Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Department of Biotechnology

Curriculum

For the Academic Year 2021-22

Under CBCS

Three Year Degree Programme in Biotechnology

(Six Semester Programme)

UG First Year

Semester I and II

Syllabus Approved by Board of Studies in Biotechnology

With effect from June, 2021

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
Biotechnology

1. Introduction:

Biotechnology is a highly interdisciplinary field that combines biological sciences with engineering technologies to manipulate living organisms and biological systems to produce products that advances healthcare, medicine, agriculture, food, pharmaceuticals and environment control. Biotechnology can be classified into two broad categories: R&D in Biological Sciences and Industrial Processes. The biological sciences aspect deals with research and development in areas such as Microbiology, Cell biology, Genetics, Molecular Biology etc. for understanding the occurrence and treatment of diseases, development of agriculture, food production, protection of the environment and many more. Most of the R&D work in biological sciences is carried out in the laboratory. The industrial processes aspect deals with the production of drugs, vaccines, biofuels and pharmaceuticals on an industrial scale using biochemical processes and techniques.

Some of the best innovations and developments that have come out of Biotechnology and allied fields are: genomic sequencing technology, natural alternatives to pesticides, production of biofuels and developments in stem cell technology.

At its simplest, biotechnology is technology based on biology - biotechnology harnesses cellular and bimolecular processes to develop technologies and products that help to improve our lives and health of our planet. Taking into consideration of the importance of Biotechnology, Rajarshi Shahu Mahavidyalaya, Latur (Autonomous), have taken an initiative to introduce a new emerging field as a undergraduate Programme in biotechnology under the faculty of science. B. Sc. Biotechnology is a Three-year graduate degree program which is started in the academic year 2004-05.

B.Sc. Biotechnology programme has been designed in Accordance with the changing scenario in the field of biological sciences, its demand and necessary needs to uplift betterment of society and environment.

With reference to global changes occurring in higher education in various national and foreign universities, the designed syllabi of B.Sc. Biotechnology is effectively implemented from June, 2017. The committee members of BoS in Biotechnology also took the local need and employability of graduate students while framing the syllabus, keeping in view of the guidelines given in the UGC curriculum. The number of objectives is taken into consideration while reforming the syllabi.

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

3. Learning Objectives of the Programme:

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

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

4. Programme Specific outcomes/ Programme Outcomes:

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

- Prepare the students with the skills, ethics, aptitude and human values of practicing the science in day-to-day life
- Understand the applications of various subjects of life sciences for societal development
- Get the knowledge about various domains of applied subjects of biotechnology for environmental sustainability
- Promote the interdisciplinary research in biotechnology for tackling the future problems threatening the society
- Equip the students with the abilities required to attain self-sufficiency and life sustainability by imparting entrepreneurial skills
- Design process equipment, plants, biosensors and recombinant molecules for biotechnological and allied processes.
- Identify measures for energy, environment, health, safety and society following ethical principles.
- Work in multi-disciplinary teams to attain project objectives, document the activities and present reports effectively.
- Apply basic science, engineering and program core to solve complex biotechnological problems.
- Isolate, purify and characterize biological samples using sophisticated analytical experimental techniques.
- Apply research-based knowledge and biotechnological methods to investigate complex biological problems

- Apply modern software tools including prediction and modeling methods on biological databases to identify issues in biomedical problems
- Assess personal, product and environmental safety, intellectual property and social responsibilities related to modern biotechnological research and development.

5. Local, Regional and Global relevance of Syllabus:

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

Global and local focus has slowly shifted to using knowledge of life Science for innovative technology development that is being used for betterment of human life. Many fundamental and advanced research fields come under the umbrella of Biotechnology e.g. Cell Biology, r-DNA Technology and Fundamentals of Biological Chemistry etc.

6. Duration of the Course: **Three years**

7. Eligibility of the Course: **XII science**

8. Strength of the Students: **160**

9. Fees for Course: **As per University/College rules.**

10. Admission / Selection procedure: **Admission by merit through Registration**

11. Teacher's qualifications: As per UGC/University/College rules

12. Standard of Passing: As per UGC/University/College rules

13. Nature of question paper with scheme of marking:

As per UGC/University/College rules

14. List of books recommended: Included in syllabus

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

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

16. Rules and regulations and ordinance if any: As per UGC/University/College rules

17. Course duration: Each theory course is of 50 Contact Lectures

18. Medium of the language: English

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
Department of Biotechnology
Course Structure of B.Sc. Biotechnology First Year
B. Sc. I [Biotechnology] Semester I

	Code No.	Course Title	Hours/ Week	Marks (50)		Credits	Total
				In Sem	End Sem		
AECC1	U-COE-101	Communicative English I	04	20	30	02	50
CCT1	U-CEB-187	Cell Biology	04	20	30	03	50
CCT2	U-BBS-188	Basic Bioscience	04	20	30	03	50
CCT3	U-INM-189	Introduction to Microbiology	04	20	30	03	50
CCT4	U-CFB-190	Chemistry for Biologists	04	20	30	03	50
CCP1	U-LAC-191	Lab Course I (Practical Based on U-CEB-187)	03	20	30	02	50
CCP2	U-LAC-192	Lab Course II (Practical Based on U-BBS-188)	03	20	30	02	50
CCP3	U-LAC-193	Lab Course III (Practical Based on U-INM-189)	03	20	30	02	50
CCP4	U-LAC-194	Lab Course IV (Practical Based on U-CFB-190)	O3	20	30	02	50
			32			**22**	**450**

B. Sc. I [Biotechnology] Semester II

	Code No.	Title of the Course	Hours/ Week	Marks (50)		Credits	Total
				In Sem	End Sem		
AECC1	U-COE-201	Communicative English II	04	20	30	02	50
CCT1	U-BBI-287	Biophysics and Bioinstrumentation	04	20	30	03	50
CCT2	U-GEN-288	Genetics	04	20	30	03	50
CCT3	U-FUB-289	Fundamentals of Biological Chemistry	04	20	30	03	50
CCT4	U-BBC-290	Biomathematics, Biostatistics and Computer	04	20	30	03	50
CCP1	U-LAC-291	Lab Course V (Practical Based on U- BBI-287)	03	20	30	02	50
CCP2	U-LAC-292	Lab Course VI (Practical Based on U-GEN-288)	03	20	30	02	50
CCP3	U-LAC-293	Lab Course VII (Practical Based on U-FUB-289)	03	20	30	02	50
CCP4	U-LAC-294	Lab Course VIII (Practical Based on U-BBC-290)	O3	20	30	02	50
Generic Elective	U-MOE-235	Moral Education (NCBC)	02	20	30	Grade	
			34			**22**	**450**

