

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY**CIRCULAR NO.SU./B.Sc.CBC & GS/11/2022**

It is hereby inform to all concerned that, on the recommendation of Faculty of Science & Technology Meeting dated 24.08.2022, **the Academic Council at its meeting held on 29 August 2022 has accepted the following Syllabi of B.Sc. Degree under the Choice Based Credit & Grading System along with Rules and Regulation** as appended herewith:-

1.	B.Sc.Computer Science (Optional)	Ist and IInd semester
2.	B.Sc.Computer Application (Optional)	Ist and IInd semester
3.	B.Sc.Computer Application (Degree)	Ist and IInd semester
4.	B.Sc.Computer Science (Degree)	Ist and IInd semester
5.	B.Sc.Horticulture (Optional)	Ist to VIth semester
6.	B.Sc.Botany (Optional)	Ist to VIth semester
7.	B.Sc. Agrochemical & fertilizer (Optional)	Ist to VIth semester
8.	B.Sc.Home Science (Optional)	Ist and IInd semester
9.	B.Sc.Automobile Technology (Degree)	Ist and IInd semester
10.	B.Sc.Workshop Technology (Degree)	Ist and IInd semester
11.	B.Sc.Refrigeration and Air Conditioning (Degree)	Ist and IInd semester
12.	B.Sc.Environmental Science (Optional)	Ist and IInd semester
13.	B.Sc.Biotechnology (Degree)	Ist and IInd semester
14.	B.Sc.Biotechnology (Optional)	Ist and IInd semester
15.	B.Sc.Dairy Sci.& Tech (Optional)	Ist and IInd semester
16.	B.Sc.Zoology (Optional)	Ist to VIth semester
17.	B.Sc.Polymer Chemistry (Optional)	Ist and IInd semester
18.	B.Sc.Fisheries Science (Optional)	Ist and IInd semester
19.	B.Sc.Instrumentation Practice (Optional)	Ist semester
20.	B.Sc.Biochemistry (Optional)	Ist and IInd semester
21.	B.Sc.Non Conventional & Conventional Energy (Degree)	Ist and IInd semester

This is effective from the Academic Year 2022-23 and onwards.

All concerned are requested to note the contents of this circular and bring notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.

Ref.No. SU/B.Sc./2022/ 8428-35

Date:-29.08.2022.

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[Signature]
Deputy Registrar,
Academic Section

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Copy forwarded with compliments to :-

- 1] **The Principal, concerned affiliated College,**
Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.
- 2] **The Director, University Network & Information Centre, UNIC, with a
request to upload this Circular on University Website.**

Copy to :-

- 1] The Director, Board of Examinations & Evaluation,
- 2] The Section Officer,[B.Sc.Unit] Examination Branch,
- 3] The Programmer [Computer Unit-1] Examinations,
- 4] The Programmer [Computer Unit-2] Examinations,
- 5] The In-charge, [E-Suvidha Kendra],
Rajarshi Shahu Maharaj Examination Branch,
- 6] The Public Relation Officer,
- 7] The Record Keeper,

JS*29082022/-

Dr. Babasaheb Ambedkar Marathwada University
Aurangabad- 431004(MS) India



Undergraduate Bachelor Degree Program
In Science(B.Sc.)
BIOTECHNOLOGY

Course Structure and Curriculum
(Outcome based Curriculum)
Choice Based Credit System
(Effective from Academic Year 2022-23)

Dr. Babasaheb Ambedkar Marathwada University
Aurangabad – 431004 (MS) India

Handwritten signature and date 29/08/22

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2. Structure and Curriculum for
Bachelor of Science (B. Sc.) BIOTECHNOLOGY
(Choice Based Credit System)

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad Choice Based Credit System (CBCS) Curriculum for Faculty of Science and Technology Course Structure and Scheme of Examination B.Sc. Three Year Undergraduate Degree Program								
Semester I								
	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Biotechnology (DSC-1A) Core Courses	BTO-111	Microbiology (Theory Paper-I)	2 hours	2	50	10	40	20
	BTO-112	Biomolecules & Cell Biology (Theory Paper-II)	2 hours	2	50	10	40	20
	BTOP-113	Lab course I Microbiology, Biomolecules and Cell biology (based on BTO-111 and BTO-112)	3 hours	1.5	50	10	40	20
Ability Enhancement compulsory courses (AECC-1)	XXX-131	Communication skills in English-I	3 hours	3	50	10	40	20
	XXX-132	Marathi/Hindi/Urdu/Sanskrit A student can opt for any one of these languages (SL-I)	3 hours	3	50	10	40	20
Non-Credit Course /Additional credits	XXX-113	Environmental Studies	2 hours	2*				
			15	11.5	250	50	200	100
Total Credits for Semester I : 11.5 (Theory : 10 ; Laboratory : 1.5)								

