119)

To be assessed through MCQ and short answers

Reference Books

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

CHOICE BASED CREDIT SYSTEM
B.Sc. Biotechnology (Semester Pattern)
III Semester

Course Title: Applied Microbiology

Course Code: U-APM-398

Marks 50

Credit: 03

Learning Objectives:

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

Course Outcomes:

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

Unit I:

Soil, water and air microbiology: Biogeochemical cycles: Mineralization in Carbon, Nitrogen, Sulfur, Phosphorous etc. Bacteriological examinations of water; (Presumptive, confirmative, complete test) MPN, SPC, IMVIC, significance of index organism, Significance of microorganism in Air; methods of enumeration and controls.

Unit II:

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

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

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

Single cell protein: Process, production and its significance.

Unit III:

Introduction to Medical microbiology

Normal flora of the body, Immune system and Immunity, Microbial and viral infections and diseases, use of antibiotics its mechanism of action, broad spectrum, narrow spectrum and its respective mechanism Chemotherapy Water born, air born, food borne diseases and their causative agents from different reservoirs.

Unit-IV:

Environmental microbiology: Scope and concern, Agricultural microbiology: Scope and concern, Industrial effluents and Waste water Assessment; Sewage treatment plants: Aerobic & anaerobic treatment processes, Integration of genetic engineering & application of genetically engineered, Microbes in Agriculture, Environmental and waste water treatments.

Reference Books:

A.N. Alexander-soil microbiology

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

Adams and Moss-Food microbiology

Pelzar-Microbiology

Brock biology of microorganism.

CHOICE BASED CREDIT SYSTEM
B.Sc. Biotechnology (Semester Pattern)
III Semester

Course Title: Lab Course IX

Course Code: U-LAC-402

Marks: 50M

Credit: 02

Course Outcomes:

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

Practicals:

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

CHOICE BASED CREDIT SYSTEM
B.Sc. Biotechnology (Semester Pattern)
III Semester

Course Title: Immunology and Virology
Marks 50

Course Code: U-IMV-399
Credit: 03

Learning Objectives:

The course involves a basic understanding of immunology and Virology.

Course Outcomes

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

UNIT I

15L

Overview of Immunology

Historical perspective

Innate and Adaptive Immune response.

Hematopoiesis, Cells of Immune system and their biological role.

Humoral and cell mediated Immunity.

The Primary and secondary lymphoid organs.

UNIT II

10L

Basics of Immunology

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

Antibody: General Structure of antibody molecule,

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

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

Immunological reactions: Precipitation and Agglutination reactions, ELISA.

UNIT III

10L

Introduction to viruses

Viruses and their importance.

Discovery of viruses.

Structure of virus: viral nucleic acid, nucleocapsid, envelope.

Variation in structure of viruses.

Viroids and Prions.

Nomenclature and Classification of viruses.

UNIT IV

10L

Structure of animal virus (HIV) and plant virus (TMV).

Life cycle and replication of DNA virus, RNA virus, Retrovirus, Bacteriophages (lytic and lysogenic)

Vaccines, antiviral drugs.

Text and References:

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

CHOICE BASED CREDIT SYSTEM
B.Sc. Biotechnology (Semester Pattern)
III Semester

Course Title: Lab Course X

Course Code: U-LAC-403

Marks: 50M

Credit: 02

Course Outcomes

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

CHOICE BASED CREDIT SYSTEM
B.Sc. Biotechnology (Semester Pattern)
III Semester

Course Title: Environmental Biotechnology
Marks 50

Course Code: U-ENB-400
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: Components of Environment and Global Environmental Problems **08**

Hydrosphere, lithosphere, atmosphere and biosphere – definitions with examples;
Environmental Studies as a multidisciplinary subject.

Green House Effect, Acid rain,

Ozone depletion,

Biodiversity loss

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

Pollution of air, water and land with reference to their causes, effects & control strategies

Environmental damage by agriculture,

Perspectives of pollution in urban, industrial and rural areas.