Rajarshi Shahu Mahavidyalaya, Latur
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B.Sc. Biotechnology
I Semester
Course Title: Communicative English I Course Code: U-COE-101
Marks: 50 Lectures: 30 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 basics 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-

- focus a lot on listening style to be the better speaker of English language
- realize the proper style of English for oral communication and can use words and sentences with proper accent and intonation.
- speak English by using proper sentence structures.
- speak fluently

Unit I: **(08L)**

Oral Communication 1

1. The notion of formal and informal communication situations

   Formal Situations – Greetings, Talking with - Principal, Government officer, doctor, bank officers and employees, and college guests

   Informal Situations - Greetings, Talking with - parents, siblings, other family members, relatives, friends, and neighbors
2. Formal, informal and functional expressions
3. Recognizing (in listening) and appropriately using (in speaking/writing) formal and informal expressions

Unit II: **(08L)**

Practical Phonetics 1

1. The IPA symbols and the sounds of English
2. The Speech Organs
3. Classification of English Sounds

Unit III: **(08L)**

Basic Grammar 1

1. Word class
2. Tense / Verb Forms
3. Articles, Prepositions

Unit IV: **(06L)**

Précis Writing

1. Introduction of précis writing
2. Examples of précis writing

Practicals

1. 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.
2. Once in a week student attend the lab class as per the lab timetable.

Recommended Textbooks and References:

1. A Textbook of Phonetics for Indian Students (1981) Balasubramanium, T. New Delhi: Macmillan
2. A Course in Phonetics and Spoken English (1997) Sethi, J. & P. V. Dhamija, New Delhi, Prentice-Hall
3. Rediscover Grammar with David Crystal (1985) Crystal, David. Longman.
4. A Course in English Grammar, Bakshi, R. N. Orient Longman
5. Foundation English, Dwivedi, R.K. and A. Kumar, Macmillan India Ltd.
6. English for Practical Purposes, Patil Z. N. Valke B. S, Thorat, Ashok & Merchant Zeenat, Chennai, Macmilan
7. A Textbook for Undergraduates, Tengse R Ajay, Soft Skills. Hyderabad, Orient Blackswan

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

Course Title: Cell Biology **Course Code: U-CEB-187**
Marks: 50 **Lectures: 45** **Credit: 03**

Learning Objectives:

- To understand basic of cell biology and its applications.
- To study Cell organelles and its Function
- To understand transport mechanism in and out of cell
- To understand cell cycle and its regulation events

Course Outcomes:

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

- discuss origin and morphology of cells
- describe physico-chemical composition of organelles and their functional organization.
- explain transport mechanism of cells
- elucidate significance of cell-cell communication

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

Introduction

Cell – Shapes, morphology, Cell theory, origin of life –Stanley miller Experiment endosymbiosis theory, Introduction to prokaryotic and eukaryotic cell, microscopic techniquesin cell biology.

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

Structural organization

Biological membrane structure organization, membrane proteins, lipids. Structure-function relationship including organelles e.g., Cell wall, Endoplasmic reticulum, Mitochondria, Chloroplast, Golgi body, nucleus and nuclear membrane, Microbodies: Glyoxysome, Peroxisome, Melanosome, lysosomes, vacuoles, Cytoskeleton, Extracellular matrix, Cell junctions.

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

Membrane transportation

Membrane transport, Transport across cell membrane, simple diffusion, passive transport, active transport, Na/K ion channel, vesicular transport, Membrane potential, Depolarization, hyperpolarization of membrane (neuronal). Generation of action potential. Types of biopotentials. Biopotential measurement instrument.

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

Cell Cycle Regulation

The mechanism of cell division, Cell division cycle and its regulation, Cell Signalling; G-Protein coupled receptor, Nitrous oxide, Calcium as secondary messenger and its role in plantand animals. Cell differentiation, Neoplasia & Cell death.

Recommended Textbooks and References:

1. Molecular Cell Biology (2004) Lodish et al " (Scientific American Book)
2. Manual of Laboratory Expts in Cell Biol . (2005) Eduard Gasque " "(W. C. Wilson Pub)
3. The Biology of the Cell (2002) 5th Edition, Alberts et al.
4. A Molecular Approach (2004) the Cell –4th Edition, Cooper & Hausman
5. Cell and Molecular Biology (2007) - 4th Edition, Gearld carp
6. Medical Physiology (2009) - Eleventh Edition-(Elsevier) Guyton & Hall

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

Course Title: Lab Course I **Course Code: U-LAC-191**
Marks: 50 **Credit: 02**

Learning Objectives:

- To study cell diversity.
- To design experiments on karyotyping
- To study different stages of cell cycle
- To provide hands-on Cell Separation Techniques

Course Outcomes:

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

- perform separation of subcellular components of cells.
- identify and describe the cellular structure of organs and tissues from prepared slides, and outline the principles of histochemical staining.
- interpret the chromosome structure, cell division events in cells.
- acquaint hands on training on isolation of chloroplast.

Practicals:

1. Cell Diversity
2. Separation of cells using sedimentation and velocity Centrifugation
3. Study of sub cellular organelles
4. Study of Karyotyping
5. Study of Mitosis, Meiosis
6. Cell harvesting and cell lysis- methodology
7. Immunoprecipitation
8. Demonstration of Antigen- Antibody reaction through clinical approach.
9. Preparation of blood smear and morphological study of different cells.
10. Determination of cell density by turbidimeter
11. Study of Tissue by Microtomy
12. Study of osmosis

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

Course Title: Basic Biosciences **Course Code: U-BBS-188**
Marks: 50 **Lectures: 45** **Credit:03**

Learning Objectives:

- To understand basics of plant transport and nutrition and apply this knowledge in practical work in agriculture to enhance the yield of field crops.
- To know the basics of plant reproduction and significance of plant hormones in plant growth and development.
- To understand the basics of structure and functions of circulatory system, respiratory system, energy production, homeostasis and its significance in mammalian life processes.
- To understand organization and role of digestive, endocrine, nervous and reproductive systems in humans.

Course Outcomes:

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

- interpret the understandings of the basics of plant anatomy, tissue organization and its function in transport and nutrition.
- understand differences between different reproductive methods in plants and the role of each plant hormone in different life processes in plants including growth and development.
- elaborate their concepts about mammalian organ systems, its organization and functions, especially the transport system, respiratory system and mechanism of homeostasis.
- explain the significance of process of digestion, organization of digestive system, endocrine system, nervous system and reproductive system.