1. Preamble

The recent pandemic has stirred up whole globe. It had impacted the world adversely in many aspects. However, it also has drawn attention of non-scientific world to the fascinating aspects of welfare biology- The biotechnology!. The new generation students are willing to take up biotechnology as a serious carrier option; and as a first step they want to take a graduation course in biotechnology. At this point of time we are presenting the students with a new pattern of study with updated curriculum.

Currently a graduation course in this university consist of three optional subjects, each to be studied in every year along with two languages and a couple of compulsory courses.

As a part of reforms in pattern university has adopted the CBCS system for the graduation studies. The following pages will elaborate on new structure of curriculum and concurrent changes within.

Semester II								
	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Biotechnology (DSC-1B) Core Courses	BTO-211	Genetics (Theory Paper-III)	2 hours	2	50	10	40	20
	BTO-212	Biomathematics & Biostatistics (Theory Paper-IV)	2 hours	2	50	10	40	20
	BTOP-213	Lab course 2 Genetics , Biomathematics and Biostatistics (based on BTO-211-and BTO-212)	3 hours	1.5	50	10	40	20
Ability Enhancement compulsory courses (AECC-2)	XXX-231	Communication skills in English-II	3 hours	3	50	10	40	20
	XXX-232	Marathi/Hindi/Urdu/Sanskrit A student can opt for any one of these languages (SL-II)	3 hours	3	50	10	40	20
Non-Credit Course	XXX-213	Constitution of India	2 hours	2*				
Non-Credit Course /additional credits	XXX-214	Environmental Studies	2 hours	2*				
			17	11.5	250	50	200	100
Total Credits for Semester II : 11.5 (Theory : 10 ; Laboratory : 1.5)								

Semester III								
	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Biotechnology (DSC-1C) Core Courses	BTO-311	Metabolism and Bioenergetics (Theory Paper-V)	2 hours	2	50	10	40	20
	BTO-312	Molecular Genetics (Theory Paper-VI)	2 hours	2	50	10	40	20
	BTOP-313	Lab course 3 Metabolism (based on BTO-311)	3 hours	1.5	50	10	40	20
	BTOP-314	Lab course 4 Molecular Genetics (based on BTO-312)	3 hours	1.5	50	10	40	20
Skill Enhancement course BIOTECHNOLOGY (SEC BT-1)	BTO-315	SEC BT-1(A) MOLECULAR BIOLOGY TECHNIQUES 1 , SEC BT-1 (B) MEDICAL BIOTECHNOLOGY-1	2 hours	2	50	10	40	20
Ability Enhancement compulsory courses (AECC-3)	XXX-331	Communication skills in English-III	3 hours	3	50	10	40	20
	XXX-332	Marathi/Hindi/Urdu/Sanskrit A student can opt for any one of these languages (SL-III)	3 hours	3	50	10	40	20
Additional credits		Computer ability	2 hours	2*	50	10	40	20
			18	15	350	70	280	140
Total Credits for Semester III : 15 (Theory : 12 ; Laboratory : 3)								

Semester IV								
	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Biotechnology (DSC-1D) Core Courses	BTO-411	Environmental Biotechnology (Theory Paper-VII)	2 hours	2	50	10	40	20
	BTO-412	Enzymology (Theory Paper-VIII)	2 hours	2	50	10	40	20
	BTOP-413	Lab course 5 Environmental Biotechnology (based on BTO-411)	3 hours	1.5	50	10	40	20
	BTOP-414	Lab course 6 Enzymology 6 (based on BTO-412)	3 hours	1.5	50	10	40	20
Skill Enhancement course BIOTECHNOLOGY (SEC BT-2)	BTO-415	SEC 2(A) BT-MOLECULAR BIOLOGY TECHNIQUES 2 SEC 2 (B) BT- MEDICAL BIOTECHNOLOGY-2	2 hours	2	50	10	40	20
Ability Enhancement compulsory courses (AECC-4)	XXX-431	Communication skills in English-IV	3 hours	3	50	10	40	20
	XXX-432	Marathi/Hindi/Urdu/Sanskrit A student can opt for any one of these languages (SL-IV)	3 hours	3	50	10	40	20
Additional credits		Computer ability	2 hours	2*	50	10	40	20
			18	15	350	70	280	140
Total Credits for Semester IV : 15 (Theory : 12 ; Laboratory : 3)								

