Rajarshi Shahu Mahavidyalaya (Autonomous), Latur

Biotechnology

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

(w.e.f. Academic Year 2017-18)

SYLLABUS FOR

B.Sc. I Year (Biotechnology)

Revised in JUNE 2020

Rajarshi Shahu Mahavidyalaya (Autonomous), Latur
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 cells technology.

At its simplest, biotechnology is technology based on biology - biotechnology harnesses cellular and biomolecular processes to develop technologies and products that help to improve our lives and health of our planet. Taking into consideration of the importance of Biotechnology Rajarshi Shahu Mahavidyalaya, Latur, have taken an initiative to introduce a new emerging field as a under graduate 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 on 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

- Apply basic science, engineering and program core to solve complex biotechnological problems.
- Isolate, purify and characterize biological samples using sophisticated analytical experimental techniques.
- Design process equipment, plants, biosensors and recombinant molecules for biotechnological and allied processes.
- 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.
- 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.

- Pursue life-long learning to enhance knowledge and skills for professional advancement.

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, Genetics 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), Latur
Department of Biotechnology
Choice Based Credit System
Course Structure of B.Sc. Biotechnology First Year (w.e.f. June 2017)

B. Sc. I [Biotechnology] Semester I

	Code No.	Title of the course	Lectures/ Week	Marks (100)		Credits
				In Sem	End Sem	
AECC1	U-COE-101	**Communicative English I**	04	20	30	02
CCT1	U-CEB-187	**Cell Biology**	04	20	30	03
CCT2	U-BBS-188	**Basic Bioscience**	04	20	30	03
CCT3	U-INM-189	**Introduction to Microbiology**	04	20	30	03
CCT4	U-CFB-190	**Chemistry for Biologists**	04	20	30	03
CCP1	U-LAC-191	**Lab Course I**	03	20	30	02
CCP2	U-LAC-192	**Lab Course II**	03	20	30	02
CCP3	U-LAC-193	**Lab Course III**	03	20	30	02
CCP4	U-LAC-194	**Lab Course IV**	03	20	30	02
		Total Credits				22

B.Sc. I [Biotechnology] Semester II

	Code No.	Title of the course	Lectures/ Week	Marks (100)		Credits
				In Sem	End Sem	
AECC1	U-COE-201	**Communicative English II**	04	20	30	02
CCT1	U-BBC-290	**Biomathematics, Biostatistics and Computer**	04	20	30	03
CCT2	U-BBI-287	**Biophysics and Bioinstrumentation**	04	20	30	03
CCT3	U-GEN-288	**Genetics**	04	20	30	03
CCT4	U-FUB-289	**Fundamentals of Biological Chemistry**	04	20	30	03
CCP1	U-LAC-291	**Lab Course V**	03	20	30	02
CCP2	U-LAC-292	**Lab Course VI**	03	20	30	02
CCP3	U-LAC-293	**Lab Course VII**	03	20	30	02
CCP4	U-LAC-294	**Lab Course VIII**	O3	20	30	02
GE	U-MOE-235	**Moral Education**	02	20	30	-
		Total Credits				22

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

Course Title: Communicative English -I **Course Code: U-COE-101**
Marks: 50 **Lectures: 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:

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

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

Communication

Definitions of Communication

Objectives of Communication

Types of communication & Barriers to Communication

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

Practical Phonetics 1

The IPA symbols and the sounds of English

The Speech Organs

Classification of English Sounds

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

Basic Grammar 1

Word class

Tense / Verb Forms

Articles, Prepositions

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

Oral Communication 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

Formal, informal and functional expressions

Recognizing (in listening) and appropriately using (in speaking/writing) formal and informal expressions

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.

Text & References:

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

Chennai, Macmilan

7. Soft Skills A Textbook for Undergraduates. Tengse R Ajay, Hyderabad. Orient Blackswan

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

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

Learning Objectives:

- This course aims to give the student an overview of basic cell biology and its application in and around the workplace.
- In particular, this module will focus on identifying key components that constitute living cells. The function and structure of each component will also be discussed.
- The focus will be orientated around 'Cell Biology at work' with emphasis on key techniques currently used in the study of cells.

Course Outcomes:

- Describe levels of organization and related functions in plants and animals.
- Identify the characteristics and basic needs of living organisms and ecosystems.
- Explain the processes of growth and development in individuals and populations.
- Design and critically assess the scientific investigations they perform.
- Demonstrate critical thinking skills.