Unit-I: **(14 L)**

Taxonomy

Biology basics, Classification and Levels of organization From cells to organism, Chemical, cellular and evolutionary foundations of life Scientific Inquiry, Chemical and physical properties on which life works ,The cell-types and features ,Evolution -the features that organisms share and those that set them apartecological systems, Taxonomic classifications of living organisms. History of taxonomy, classification and nomenclature in brief. Whittaker's five kingdom systems of biological classification Taxonomical hierarchy, Binomial nomenclature Classification of kingdom Plantae Classification of kingdom Animalia Levels of organisms in Eukaryotes , Plants and animals' level of organization from cell to organism level.

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

Plant Structure and Function

Biophysical processes: Diffusion, Osmosis, facilitated diffusion, water potential, active transport in plant, imbibition, Plant structures: -A typical structure of , angiosperm plant including Root, Stem and leaf Anatomy of Monocot and Dicot Leaf.

Photosynthesis: Structure of chloroplast, Light Reactions-Cyclic and non-cyclic photophosphorylation, Dark reaction, Carbon dioxide gain and water loss: Stomatal structure and functions.

Water transport - xylem transport of water and dissolved nutrients from soil. Transport of carbohydrates (Phloem transport),Mineral nutrition in plants.

Reproduction in plants: Asexual and Sexual reproduction.

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

Life processes in Animals-I

Animal nervous system: structure and functions of Human brain and Spinal cord , Animal endocrine system: Endocrine gland and Hormones in brief

Animal cardiovascular system: structure and function of Heart, Blood vessels – Arteries,Veins, Capillaries, Blood

Animal Respiratory systems: Structure and function of Human respiratory system, Oxygen by hemoglobin.

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

Life processes in animals – II

Animal metabolism, Nutrition and Digestion, Patterns of animal metabolism: Metabolic rate depends on activity level, body size, and body temperature .Nutrition and diet, digestive tract(gut)

Animal Renal systems: Water and waste water and electrolyte balance, Excretion of wastes .

Animal reproduction and development: Human reproductive anatomy and physiology Male reproductive system and function, Female reproductive system and function, Menstrual/reproductive cycle in human female, Gametogenesis, fertilization, gestation and birth/parturition in humans in brief. Lactation in human female,Birth control measures in brief: - Physical, Chemical and other methods.

Recommended Textbooks and References:

1. Biology, (2009) 7th edition, Campbell, Neil A., Reece, Jane B. [Benjamin Cummings] Pearson education
2. Life the science of biology (2011), , Eighth edition, Sadava, Hillis, Heller, Berenbaum, W H Freeman
3. Botany: An Introduction to Plant Biology (2009) 4th edition, James. D. Mauseth, Jones and Bartlett
4. An Introduction to Zoology -Investigating the Animal World (2013), ,2nd edition, Joseph springer, Dennis Holley,Jones and Bartlett
5. Human Body Systems, Structure, function and environment (2012) 2nd edition, Daniel D. Chiras, Jones and Bartlett
6. Reproductive biology (2007) 1st edition, Gayatri Prakash, Alpha science international limited
7. Class XI and class XII Biology NCERT (2012), Bijnan Sutar, Shashi Chadha National Council of Educational Research and Training, 2010

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

Course Title: Lab Course II **Course Code: U-LAC-192**
Marks: 50 **Credit: 02**

Learning Objectives:

- To know the types and levels of organization of a variety of plant tissues.
- To understand stomata, the mechanism of transpiration, and factors affecting transpiration in plants.
- To understand significance of light in photosynthesis, processes of respiration in plants and sexual reproduction in plant.
- To analyze food materials such as sugars, proteins and lipids qualitatively.

Course Outcomes:

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

- prepare anatomical slides of stem, root to understand levels of organization in plants.
- understand the position and structure of stomata on leaves, process of transpiration and factors affecting transpiration.
- understand the significance of light and other physiological processes in plant growth and development.
- qualitatively analyze the presence or absence of sugars, proteins and lipids in different food types.

Practicals:

1. To study parts of a compound microscope
2. To identify and study the morphology of representative types of bacteria, fungi anddifferent animal and plant groups.
3. Study of tissues and diversity in shapes and sizes of plant cells.
4. To study anatomy of stem and root of monocots and dicots
5. Preparation of herbarium sheets of flowering plants
6. To study the distribution of stomata on the upper and lower surfaces of leaves.
7. To investigate and measure factors affecting rate of transpiration using a photometer.
8. To detect the presence of carbohydrates like glucose, sucrose and starch
9. To detect the presence of proteins.
10. To detect the presence of fats (lipid) in different plants and animal materials
11. To detect the presence of urea in the given sample of urine
12. To test the presence of sugar in the given sample of urine.
13. To show that light is essential for photosynthesis.
14. To show that carbon dioxide is essential for photosynthesis.
15. To study the liberation of carbon dioxide gas during aerobic respiration.
16. To study the liberation of carbon dioxide gas during fermentation
17. To study the reproductive parts of commonly available flowers
18. To understand the diversity of living organisms through educational tours.

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

Course Title: Introduction to Microbiology Course Code: U-INM-189
Marks: 50 Lectures: 4 Credit: 03

Learning Objectives:

- To learn and understand the contributions of various scientists in microbiology
- To study physical and chemical methods of sterlization
- To understand apply pure culture technique for isolation of microorganisms
- To observe, understand and measure microbial growth

Course Outcomes:

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

- interpret the structural similarities and differences among microorganisms and the unique structure/function relationships of prokaryotic cells.
- acquire the knowledge about types of media and their components
- acquaint hands on training on the isolation and characterization of microorganisms
- interpret the environmental factors affecting microbial growth

Unit-I: (10 L)

History of Microbiology

Discovery of microscope and Microbial world: Micrographia of Anton von Leeuwenhoek and Robert Hooke. Controversy over Abiogenesis: Aristotle's notion about spontaneous generation, Redi's experiment, Louis Pasteur's & Tyndall's experiment. Theory of fermentation, Discovery of anaerobic life & physiological significance of fermentation. Surgical antisepsis, Germ theory of disease – Koch's postulates & River's postulates.

Unit-II: (13 L)

Morphology of Bacteria, Size and shape, Arrangements

Ultrastructure of Bacteria Structure, function and chemical composition of Capsule, Flagella, Pili and Fimbriae, Cell Wall (Gram positive & Gram negative), Cell membrane, Mesosome, Cytoplasm, Nucleoid and ribosomes. Cytoplasmic inclusion – PHB granules, glycogen, carbohydrates, Magnetosome, Gas vesicles, chlorosome, sulphur, granules. Spore and Cyst- Endospore and Exospores, Germination and Sporulation of endospore

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

Microbial Nutrition, cultivation

Concept of Systematic and Classical taxonomy including Bergey's Manual of Bacteriology Nutritional requirements – Major and Minor elements and growth factors. Nutritional types ofmicroorganisms. Types of Culture media with examples (Defined, Selective, Natural,Differential, enrichment, Synthetic). Pure culture techniques (Streak, pour, spread plate androll tube method).