Semester V								
	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Biotechnology (DSE-1 A) Discipline Specific Elective	BTO-511	DSE-1A(1) (Theory Paper-IX) A- INDUSTRIAL TECHNOLOGY I B- PLANT TISSUE CULTURE I C- BIOPHYSICAL TECHNIQUES I D- BIOGAS TECHNOLOGY I (Select any one paper from ABOVE)	2 hours	2	50	10	40	20
	BTO-512	DSE-1A(2) (Theory Paper-X) A -Recombinant DNA Technology –II B- PLANT TRANSFORMATION TECHNIQUES –II (Select any one paper from A OR B)	2 hours	2	50	10	40	20
	BTOP-513	Lab course 7 (based on BTO-511)	3 hours	1.5	50	10	40	20
	BTOP-514	Lab course 8 (based on BTO-512)	3 hours	1.5	50	10	40	20
	BTO-515	SEC-3 (Any one skill to be chosen out of two) SEC-3(E) MICROBIAL CULTURE PRESERVATIONS, SEC-3 (F) PRODUCT RECOVERY OPERATIONS	2 hours	2	50	10	40	20
Skill Enhancement course BIOTECHNOLOGY (SEC BT-3)	BTO-515	SEC-3 (Any one skill to be chosen out of two) SEC-3(E) MICROBIAL CULTURE PRESERVATIONS, SEC-3 (F) PRODUCT RECOVERY OPERATIONS	2 hours	2	50	10	40	20
Non-Credit Course	BTO-516	Professional Ethics and Moral Values	2 hours		50	10	40	20
			14	9	250	50	200	100
Total Credits for Semester V : 9 (Theory : 06 ; Laboratory : 03)								

Semester VI								
	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Biotechnology (DSE-1 B) Discipline Specific Elective	BTO-611	DSE-1B (1)(Theory Paper-XI) A- INDUSTRIAL TECHNOLOGY II B- PLANT TISSUE CULTURE II C- BIOPHYSICAL TECHNIQUES II D- D- BIOGAS TECHNOLOGY I (Select any one paper from ABOVE)	2 hours	2	50	10	40	20
	BTO-612	DSE-1B(2) (Theory Paper-XII) A -Recombinant DNA Technology –II B- PLANT TRANSFORMATION TECHNIQUES –II (Select any one paper from A OR B)	2 hours	2	50	10	40	20
	BTO-621	Lab course 9 (based on BTO-611)	3 hours	1.5	50	10	40	20
	BTO-622	Lab course 10 (based on BTO-612)	3 hours	1.5	50	10	40	20
Skill Enhancement course BIOTECHNOLOGY (SEC BT-4)	BTO-613	SEC-4 Any one skill to be chosen out of two SEC-4(G) ALGAL CULTURE TECHNOLOGY, SEC-4 (H) MUSHROOM PRODUCTION TECHNOLOGY	2 hours	2	50	10	40	20
			15	9	250	50	200	100
Total Credits for Semester V : 09 (Theory : 06 ; Laboratory : 03)								
Total Credits for three years : Sem I (11.5) + Sem II (11.5) + Sem III (15) + Sem IV (15) + Sem V (09) + Sem VI (09) = 71 Credits								

3. Vision:

To develop the students of Dr. Babasaheb Ambedkar Marathwada University to be an Epitome of Excellence by creating and imparting Quality Education. to address Changing Scenario, keeping Research and Development at its core, for 'Anyone' at 'Anytime' and 'Anywhere'.

4. Mission:

To provide an opportunity to quality and world class curriculum to underprivileged students from Marathwada region

To impart value added, culturally rich education by adopting the local to global approach.