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 techniques in 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: **(13 L)**

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: **(12 L)**

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 plant and animals. Cell differentiation, Neoplasia & Cell death,

Text & References:

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

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

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

Learning Objective:

- This course aims to give the student an overview of basic cell biology and its application in and around the workplace.
- In particular, this module will focus on identifying key roles of mitosis and meiosis during the life cycle, stages of mitosis and meiosis, highlighting similarities and differences.
- Describe stages of the cell cycle; focus on behavior of Chromosomes

Course Outcome:

- Discuss the principles of the techniques by which subcellular components of mammalian cells can be isolated, how their presence can be verified experimentally, and how such techniques may be utilized in research or diagnostics
- Identify and describe / draw the cellular structure of organs and tissues from prepared slides, and outline the principles of histochemical staining
- Perform experimental techniques as instructed making accurate observations; record, analyze and interpret data

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

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

Learning Objective:

- To study the scientific methods for the study of different biological basics.
- To understand fundamentals of biology, especially in reference with botany and zoology.
- Understanding fundamentals help students to design experiments related with structural and functional biology.
- Students are also able to think critically about each concept and able to face examinations related to P.G. entrance exams of different institutions.

Course Outcomes:

- Students will be able to understand biological processes that take place in and between cells and in and between organisms in nature. This understanding will make them capable of describing and explaining both biological processes and their importance for living organisms.
- Student will acquire knowledge of the most important research methods that are in use today to develop their knowledge in. biological disciplines

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

Introduction

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 apart

ecological 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 noncyclic 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: (8 L)

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: **(15 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

The digestive tract(gut) has regions specialized for digestion, absorption, storage and elimination

Animal Renal systems: Water and waste

water and electrolyte balance

Excretion of wastes

The mammalian kidney

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.

Text & References:

1. Biology by Campbell, Reece (seventh edition)2009 Pearson education
2. Life the science of biology by Sadava, Hillis, Heller, Berenbaum (eighth edition)2011 W H Freeman
3. Botany: An Introduction to Plant Biology by James D. Mauseth (Fourth edition)2009 Jones and Bartlett
4. An Introduction to Zoology -Investigating the Animal World by Joseph springer, Dennis Holley 2013 Jones and Bartlett
5. Human Body Systems, Structure, function and environment by Daniel D. Chiras (second edition)2012 Jones and Bartlett
6. Reproductive biology by Gayatri Prakash (2007) alpha science international limited
7. NCERT XI and NCERT XII(Biology)2012

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

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

Learning Objectives:

- To study the scientific methods for the study of different biological basics.
- To understand fundamentals of biology, especially in reference with botany and zoology.
- To understand fundamentals with structural and functional biology.

Course Outcomes:

- Students will be able to understand biological processes that take place in and between cells and in and between organisms in nature. This understanding will make them capable of describing and explaining both biological processes and their importance for living organisms.
- Students will acquire knowledge of the most important research methods that are in use today to develop their knowledge in. biological disciplines.

Practicals:

1. To study parts of a compound microscope
2. To identify and study the morphology of representative types of bacteria, fungi and different 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 (Autonomous), Latur
B.Sc. Biotechnology (Semester Pattern)
I Semester

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

Learning Objectives:

- The study program "Microbiology" builds consecutively on a biological education and is focused on research.
- A good scientific basic education in a Bachelor study program (normally in biology), enables enrolled students in the Master program to independent scientific work in a modern interdisciplinary scientific field.
- The study program is especially dedicated to the integration and consolidation of knowledge in microbiology.

Course Outcomes:

- Understand the structural similarities and differences among microorganisms and the unique structure/function relationships of prokaryotic cells.
- Appreciate the diversity of microorganism and microbial communities and recognize how microorganism solve the fundamental problems their environments present.
- In the laboratory students will learn the proper use of a microscope to observe microorganisms and report observed characteristics.
- Master aseptic technique and be able to perform routine culture handling tasks safely and effectively.
- Develop scientific literacy in field microbiology.

Unit-I: **(12 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 of microorganisms. Types of Culture media with examples (Defined, Selective, Natural, Differential, enrichment, Synthetic). Pure culture techniques (Streak, pour, spread plate and roll tube method).

Unit-IV: **(12 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.

Text & 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. 9thedition.Pearson Education limited.

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

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

Learning Objectives:

- Practicals are designed 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.

Course Outcomes:

- Comprehend the importance of standards/controls in biological analysis.
- Isolate and enumerate 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 (Autonomous), Latur
B.Sc. Biotechnology (Semester Pattern)
I Semester

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

Learning Objectives:

- To understand basic chemical concept with application.
- To understand usage of basic instruments which need in different chemical tests.
- To design, carry out, record and analyze the results of chemical experiments.