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

Bacterial Growth

Growth curve; Generation time, Growth rate, specific growth rate. Methods of Enumeration - Microscopic methods, Plate counts, Biomass, Chemical methods, Optical density. Continuous culture – Chemostat and Turbidostat models, Diauxic growth and Synchronous culture.

Recommended Textbooks and References:

1. Elementary Microbiology Volume I and II – H. A. Modi
2. General Microbiology- Powar and Daginawala- Himalya Publication
3. Fundamental Principles of Bacteriology- A.J.Salle- TATA-McGraw Hill
4. General Microbiology-Pelczar- Tata McGraw Hill
5. Text-book of Microbiology- Anantnarayan, C.K. Jayram, Panikar, Orient Longman.
6. General Microbiology- Stanier R.-. Macmillan Press Ltd.
7. Text Book of Microbiology- R.C. Dubey- S. Chand
8. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education limited.

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

Course Title: Lab Course III **Course Code: U-LAC-193**
Marks:50 **Credit: 02**

Learning Objectives:

- To educate students in a variety of important microbiological disciplines
- To promote and develop skills in the use of tools, technologies and methods common to microbiology.
- To understand pure culture techniques and media required for microbial growth.
- To study and understand the microbial world and its diversity.

Course Outcomes:

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

- acquaint the knowledge about isolation and characterization of bacteria.
- identify microbes using microscopic and biochemical tests.
- determine, interpret and discuss the growth kinetics of microbes growing in batch culture.
- act in accordance with safe laboratory practice in terms of conduct, attire, risk minimization and appropriate waste disposal.

Practicals:

1. General Rules and Safety in Microbiology Laboratory.
2. Study of basic requirements in Microbiology Laboratory- Autoclave, Hot air oven &Incubator
3. Staining techniques (Monochrome staining, Gram's staining, Negative staining)
4. Preparation of solid and liquid media
5. Isolation of bacteria by spread plate, streak plate and pours plate method
6. Isolation of microorganisms from soil, water and air.
7. Isolation of microorganisms by using selective media.
8. Study of motility of Microorganisms by hanging drop method
9. Study of bacterial growth curve
10. Effect of environment on growth of microorganisms.

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

Course Title: Chemistry for Biologists **Course Code: U-CFB-190**
Marks: 50 **Lectures: 45** **Credit: 03**

Learning Objectives:

- To understand basic chemical concepts and the basics of organic chemistry.
- To get idea about the Laws of Thermodynamics and its significance
- To understand the difference between work and power and calculate the power for physical situations.
- To study the role of light in special reference to bioinstrumentation design

Course Outcomes:

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

- explain the concept of valency can account for, and predict the formulas of compounds.
- interpret the role of the internal energy, enthalpy, entropy, temperature, pressure and specific volume thermodynamic properties.
- define role of mechanical energy and relate it to the amount of kinetic energy and potential energy.
- analyze and calculate interference between plane waves and spherical waves, reflection and transmission of plane waves, and optical waves guiding within thin plates and optical fibers.

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

Basic concepts of Chemistry

Chemical bonding- various theories (Valence bond theory and Valence Shell Electron Pair Repulsion (VSEPR) theory), Type of Chemical bonds, Acids & Bases, Buffer solutions, solubility products, Ways of expressing concentrations of solution- (Molarity, Normality, Molality, Formality), Colligative properties- Lowering of vapour pressure, Osmosis and osmotic pressure, Elevation in boiling point, Depression in freezing point.

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

General Organic Chemistry

Basics in organic chemistry- Tetra covalency of Carbon, Hybridization, Substrates & Reagents,Bond fission, Types of Reagents, Reactive intermediates- Carbocation, Carbanion, Free radicals, Types of organic reactions- Substitution, Addition, Elimination, Rearrangementreactions, Oxidation reactions of carbohydrates, Osazone formation reaction, Ruff degradation,Kiliani-Fischer synthesis.

Unit-III: (13 L)

Reaction Kinetics & Thermodynamics:

Reaction Kinetics: Rate constant, Order of reaction & Molecularity of reactions, Activation Energy, Zero, First & Second order kinetics, Catalysis & enzyme catalysis for elementary reactions.

Thermodynamics: Recapulation of definition & terms involved in thermodynamics, Laws of thermodynamics, Hess law, Heat of formations, free energy, work function & Kirchhoff's equations.

Unit-IV: (10 L)

Stereochemistry & Spectroscopic methods

Isomerism and its types-Optical & Geometrical isomerism, Representation of molecules- Fischer Projection formulae, Sawhorse Projection, Newman & Flying & Wedge model.

Definition of spectroscopy, Electromagnetic spectrum & its characterization (frequency, wavelength, Wave number), Principle & applications of various spectroscopic techniques.

Recommended Textbooks and References:

1. Principles of Physical Chemistry (2017) 4th edition, S.H. Marron and C.F. Prutton, CBS Publishers And Distributors Pvt Ltd.
2. Physical Chemistry (2020) Puri Sharma and Pathania, Vishal Publishing Company
3. Advanced Organic Chemistry(2015) 7th Edition J. March, Wiley Publication.
4. Concise Inorganic Chemistry, 5th Edition (2016) J. D. Lee., Wiley Publication.
5. Principles of Inorganic Chemistry, 32nd edition (2014)Puri Sharma and Kalia, Milestone publishers & distributors.
6. Organic Chemistry, 5th Edition (1987) Morrison, Prentice Hall of India Pvt. Ltd. Boyd, New Delhi.
7. Guidebook to Mechanism in Organic Chemistry (2003) 6th Edition, Peter Sykes, Orient Longman.
8. Physics, (Vol-I and Vol-II) (2001) Devid Hallday Roberet Resnik, Wiley Eastern limited
9. Fundamentals of optics (2017) Jenkins white, McGraw Hill Publication.
10. Text book of optics, N. Subrahmanyan Brijlal, S. Chand and Company Limited.
11. Stereochemistry by P.S. Kalsi

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

Course Title: Lab Course IV **Course Code: U-LAC-194**
Marks:50 **Credit: 02**

Learning Objectives:

- To understand basic chemical concepts with application related to safety measures in a Chemical laboratory, preparation of standard solutions etc.
- To aware students about different uses of chemicals, its handling and the safety precautions.
- To determine the concentration of an acid or base by exactly neutralizing it with a standard solution of base or acid having known concentration with the help of titration method.
- To demonstrate conceptual understanding of fundamental principles of physics.