Habitat Pollution with example

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

Solid waste management.

UNIT: III-Waste water treatment and management **15**

Waste Water Treatment Process: Preliminary, Primary, Secondary and Tertiary.

Methods of Waste water treatment- Physical, Chemical & Biological

Waste water treatment Reactors: Introduction and types in brief

Aerobic Biological Treatments: Activated sludge process

Anaerobic Biological Treatments: upflow anaerobic sludge blanket (UASB) reactor
Difference between aerobic & anaerobic treatment

.UNIT IV Biodegradation and Bioremediation

12

Biodegradation - Aerobic & Anaerobic Biodegradation

Xenobiotics biodegradation with suitable example

Bioremediation: Introduction, Definition and Concept,

Methods of Bioremediation (In Situ and Ex Situ Methods)

Microbial Bioremediation & Phytoremediation: Concept and Types

Reference books:

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

CHOICE BASED CREDIT SYSTEM
B.Sc. Biotechnology (Semester Pattern)
III Semester

Course Title: Lab Course XI

Course Code: U-LAC-404

Marks: 50M

Credit: 02

Course Outcome:-

- To train the students about environmental parameter analysis like water analysis, soil analysis.
 - Understanding of environmental problems and suggests the remedial measures.
1. Visit and Observe any two pollutant sights and write a short report on cause, effects and Remedial measures through biotechnology.
 2. Waste water analysis for pollution and compare it with drinking water standards.
 1. Determination of Dissolved oxygen(D.O.)
 2. Determination of carbon dioxide(CO_2)
 3. Determination of Biochemical oxygen demand (BOD).
 4. Determination of Chemical Oxygen demand(COD)
 5. Determination of Hardness of given water sample.
 6. Determination of P^{H} of given water sample
 7. Determination of alkalinity and chlorinity of given water sample.
 3. Detection of potability of water through Bacterial Examination of Water by MPN Test: Presumptive and Confirmed Coliform test.
 4. Isolation of hydrocarbon degrading bacteria and test it for degradation of aromatic hydrocarbons.
 5. To observe effects of air pollutants on plants and note the nature of pollution in your Surrounding and suggest remedial measures.

CHOICE BASED CREDIT SYSTEM
B.Sc. Biotechnology (Semester Pattern)
III Semester

Course Title: Metabolism
Marks 50

Course Code: U-MET- 401
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

11 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

11 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

12L

Photorespiration C4 cycle, CAM Pathway

Glyoxylate PW. Pentose Phosphate Pathway, Entner-Doudoroff PW

Carbohydrate metabolism – Gluconeogenesis, Glycogen Metabolism.

Lipid Meatbolism – 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

11 L

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.

Reference:

1. Lubert Stryer, Biochemistry, 4th Edition, W.H.Freeman and Company, 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. J. Zubay. Biochemistry

CHOICE BASED CREDIT SYSTEM
B.Sc. Biotechnology (Semester Pattern)
III Semester

Course Title: Lab Course XII

Course Code: U-LAC- 405

Marks: 50M

Credit: 02

Course Outcomes

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

CHOICE BASED CREDIT SYSTEM
B.Sc. Biotechnology (Semester Pattern)
III Semester
Skill Enhancement Course

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

Marks: 50M

Credit: 02

Learning Objectives:

1. Prepare students for practical study in life science laboratories.
2. Students able to handle safely every laboratory facility and know troubleshoot measures during laboratory processes.
3. Student able to keep, analyse laboratory data with accuracy.
4. 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:

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

Practicals

Standard Operating Procedures

Unit II:

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:

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:

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

Reference books:

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)

CHOICE BASED CREDIT SYSTEM
B.Sc. Biotechnology (Semester Pattern)
III Semester
Skill Enhancement Course

Course Title: HED- Human Excellence Development
Marks 50

Course Code: U-ADC-334
Credit: 02

Objective -To help Students:

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

Course Outcomes:

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

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

- 09. Paradigm Shift - Understanding challenges and try to accept them
- 10. Motivation - Self Motivation Making friends for Progress
- 11. Aptitude Skills - Understanding aptitude Role plays Small Test
- 12. Becoming better Student - Plan to become better student on daily basis
- 13. Preparing for Interview - Dress Code, Eye Contact, Killing nervousness, Building Confidence, Winning the interviewer

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

Unit III Written Communication

(Lectures 12 Practical 06)

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

To be assessed through MCQ and short answers

Reference Books

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

CHOICE BASED CREDIT SYSTEM
B.Sc. Biotechnology (Semester Pattern)
IV Semester

Course Title: Plant Biotechnology
Marks 50

Course Code: U-PLB-497
Credit: 03

Learning Objectives:

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

Course Outcomes:

Students would be more aware about PTC technique and lab organization with necessary explanations.

By studying all these 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:

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:

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

Aseptic techniques – Washing & preparation of glassware, packing & sterilization, media sterilization, surface sterilization, aseptic work station, precautions to maintain aseptic conditions. Culture Medium – Nutritional requirements of the explants, PGR's & their *in vitro* roles. Media preparation. Preparations of stock solutions and their sterilization 'Explants' for plant tissue culture – histological and/or cellular characteristics Dedifferentiation and dedifferentiation, Organogenesis, Embryogenesis

Unit IV

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

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

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

Plant secondary metabolites and its applications.

Germplasm conservation and cryopreservation.

Application of plant tissue culture technology and their commercialization.

Reference Books:

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

CHOICE BASED CREDIT SYSTEM
B.Sc. Biotechnology (Semester Pattern)
IV Semester

Course Title: Lab Course XIII
Marks 50

Course Code: U-LAC-501
Credit: 02

Course Outcomes:

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

Practicals:

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

CHOICE BASED CREDIT SYSTEM
B.Sc. Biotechnology (Semester Pattern)
IV Semester

Course Title: Enzymology
Marks 50

Course Code: U-ENZ- 498
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. Also it deals with current applications and future potential of enzymes.

Course Outcome

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

UNIT I (15)

ENZYMES & ENZYME CATALYSIS:

General Features of enzymes , Classification : IUB system, rationale, overview and specific examples, Characteristics of enzymes, enzyme substrate complex, Concept of active 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 (8)

APPLICATION AND CHARACTERISATION OF ENZYMES

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

UNIT III (12)

ENZYME KINETICS:

Michaelis - Menten Equation - form and derivation, steady state enzyme kinetics, Significance of 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

ENZYME REGULATION & IMMOBILIZED ENZYMES

(10)

Product inhibition, feedback control, enzyme induction and repression and covalent modification, Allosteric regulation, Relative practical and economic advantage for industrial use, effect of partition on kinetics and performance with particular emphasis on charge and hydrophobicity (pH, temperature and 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.

Reference:-

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), 5th Edition, 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

CHOICE BASED CREDIT SYSTEM
B.Sc. Biotechnology (Semester Pattern)
IV Semester

Course Title: Lab Course XIV
Marks 50

Course Code: U-LAC- 502
Credit: 02

Course Outcome

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

1. 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 Benedicts method
10. Indirect estimation of lactate dehydrogenase
11. Purification of enzyme
12. Problems based on MM equation and lineweaver burk plot

CHOICE BASED CREDIT SYSTEM
B.Sc. Biotechnology (Semester Pattern)
IV Semester

Course Title: Process Biotechnology
Marks 50

Course Code: U-PRB- 499
Credit: 03

Learning Objectives

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

Course Outcome

Understanding of bioprocess engineering and its relation to other disciplines

Ability to list bioprocess engineering processes, units, and the corresponding equipments

Awareness of career options, potential job functions, contemporary and professional issues. • Familiarity with computer applications in process industries.