4. Program Educational Objectives:

- A course in biotechnology at Bachelor provides an amalgamated approach of basic concepts of biology, molecular biology, genomics, rDNA technology, microbiology, biochemistry and bioinformatics with technological applications.
- The main objective of this optional course is to enable students with enhanced skills and knowledge to carry out higher studies, entrepreneurship or research and development (R&D) in the various health, research and industrial areas.
- Develop proficiency in application of current and modern aspects of biology, that include molecular biology, rDNA technology, bioinformatics and genomics. etc
- Students will be able
 - to use state of the art techniques relevant to academia and industry,
 - to undertake further studies in the field of applied aspects of biotechnology, molecular biology, Recombinant DNA technology, and other related field.

- Deliver an education that improve communication skills, the ability to work in a team, to inculcate leadership quality, and develop a sense of social responsibility with an ethical attitude

5. **Programme Outcomes (POs) and Programme Specific Outcomes:**

- **PO1:** Students develop wider capacities in the area of basic and applied biological sciences for sustainable development.
- **PO2:** Blending traditional and modern teaching methods for enhancing the subject knowledge of students by using 'perform and learn' strategy.
- **PO3:** To enrich students' knowledge in cutting edge domains of biology
- **PO4:** To train students in various branches of Biotechnology such as genetics, molecular biology, biochemistry, immunology, fermentation technology, environmental biotechnology and tissue culture techniques.
- **PO4:** To groom the students to meet futuristic challenges and national interests

Programme specific outcomes

PSO1: To bestow the students with all the research skills required to work independently to understand the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena. Students will demonstrate an understanding of major concepts in all disciplines of biology

PSO2: To develop scientific temperament and social responsibilities in the students. in all aspects related to life

PSO3: To inculcate 'nature care' by imparting knowledge of advanced modern techniques

PSO4: As Biotechnology is an interdisciplinary course, empower the students to acquire technological knowhow by connecting disciplinary and interdisciplinary aspects of biotechnology.

PSO5: Acquire knowledge in students of biotechnology enabling their applications in industry and research.

PSO6: Understand the issues of environmental contexts and sustainable development.

6. **Eligibility:** Any student with 12th Science passed at least 45% marks shall be eligible to get admission to Biotechnology as an optional subject in B.Sc. course. However preference may be given to students who have studied **Biology** at 12th Science
7. **Duration:** Currently Biotechnology is one the three optional subjects in a three year full time graduation program. As this subject involve extensive practical work, a student should be prepared to stay for long duration in laboratory
8. **Medium of Instructions:** As on today English is the medium instruction
9. **Choice Based Credit System (CBCS) and Credit-to-contact hour Mapping:**

Each Credit = **15 Lecture of 60 minute**

Each credit will be equivalent to 15 clock hours of teaching and each practical credit is equivalent to **30 clock hours** of teaching in a semester.

10. **Attendance:** As per government regulation a **minimum of 75% attendance** is must for a student to appear for examination. However a student is expected to be present to the maximum number of lectures and practicals to have a clear and undoubtful understanding of concepts in the frontier area of biology.
11. **Evaluation Methods/ Scheme of Examination, Earning Credits, Grading System**

Evaluation is an integral part of learning. As the learning abilities of students are varied, evaluation also need to comprehensive. Therefore evaluation will have a blend of continuous evaluation as well as end semester evaluation. The end semester examination will be designed to adjudge the reasoning ability, comprehension capability and critical thinking. The practical skills will be tested by the end semester practical examinations while understanding and acquiring other objectives of course will be assessed through and a blend of objective-descriptive (subjective) examination

The internal evaluation will carry 20% weightage and end semester examination will be of 80%

A student is expected to attend all classes conducted during a session, appear for all sort of testing and earn the credits as specified. The grading will be done based on the overall performance of students on OABCDF SCALE.

B. Sc. First Year, Semester I
Curriculum for Optional Subject
BIOTECHNOLOGY

Course code	BTO-111
Course title	Microbiology
MARKS-	50
Credits	2 Cr
Time Duration	<u>2 hours /week</u>
Contact hours	30

Unit: 1

Scope of Microbiology: Microorganisms in human affairs and industry.

History of Microbiology: Contributions of Anton van Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch and Alexander Fleming.

Prokaryotic Cell: Cell wall. Distinction between cell wall of Gram positive and Gram negative bacteria. Cell membrane, Cytoplasm, nucleoid, endospore, flagella, pili, glycocalyx. Structure of Achaea cell.