Course Outcomes:

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

- prepare a buffer solution at a given pH and concentration.
- analyze the titration curve for the titration of Weak acid with a strong base.
- be skillful in problem solving, critical thinking and analytical reasoning in interdisciplinary research.
- demonstrate the ability to apply knowledge/skills of physics in reference to bioinstrumentation design

Practicals:

1. Safety Measures in Laboratory, care of Glassware, Handling of Instruments.
2. Preparation of Standard Solutions, Molar, Normal Percent, Buffer Preparations (Milimoles and Micromoles).
3. Determination of pKa of weak acid (Acetic acid / Amino acid) by pH metry
4. Steam Distillation
5. Column Chromatography
6. Determine the Strength and Normality of an acid.
7. Study of kinetics of cooling of Hot water
8. Synthesis of aniline from Nitrobenzene by reduction with Sn/Hcl
9. Synthesis of Congo Red Dye/ P-amino azobenzene/orange-II.
10. Determination of Activation energy of Reaction between KI and $K_2S_2O_8$
11. Preparation of Standard Solution of $K_2Cr_2O_7$ and standardization of given $FeSO_4$ solution.
12. Preparation of Standard Solution of Na_2CO_3 and standardization of given HCl solution and estimate the amount of NaOH in the given solution
13. Determination of Physical constant of organic compounds M.P. - Naphthalene, m-dinitrobenzene, acetanilide, Benzoic acid.
14. Determination of Physical constant of organic compounds B.P.- Aniline, Acetophenone, Benzaldehyde, Acetone.

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

Course Title: Communicative English II **Course Code: U-COE-201**
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 basics of pronunciation.
- To help learners to recognize and make use of sentence structures in English

Course Outcomes:

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

- focus a lot on listening style to be the better speaker of English language
- realize the proper style of English for oral communication and can use words and sentences with proper accent and intonation.
- speak English by using proper sentence structures
- complete the paper which has three units to be done in each semester.

Unit I: **(08L)**

Oral Communication 2

1. Dialogues (formal and informal)
2. Monologues (formal and informal) – self-introduction (name, class, schooling, family information in detail, aims and objectives, hobbies, likes –dislikes, future plans), short stories, To be assessed through MCQ, short /long answer questions.

Unit II: **(08L)**

Practical Phonetics 2

1. Syllable
2. Word Accent (11 rules), accent rules of the past/present and plural forms of the words.
3. Transcription
4. Intonation patterns (Falling and Rising)

To be assessed through MCQ, short /long answer questions.

Unit III: **(08L)**

Basic Grammar 2

1. Basic Clause types (S V O C A)
2. Kinds of sentences (Simple, Compound, Complex etc)
3. Common Errors

Unit IV: **(06L)**

Explanatory Writing

1. An Important Person I Know about
2. At Library
3. Food I don't like
4. What I know about an animal?
5. Who I will be in the future?

Practical:

1. 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.
2. Once in a week student attend the lab class as per the lab timetable.

Recommended Textbooks and References:

1. A Textbook of Phonetics for Indian Students (1981) Balasubramanium, T. New Delhi: Macmillan
2. A Course in Phonetics and Spoken English (1997) Sethi, J. & P. V. Dhamija, New Delhi, Prentice-Hall
3. Rediscover Grammar with David Crystal (1985) Crystal, David. Longman.
4. A Course in English Grammar, Bakshi, R. N. Orient Longman Dictionary of Common Errors ,2004, Turton N.D., Heaton J. B. Longman, Pearson Longman

Rajarshi Shahu Mahavidyalaya, Latur
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B.Sc. Biotechnology (Semester Pattern)
II Semester
Course Title: Biophysics and Bioinstrumentation
Course Code: U-BBI-287
Marks: 50 Lectures: 45 Credit: 03

Learning Objectives:

- To understand the analytical techniques and equipment used in Biological science.
- To understand the basic principle and applications of microscopy and centrifugation.
- To acquire knowledge on the Chromatographic and electrophoretic method for the separation of biological molecules.
- To use scientific understanding of analytical techniques and detailed interpretation of results.

Course Outcomes :

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

- explain the use and applications of microscopy and centrifugation.
- interpret the mechanism of bio-molecular separation and purification using chromatography
- understand the separation of nucleic acids and proteins by electrophoresis.
- understand the uses and applications of radioactivity in biological sciences.

Unit-I: (11 L)

Magnetism, Fluid Statics, Atomic structure

The magnetic field. The definition of B. Poles and dipoles. Gauss' law of magnetism. Magnetism of earth. Para magnetism. Diamagnetism. Ferromagnetism. Biomagnetism with examples.

Fluid Statics: Fluids: Definition, Pressure and Density. Pascal's Principle. Measurement of pressure. Various units of pressure.

Atomic structure: Historical background up to Bohr model. Significance of second and third postulate of Bohr's model. Quantization of energy levels using Rydburg's constant, Bohr – Sommerfeld model. Quantum numbers. Uncertainty Principle, Pauli's exclusion principle.

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

Chromatography, Spectroscopy

General Principle, Plane Chromatography: Paper/TLC, Column Chromatography: Ion Exchange**.**

Spectroscopy: Definition. Electromagnetic wave. Electromagnetic spectrum. Applications of each region of the electromagnetic spectrum for spectroscopy. Excitation. Absorption. Emission. Rotational spectra. Vibrational spectra. Principle, construction and working of colorimeter, UV- Visible Spectrophotometer, Application to biomolecules (Proteins, DNA, Hb, Chlorophyll).

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

Electrophoresis, Radioactivity

General Principle, Electrophoretic Mobility, Factors Affecting electrophoretic Mobility Example: Agarose Electrophoresis

Radioactivity: Atomic Nucleus. Properties. Nuclear forces. Radioactive nucleus. Types of Radioactive decay. Half-life-physical and biological. Handling and standardization of alpha and beta emitting isotopes. Radiopharmaceuticals and their application. GM counter- Principle,construction and working.

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

Bio instruments, Thermoregulation, Microscopes Optics

Principle, construction, working and applications for analysis of biomolecules of following instruments. pH meter, Viscometer, Centrifuge, different types of centrifuges.

Thermoregulation: Thermometric properties and types of thermometers (clinical, thermocouple, bimetallic, platinum resistance, thermistor - thermometers). Body temperature and its regulation.

Microscopes Optics: Properties of light: Reflection, refraction, dispersion, diffraction, Interference and Polarization.

Concepts - Resolving power. Chromatic and achromatic aberrations. Construction and working of following microscopes–Dissecting, Compound light and Darkfield. Phase contrast. Electron microscopes: Working of electron gun. Construction and working of SEM, TEM, STEM. Sample preparation.