UNIT-I:

12L

Introduction to Concepts of Bioprocess engineering:

Definition of Bioprocesses engineering. Introduction to Simple engineering calculations, Mass & Energy Balances. Oxygen uptake rate (OUR), 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 Equipments used in sterilization; Constituents of media, Media Optimization their estimation & quantification. Design of media. Costing of media

UNIT-III:

11L

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

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

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

UNIT-IV:

11L

Measurement & Control of Bioprocesses Parameters: Cell growth. pH, temperature, Substrate consumption, product formation, Measurement of 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

CHOICE BASED CREDIT SYSTEM
B.Sc. Biotechnology (Semester Pattern)
IV Semester

Course Title: Lab Course XV
Marks 50

Course Code: U-LAC- 503
Credit: 02

Course Outcomes

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

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

CHOICE BASED CREDIT SYSTEM
B.Sc. Biotechnology (Semester Pattern)
IV Semester

Course Title: Fundamentals of Molecular Biology
Marks 50

Course Code: U-FMB-500
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: The beginnings of molecular biology 10 L

1. Introduction

Historical perspective

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

Genome organization: from nucleotides to chromatin

1 .Introduction

2 .Eukaryotic genome

3. Bacterial genome

DNA replication and Telomere maintenance

08

1. Introduction

2. DNA polymerases and other enzymes that catalyze DNA synthesis

3. DNA replication- In prokaryotes and brief introduction to eukaryotes

4. Telomere maintenance: the role of telomerase in DNA replication, aging, and cancer

UNIT II: From gene to protein

12

1.Introduction

2.The central dogma

3.The genetic code

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

Prokaryotic Transcription

Brief introduction to Eukaryotic Transcription

Post Transcriptional Modifications in Eukaryotes

UNIT III: Translation

Protein structure, Protein function

Prokaryotic Translation

Brief introduction to Eukaryotic Translation

Post Translational Modifications in Eukaryotes

UNIT IV: DNA repair, recombination and gene expression

15

1. Introduction

2. Types of mutations and their phenotypic consequences

3. General classes of DNA damage

4. Repair of single Base excision repair

-Mismatch repair

- Nucleotide excision repair

Disease - Hereditary nonpolyposis colorectal cancer: a defect in mismatch repair Base changes and structural distortions by removal of DNA damage

5. Double-strand break repair by removal of DNA damage

-Homologous recombination

-Nonhomologous end-joining

Disease -*Xeroderma pigmentosum* and related disorders: defects in nucleotide excision repair

Disease - Hereditary breast cancer syndromes: mutations in *BRCA1* and *BRCA2*

6. SOS repair

7. Prokaryotic gene expression and regulation

-Operon concept-Lac operon, Tryptophan operon, Arabinose operon

8. Eukaryotic gene expression and regulation (in brief)

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, ArchanaAyyagari Tata mac graw hill publication

5. Concepts of genetics (Sixth Edition), William S. Klug & Michael R, Cummings, Person

6. Genetics, M.W., Strickberger, Prentice Hall College Division.

7. Concepts of Genetics, P.J. Russell, Benjamin/Cummings.

8. Principles of Genetics, E.J. Gardner, John W.H. Sons Inc.

CHOICE BASED CREDIT SYSTEM
B.Sc. Biotechnology (Semester Pattern)
IV Semester

Course Title: Lab Course XVI
Marks 50

Course Code: U-LAC-504
Credit: 02

Course Outcome

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

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

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

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

CHOICE BASED CREDIT SYSTEM
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:

1. In order to introduce this course student would be able to learn collection, maintenance and preservation of algal culture.
2. This course would be beneficial for the study of basic and applied area concerning with this micro-creatures.

Course outcome:

1. Student would be more learned about the micro and microorganism, its method of isolation to identification, screening and chromatographic identification of concerned products.
2. 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

Theory:

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

Practical:

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

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Unit II

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**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**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.

CHOICE BASED CREDIT SYSTEM
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.

Unit: I 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.

Unit: II 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 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 Casting materials & Case running:

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

Unit: V 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

Reference Books:

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
2. Preparation of culture, mother spawn production, multiplication of spawn,
3. Cultivation techniques, harvesting, packing and storage;
4. 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.