Course Outcome:

- Have firm foundations in the fundamentals and application of current chemical and scientific theories.
- Are able to use modern instrumentation and classical techniques, to design experiments, and to properly record the results of their experiment.
- Are skilled in problems solving, critical thinking and analytical reasoning.
- Are able to identify and solve chemical problems and explore new areas of research.
- Are able to use modern library searching and retrieval methods to obtain information about a topic, chemical, chemical technique, or an issue relating to chemistry.
- Knows the proper procedures and regulations for safe handling and use of chemicals and can follow the proper procedures and regulations for safe handling when using chemicals.

Unit-I: **(13 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, Rearrangement reactions, 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: **(12 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.

Text & References:

1. Principles of Physical Chemistry, 4thedition by S.H. Marron and C.F. Prutton
2. Physical Chemistry by Puri Sharma and Pathania
3. Advance Organic Chemistry by J. March
4. Concise Inorganic Chemistry by J. D. Lee 5thEdition
5. Principles of Inorganic Chemistry by Puri Sharma and Kalia.
6. Organic Chemistry, 5thEdition by Marrison Prentice Hall of India Pvt. Ltd. Boyd, New Delhi
7. Guide book to Mechanism in Organic Chemistry by Peper Sykes, 6thEdition, Orient Longman

8. Organic Chemistry by I.L. Finar, Volume-II, 5thEdition
9. The elements of Physical Chemistry by P.W. Atkins
10. Physical Chemistry for biological sciences by Raymond Chang (University science)
11. Stereochemistry by P.S. Kalsi

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

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

Learning Objective:

- To understand basic chemical concept with application related to safety measures in a Chemical laboratory, preparation of standard solutions etc.
- To aware students about different uses of chemicals and their uses.

Course Outcome:

- Student will able to design, carry out, record and analyze the results of chemical experiments.
- Student will able to use modern instrumentation and classical techniques, to design experiments, and to properly record the results of their experiment.
- Student will be skillful in problems solving, critical thinking and analytical reasoning.

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

Learning Objectives:

- The course involves a working understanding of Basic physics and its technical applications in Life Sciences.
- Describe different properties of magnetism.
- To study the basic instruments used in bioinstrumentation.

Course Outcomes:

- Apply key principles of biophysics toward evaluating and analyzing primary literature in the field. Be able to explain key concepts in physiology and biophysics (and supporting disciplines).
- Critically evaluate current scientific literature and demonstrate the ability to write reports that synthesize and integrate data and hypotheses.
- Demonstrate competency in carrying out standard laboratory techniques used in the discipline.
- Relate structure and function at the atomic, molecular, cellular and organismal level by integrating principles of the supporting disciplines.

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: **(15 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.

Text & 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. Keith Wilson and John Walker. Practical Biochemistry- principles and techniques; Cambridge University press, London, UK. (Fifth edition).
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, by K. Barker, Cold Spring Harbor Laboratory Press, 2005.
15. Cell and Molecular Biology: Concepts and Experiments, Gerald Karp, John Wiley & Sons, 19-Oct-2009

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

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

Learning Objectives:

- The course involves a working understanding of Basic physics and its technical applications in Life Sciences.
- To study the importance of the scientific method to understand natural phenomena.

Course Outcomes:

- Describe basic biological concepts and principles,
- Understand that biology has a chemical, physical, and mathematical basis,
- Effectively communicate scientific data and ideas, both orally and in writing, critically evaluate data, develop a hypothesis, and design experiments to address an interesting and novel problem.

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

Course Title: Genetics **Course Code: U-GEN-288**
Marks: 50 **Lectures: 50** **Credit:03**

Learning Objectives:

- To understand the basics of genetics behind heredity and variations amongst living organisms.
- To know recent trends in genetics and present applications.

Course Outcomes:

- Genetics is a fundamental branch of biology up to now contributes more in different fundamental biological science understanding fundamentals of genetics helps students to build in for applied biological sciences, such as molecular biology, genetic engineering. Genomics, proteomics etc.
- Study of genetics improves logical thinking in biology.
- Genetics study also helps to know, how biostatistics and biomathematics applicable to biology to get final conclusion

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 crossing over

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: **(15 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, Turner syndrome, 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.

Text & References:

1. Principles of Genetics by Robert H. Tamarin. Tata-McGraw Hill, Seventh Edition 2002).
2. Genetics, Principles and Analysis by Daniel Hartl & E.W. Jones. 4th Edition 1998; Jones & Bartlett Publication.
3. The science of Genetics by Atherly, A. G. Girton, J. R & MC Donald, J. F. (1999) Saunders College Publications / Harcourt Brace.
4. Genetics – M.W. Strickberger Macmillan Publications New York.
5. Snustad D P, M J Simmons and J P Jenkins, 1997. Principles of Genetics. John Wiley and Sons, INC.