Recommended Textbooks and References:

1. Perspectives of modern physics – Arthur Beiser (Mc Graw Hill)
2. Nuclear physics an introduction – S.B. Patel (New Age International)
3. Introduction to atomic spectra – H.E. White (Mc Graw Hill)
4. Textbook of optics and atomic physics – P.P. Khandelwal (Himlaya Publishing House).
5. Molecular cell biology – Lodish, Berk, Matsudara, Kaiser, Krieger, Zipursky, Darnell(W.H. Freeman and Co.)
6. Biophysics - Cotrell (Eastern Economy Edition)
7. Practical Biochemistry- principles and techniques (Fifth edition)Keith Wilson and John Walker.;Cambridge University press, London, UK.
8. Clinical Biophysics –Principles and Techniques- P. Narayanan (Bhalani Pub., Mumbai)
9. Biophysics – Pattabhi and Gautham (Narosa Publishing House)
10. Instrumentation measurements and analysis – Nakara, Choudhari (Tata Mc Graw Hill)
11. Handbook of analytical instruments – R.S. Khandpur (Tata Mc Graw Hill)
12. Biophysical Chemistry- Upadhyay, Upadhyay and Nath – (Himalaya Pub. House, Delhi)
13. Medical Physiology- Guyton & Hall- Eleventh Edition-(Elsevier)
14. At the Bench- A Laboratory Navigator (2005) K. Barker, Cold Spring Harbor Laboratory Press.
15. Cell and Molecular Biology: Concepts and Experiments(2009) Gerald Karp, John Wiley and Sons

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

Course Title: Lab Course V **Course Code: U-LAC-291**
Marks:50 **Credit: 02**

Learning Objectives:

- To learn the use and applications of various bio-instruments used in life sciences
- To understand the principle, working and uses of microscopy and centrifugation.
- To get knowledge of separation, purification and quantification of biomolecules.
- To understand the various biophysical techniques such as chromatography, electrophoresis and spectroscopic methods.

Course Outcomes:

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

- get the knowledge about the various instrumentation and its handling.
- study the various methods for separation, purification and quantification of biomolecules.
- understand the centrifugation, microscopy, chromatography and spectroscopic analysis of biomolecules.
- to solve the problems related to principals and use of various bioinstruments

Practicals:

1. Safety measure – time
2. Temperature measurement: using thermocouple, RTD
3. Study of Lambert's & Beer's law
4. Absorption spectrum of protein
5. Paper/ TLC
6. Instrumentation – Colorimeter
7. pH meter
8. Microscopy – light
9. Agarose Electrophoresis
10. Problems based on Radioactivity

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

Course Title: Genetics **Course Code: U-GEN-288**

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

Learning Objectives:

- To learn basics or fundamentals of classical genetics including, mendelian genetics, gene interactions, sex determination etc.
- To understand concepts of cytogenetic and microbial genetics including chromosome mapping.
- To learn the concepts of mutation, mutagens, mutagenesis, point mutations and chromosomal aberrations.
- To understand advanced and applied concepts of population and quantitative genetics.

Course Outcomes:

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

- interpret the distinct features of various patterns of inheritance in plants and animals and be able to solve the genetics problems based on it.
- understand morphological, molecular features of chromosomes, phenomenon of linkage, crossing over, and microbial genetics.
- understand the concept of mutations, its beneficial applications and harmful effects on living organisms.
- get the details of population and quantitative genetics and its applications in studying life and improvements of crops in agriculture.

Unit-I: **(14 L)**

Introduction

Introduction: Genetics and the organisms, Scope and significance of genetics, a brief idea from gene to phenotype, genetic symbols, Transmission genetics Mendelism: An overview of Mendel's work, Monohybrid cross, Dihybrid cross, Test cross, reciprocal cross, principles of Mendel, application of Mendelian principles in the study of human traits., Extensions and modifications of basic principles: Lethal alleles, Multiple alleles, Gene interactions –complementary gene interaction, epistasis, duplicate gene interaction.

Interaction between sex and heredity**:** sex- influenced and sex- limited characteristics, Cytoplasmic inheritance.

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

Linkage and Sex determination

Linkage, recombination and eukaryotic gene mapping, crossing over-mechanism of crossingover, Sex determination in animals: chromosomal theory of sex determination, genic balance theory, Sex determination in plants, Sex linkage, Pedigree analysis, Prokaryotic gene mapping by using conjugation, transformation and transduction techniques.

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

Gene mutation and chromosomal mutations

Concept of Mutation, Mutagens, spontaneous and induced mutation,complementation test,Benzer's experiment about rIl locus inT_4 bacteriophage, point mutation

Cytogenetics: chromosome structure, number and size, Karyotyping of chromosomes,structural chromosomal mutations, numerical Chromosomal mutations

Chromosomal aberrations: syndromes-Down syndrome, Klinefelter syndrome, Turnersyndrome, Cri-du-chat syndrome.

Application of mutation in improvement of plants and microbes for human welfare.

Unit-IV: **(09 L)**

Recent trends in genetics

A brief idea about Quantitative genetics, Population genetics: Gene and genotypic frequencies, Hardy –Weinberg equilibrium.

Recommended Textbooks and References:

1. Principles of Genetics (2002), Seventh Edition, Robert H. Tamarin, Tata-McGraw Hill,.
2. Genetics, Principles and Analysis (1998), 4th Edition; Daniel Hartl & E.W. Jones, Jones & Bartlett Publication.
3. The science of Genetics (1999), 1st edition, Atherly, A. G. Girton, J. R & MC Donald, J. F., Saunders College Publications / Harcourt Brace.
4. Genetics, (1995),, 3rd edition, M.W. Strickberger, Macmillan Publications ,New York.
5. Principles of Genetics (1997), 4th edition, Snustad D P, M J Simmons and J P Jenkins, John Wiley and Sons, INC.
6. An introduction to genetic analysis (2000). 6th edition, Griffiths A J F, H. J. Muller, D. T. Suzuki, R. C. Lewontin and W. M. Gelbart, W. H. Greeman. New York
7. Genetics: a molecular approach (2016), 3rd edition, Peter J. Russell,Pearson
8. Concepts of genetics (2003), ,7 th edition, William S. Klug, and Micheal R. Cummings , Pearson.

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

Course Title: Lab Course VI **Course Code: U-LAC-292**
Marks:50 **Credit: 02**

Learning Objectives:

- To solve problems based on monohybrid and dihybrid cross.
- To solve problems related with interaction of genes, probability, student's t test and chi square test.
- To Understand Pedigree analysis of humans and to solve problems related with hardy-weinberg law.
- To test the blood group of given blood samples and understand human traits and their inheritance.

Course Outcomes:

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

- solve genetics problems based on monohybrid cross, dihybrid cross and interaction of genes.
- understand inheritance patterns in human pedigree about inheritance of genetic diseases and other human traits.
- solve problems related with application of biostatistics in genetics and hardy-weinberg law.
- understand the blood group test and properly interpret the results of blood group test.

Practicals:

1. Problems based on monohybrid and dihybrid cross.
2. Problems based on interaction of genes
3. Problems based on pedigree analysis.
4. Problems based on Hardy-Weinberg equilibrium.
5. To study the human blood group by using a given blood sample.
6. Study of karyotype.
7. Study of Human traits, Animal traits and plant traits for its diversity in phenotype.

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B. Sc. Biotechnology (Semester Pattern)
II Semester
Course Title: Fundamentals of Biological Chemistry
Course Code: U-FUB-289
Marks: 50 Lectures: 45 Credit: 03

Learning Objectives:

- To understand the basic concepts in formation and function of nucleic acids.
- To discuss the benefits of simple carbohydrates and to describe the structures of saturated and unsaturated fatty acids and outline their roles and importance in the human body.
- To understand the significance of domains in protein function and how they have arisen.
- To understand that sodium, potassium, calcium and chloride ions are important in maintaining the correct composition of cells and of the tissue fluids around them.

Course Outcomes:

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

- interpret the properties of nucleotides, how they contribute to secondary and tertiary structures of nucleic acids at the molecular level.
- distinguish between monosaccharides, disaccharides, and polysaccharides.
- correlate the structural and functional role of amino acids and proteins in construction of life forms
- develop the ability to identify both deficiency and toxicity symptoms of each micronutrient, and determine how these may occur.

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

Atoms, Carbohydrates

Structure of atom, Molecules, weak interaction stabilizing biomolecules, Henderson-Hasselback equation pH, pK, buffers, and thermodynamics principles.

Carbohydrates: Introduction, biological importance. Definition, Classification, Monosaccharides other than glucose, glycosidic bond, disaccharides, polysaccharides [starch,glycogen].

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

Lipids and Nucleic acids

Lipids: Introduction, Classes, Fatty acids [Physical properties. Chemical properties, Saponification value, acid value, iodine number, rancidity]. Glycerolipid, Sphingolipid.

Nucleic acids: Nucleosides, nucleotides, Polynucleotide, DNA and its different forms [A,

B,C, D, E and Z], RNA and its types. Forces stabilizing nucleic acid structure.

Unit-III: (10 L)

Amino acids and Proteins

Amino acids: Structure and / classification. Properties of amino acids, Acid base behavior/

/color reactions/Zwitterions.

Protein structure: Classification, Conformation of proteins (primary, secondary, super secondary, quaternary domains) Peptide bond. Biological function of protein.

Unit-IV: (11 L)

Enzymes

Enzymes: Basic concept, active site, energy of activation. Lock and key hypothesis, inducedfit hypothesis.

Co-enzymes: Niacin, Folic acid, Cyanocobalamin.

Recommended Textbooks and References:

1. Outlines of Biochemistry (2006), , 5th Edition, Conn and Stumpf. Wiley Publication.
2. Principles of Biochemistry (1995), Jeffory Zubey, WCB Publishers.
3. Biochemistry (2015), L. Stryer ,WH Freeman Publication.
4. Principles of biochemistry, Lehninger , Nelson, Cox., , CBS Publishers.
5. Fundamentals of Biochemistry (2016), 5th Edition, Voet et al., Wiley Publication.

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

Course Title: Lab Course VII **Course Code: U-LAC-293**
Marks:50 **Credit: 02**

Learning objectives:

- To develop skill and proficiency in preparation of laboratory reagents, normal and molar solutions.
- To apply the properties of functional groups of organic compounds to carry out selective organic reactions.
- To understand the various methods of quantitative and qualitative estimation of different biomolecules.
- Demonstration of basic oxidation and reduction reactions.

Course outcomes:

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

- prepare different standard solutions, Buffer etc.
- skillfully estimate concentration of proteins, lipids, nucleic acids, and carbohydrates
- determine presence of biomolecules like carbohydrates, proteins, lipids, etc. in known and unknown samples.
- acquire skills to determine saponification value and iodine value of oil and different types of fats.

Practicals:

1. Preparation of solutions, buffer sensitivity, specificity accuracy, Molarities, molality,normality.
2. Qualitative test for carbohydrates
3. Titration of Oxalic acid and amino acid
4. Determination of Acid value of fat
5. Saponification of Fat
6. Estimation of DNA by DPA method
7. Estimation of RNA by Orcinol Method
8. Estimation of Total reducing Sugar by DNSA method
9. Estimation of Amino acids by Ninhydrin method
10. Estimation of Protein by Biuret and Lowry Method

Rajarshi Shahu Mahavidyalaya, Latur
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B.Sc. Biotechnology (Semester Pattern)
II Semester
Course Title: Biomathematics, Biostatistics, and Computer
Course Code: U-BBC-290
Marks: 50 Lectures: 45 Credit: 03

Learning Objectives:

- To perform the operations of union, intersection, complement, and difference of sets in set theory using proper mathematical notation.
- To understand the representation of data in interactive graphical representation
- To understand the central tendency of various types of frequency distribution with correlation and regression
- To navigate and perform common tasks in Word, such as opening, viewing, editing, saving, and printing documents, and configuring the application.

Course Outcomes:

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

- enhance knowledge and understanding of mathematical modelling and statistical methods in the analysis of biological systems.
- communicate key statistical concepts to non-statisticians and they will gain proficiency in using statistical software for data analysis.
- calculate the range of a data set, and recognize its limitations in fully describing the behavior of a data set.
- perform repetitive operations efficiently using tools such as Find and Replace, Format Painter, and Styles.

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

Biomathematics

Set Theory: Definition, types of representation of sets, types of sets, operation on sets, difference set, complement of set, union of set, intersection of set, cardinality and its properties. Basic Probability: Concept of probability, sample space, types of events, factorial, permutation & combination, conditional probability, addition theorem of probability. Determinant: introduction, value of determinant, properties of determinants. Matrices: calculation, types of matrices, addition & Multiplication of matrices

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

Biostatistics

Basics Statistics: Introduction, classification of data, presentation of statistical data, presentation of statistical data, values of variable and frequency, cumulative frequency distribution, diagrammatic presentation of statistical data, type of graphs, charts and diagrams, Histogram Bar chart, pie chart, frequency polygon, OGIVE, quartiles, deciles and percentiles

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

Measures of central Tendency

Measures of central Tendency: Introduction, mean, properties of arithmetic mean, Short cut method of calculating A.M for discrete series, Calculation of arithmetic mean for grouped frequency, Distribution: continuous series, calculation of arithmetic mean from grouped frequency distribution with open end class, geometric mean, Harmonic mean, advantages and disadvantages of A.M, G.M and H.M., Median, Mode and Correlation and Regression

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

R Software

R Software: Basic fundamentals, installation and use of software, data editing, use of R as a calculator, functions and assignments. Use of R as a calculator, functions and matrix operations, missing data and logical operators.