6. Griffiths A J F, H. J. Muller, D. T. Suzuki, R. C. Lewontin and W. M. Gelbart, 2000. An introduction to genetic analysis. W. H. Greeman. New York
7. genetics:A mendelian approach by russel
8. Concepts of genetics by klug and cummings

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

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

Learning Objective:

- To understand the basics of genetics behind heredity and variations amongst living organisms.
- To know recent trends in genetics and present applications

Course Outcomes:

- Understanding fundamentals of genetics helps students to build in for applied biological sciences, such as molecular biology, genetic engineering Genomics, proteomics etc.
- Study of genetics improves logical thinking in biology.

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.

Rajarshi Shahu Mahavidyalaya (Autonomous), Latur
B.Sc. Biotechnology (Semester Pattern)
II Semester
Course Title: Fundamentals of Biological Chemistry
Course Code: U-FUB-289
Marks: 50 Lectures: 50 Credit: 03

Learning Objectives:

- Objective of the course is to focus on the basic concept of biomolecules and their physiological role.
- To understand the basic concepts in fundamentals of biological chemistry.

Course Outcomes:

- Biochemistry will gain proficiency in basic laboratory techniques in both chemistry and biology
- Students be able to apply the scientific method to the processes of experimentation and hypothesis testing.

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: **(15 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, induced fit hypothesis.

Co-enzymes: Niacin, Folic acid, Cyanocobalamin.

Text & References:

1. Outlines of Biochemistry: Conn and Stumpf
2. Principles of Biochemistry: Jeffory Zubey,WCB Publishers
3. Biochemistry: L.Stryer
4. Principles of biochemistry-Lehninger , Nelson,Cox,CBS Publishers.
5. Fundamentals of Biochemistry-Voet etal., John Wiley and sons, Inc.

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

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

Learning objectives:

- Objective of this course is to focus on the basic concept of biomolecules and their physiological roles
- To understand the various methods of quantitative and qualitative estimation of different biomolecules.

Course Outcomes:

- Students will be able to estimate concentration of proteins, lipids, nucleic acids, and carbohydrates
- Students will be able to prepare different standard solutions, Buffer etc.
- Students will use current biochemical techniques to plan and carry out experiments

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 (Autonomous), Latur
B.Sc. Biotechnology (Semester Pattern)
II Semester
Course Title: Biomathematics, Biostatistics and Computer
Course Code: U-BBS-290
Marks: 50 Lectures: 50 Credit: 03

Learning Objectives:

- The course involves a working understanding of tools of mathematical and computational skills in the field of Biology
- Involves learning how to present their research in writing or/and in front of an audience.

Course Outcomes:

- Understand mathematical definitions and use them correctly.
- Recognize where and how to use the major theorems, enabling them to see the big picture in various areas of mathematics.
- See where and how to use mathematical procedures.
- Provide a description of the method used for analysis, including a discussion of advantages, disadvantages, and necessary assumptions.
- Provide a discussion of the results and of the statistical analysis.
- Provide a conclusion to the study including a discussion of limitations of the analysis.
- Provide a derivation for mathematical statistics problems.

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: **(15 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.

Text & 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-R.G. Bartle and D.R. Sherbert (2nd edition)-1992, John Wiley, New York
4. Elementary Differential equations – McMillan, New York E.D. Rainville and P.E. Bedient (1989)
5. Fundamentals of Biosatistics (low price Third Revised edition) ; Ukaaz Publication Khan and 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- Mr. Akash J. Waghmare, Mr. Mahesh S. Wavare,

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

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

Learning Objectives:

- The course involves a working understanding of tools of mathematical and computational skills in the field of Biology
- To know how to present their research in writing or/and in front of an audience.

Course Outcomes:

- Provide a description of the method used for analysis, including a discussion of advantages, disadvantages, and necessary assumptions.
- Provide a discussion of the results and of the statistical analysis.
- Provide a conclusion to the study including a discussion of limitations of the analysis.
- Provide a derivation for mathematical statistics problems.

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, move directory
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.

Sr. No.	Cross Cutting Issues	Related course
1.	**Gender Sensitization**	_
2.	**Environment & Sustainability**	Basic Bioscience
3.	**Human Values**	Moral Education
4.	**Professional Ethics**	Communicative English Biomathematics, Biostatistics and Computer

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