Recommended Textbooks and References:

1. Mathematical Analysis Malick, S.C. and Arora
2. Maths :- a self-study Guide – Cambridge Low prices edition Jenny Olive
3. Introduction to real analysis (1992) 2nd edition, R.G. Bartle and D.R. Sherbert, JohnWiley, New York
4. Elementary Differential equations (1989) McMillan, New York E.D. Rainville and P.E. Bedient
5. Fundamentals of Biosatistics (low price Third Revised edition) ; Ukaaz Publication Khanand Khanum
6. Fundamental of Statistics: S.P.Gupta
7. Statistical methods in Biology Baily N.T..J
8. Computer Fundamentals – P.K. Sinha

9. THOMAS' CALCULUS/Single Variables (Twelfth edition) – Addison Wisley George Thomas
10. The Calculus Lifesaver-Princeton University Press. Adrian Banner
11. R software for Beginners (2018), 1st Edition, Mr. Akash J. Waghmare, Mr. Mahesh S. Wavare, Shaurya Publication, Latur

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II Semester

Course Title: Lab Course VIII **Course Code: U-LAC-294**
Marks:50 **Credit: 02**

Learning Objectives:

- To introduce students to various statistical methods relevant to biologies like a measure of central tendency.
- To use mathematical tools, including calculus and mathematical statistics and in the description and development of statistical procedures.
- To understand Microsoft Office and its variety of business-based applications.
- To understand various aspects of the R language.

Course Outcomes:

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

- recognize, describe and represent numbers and their relationships, and also they are able to count, estimate, calculate and check with competence and confidence in solving problems.
- apply statistical theory, methods and techniques to public health research data and the planning, implementation and evaluation of public health programs.
- find the middle, average of a data set and to determine the typical numerical point in a set of data. Create documents for printing and sharing and to create and share presentations.
- understand graphical representation by using statistical techniques with the help of the R language.

Practicals:

1. Exercise based on mathematics
2. Exercise based on statistical methods for biologists
3. Computer – Getting familiar with the hardware, booting & operating
4. Tutorials operating systems: DOS, Windows, Linux etc.
5. File handling: copy, rename, delete, type etc. Directory structure: make, rename, movedirectory
6. Use of internet – Downloading & Installing software/plugins on Windows (Acrobat Reader,Post Scripts Viewer, etc.)
7. R Software: Basic fundamentals, installation on different operating systems
8. R is used Graphics function and plots
9. Statistical functions for central tendency, variation, skewness and kurtosis
10. Handling of data through graphics, programming and illustration with examples.

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	Cell Biology	U-CEB-187	Professional Ethics	Expertise in cell culture techniques will create employability in Pathology labs and Research Institutes
2	Introduction to Microbiology	U-INM-189	Professional Ethics	Expertise in Microbiological techniques will create employability in Pathology Labs, Research and Industries
3	Biophysics and Bioinstrumentation	U-BBI-287	Professional Ethics	Expertise in Handling of Instruments
4	Genetics	U-GEN-288	Professional Ethics	Expertise in Genetics and create employability as Laboratory geneticist
5	Fundamentals of Biological Chemistry	U-FUB-289	Professional Ethics	Expertise in qualitative and

				Quantitative analysis of biomolecules will create employability in Pathology labs, QA and QC
6	Biomathematics, Biostatistics, & Computer	U-BBC-290	Professional Ethics	Expertise in data analysis

Sr. No.	Course Name	Code	Relevant to Human Values	Description
1	Moral Education	U-MOE-235	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 with Local/National/Regional/Global development
1	U-CEB-187	Cell Biology	Basic Cellular Information and Techniques (Competitive Examination and Research)
2	U- BBS-188	Basic Bioscience	Plant and Animal Physiology (Competitive Examination and Research)
3	U-INM-189	Introduction to Microbiology	Basic Microbial Techniques (Research)
4	U-CFB-190	Chemistry for Biologists	Basic Chemical and Physical Concepts ((Competitive Examination)
5	U-BBI-287	Biophysics and Bioinstrumentation	Basic Techniques (Competitive Examination, Research, Industry etc)
6	U-GEN-288	Genetics	Genetics (Competitive Examination and Research)
7	U-FUB-289	Fundamentals of Biological Chemistry	Qualitative and Quantitative Analysis of Biomolecules (Industry, Research etc.))
8	U-BBC-290	Biomathematics, Biostatistics, and Computer	Concepts applicable to Scientific Research

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	Cell Biology	U-CEB-187			student will understand basics of cell structure and function which will help them to develop research aptitude and encourage them to enrol in research field	2017-18
2	Basic Bioscience	U-BBS-188	Basics of Physiology helps in consolidating ideas about employability in application in biology	Knowledge of Basic bioscience boosts the ideas about applicability of biology in plant and animal-based industry.	Skills in taxonomy and basic physiology of plants and animals developed	2022-23
3	Introduction to Microbiology	U-INM-189	This course will produce Employability to students in different sectors like Pharmaceutical Industries. Universities. Laboratories. Private Hospitals.	This course knowledge will help students to open the Pathology lab, Healthcare & medicine industry	This course produce student with expertise in Microbial Techniques which help them for	2017-18

			Research Organizations.4EnvironmentalAgencies. Food Industry. Beverage Industry.		fetching job in Industries.	
4	Chemistry for Biologists	U-CFB-190	Students can get the job as Lab. Technician.		Students will skill in Chemical preparation dealing with chemicals.	2022-23
5	Biophysics and Bioinstrumentation	U-BBI-287	Students can get the job for handling the instruments.	This course knowledge will help students for operating Medical Instrumentation and Devices.	This course helps the student to understand the principle and working of every instrument.	2022-23
6	Genetics	U-GEN-288	Student can work as genetic counsellor	Research and development of new varieties of agricultural and industrial importance.	Genetics improves the logical thinking of students in biology.	2022-23
7	Fundamentals of Biological Chemistry	U-FUB-289	Student can work as Biochemist		Student gains proficiency in basic laboratory techniques in both Chemistry and Biology	2022-23
8	Biomathematics, Biostatistics, and Computer	U-BBC-290			The main focus is given to types of data, measurement of central	2017-18

					variations, and basic tests, which are useful for analysis of different types of observations. Few parameters like a normal distribution, calculation of sample size, level of significance, null hypothesis, indices of variability, and different test	