Unit: 2

Diversity of Microorganisms: General account of Bacteria, Fungi, Protozoa, Algae and Viruses. Taxonomy: Naming of microorganisms. Contribution of C. Linnaeus, Taxonomy hierarchy, Whittaker's five kingdom and Carl Woese's three domain classification system. Classification of bacteria and cyanobacteria: Bergery's Manual of Systematic Bacteriology. Classification of Fungi and Protistean Algae.

Unit: 3

Visualisation of Microorganisms: Principle and structure of Light Microscope, Numerical Aperture, Resolving Power. Magnification. Principle and structure of electron microscope (SEM and TEM). Comparison between light and electron microscope. **Preparation and staining of specimens for light microscopy:** Fixation, Dyes and simple staining, Differential staining- Gram staining, acid-fast staining, Staining specific structures-negative staining, endospore staining, flagella staining.

Unit: 4

Microbial Nutrition: Common nutrient requirements, Nutritional types of microorganisms, growth factors. Uptake of nutrients by cells. Culture Media: Synthetic or defined media. Commonly used media. Types of Media- Selective, differential and enrichment media. **Aseptic Techniques:** Disinfection, Sterilization. Cultivation of bacteria, fungi and viruses. Pure culture: Concept of pure culture. Methods of pure culture of microorganisms – Spread plate, streak plate and pour plate.

References:

1. Keshav Trehan Biotechnology, Willey Eastern Ltd. New Delhi, 1990.
 2. Alan Wiseman, Principles of Biotechnology, Surrey University press, 1983.
 3. General Microbiology by Stanier.
 4. Microbiology by Pelzar.
 5. General Microbiology Powar and Daginawala.
 6. Microbiology and Introduction by TorTora Funke, Case.
- The world of the cell, Becker, Kleinsmith, Hardin

Course code	BTO-112
Course title	Biomolecules & Cell Biology
MARKS-	50
Credits	2 Cr
Time Duration	<u>2 hours /week</u>
Contact hours	30

Unit: 1

Chemistry of Living Cell: Cell & its components, various classes of biological molecules & functions, Chemicals inside the cell- Large & small molecules Origin of life: Origin of amino acids, Nucleotides, Urey Miller's Experiment.

Unit: 2

Amino acid & Protein: Structural classification of amino acids based on R side chain, Structural levels of Proteins, Classification of Proteins based on Composition, Functions of Proteins. Carbohydrates:- General classification of Carbohydrates, Structural Classification of Monosaccharides, Ring formation in Monosaccharides, Mutarotation, Oligosaccharide Glycosidic bond, Disaccharides (Sucrose, Maltose, Lactose) Polysaccharides (e.g. Starch, Glycogen, Cellulose, Heparin, Pectin), Biological functions of Carbohydrates. Molecules involved in generation of Mechanical Stability: Peptidoglycan, Polysaccharide (Cellulose in Plant).

Unit: 3

Membrane lipid, Definition of lipid. Examples of membrane lipid Phospholipids, Sphingolipid. **Membrane models**- Overton's lipid nature of membrane, Langmuir's lipid monolayer, Gorter and Grendel's lipid bilayer, Davson and Danielli's lipid bilayer plus protein sheet, Robertson's Unit membrane, Singer and Nicolson's fluid mosaic. **Membrane structure**- 2D Lipid bilayer, composition of lipid bilayer, asymmetric nature, fluidity, membrane proteins and their function.

Membrane Transport: Movement across membranes- **Passive transport**: simple diffusion, facilitated diffusion-transporters (uniporters and Cotransporters) and channel proteins. **Active transport**: Pumps, Group Translocation and Electrochemical Gradients. Protein sorting and intracellular compartments- Vesicular transport; transport of proteins into mitochondria, Vesicular traffic in the secretory and endocytic pathway

Unit: 4

Structure and Functions of Organelles: Endoplasmic Reticulum, Lysosome, Golgi Complex, Peroxisome (Microbody), Centriole, Mitochondria, Cytoskeleton-microtubules, intermediate filaments, actin filaments, mechanism of muscle contraction, motors and movements, Cilia & Flagella, Nucleus, Cell division & cell cycle: i) Mitosis ii) Cell cycle- a) interphase b) G1 Phase c) G2 Phase d) Mitosis iii) Meiosis

References:

1. Outline of Biochemistry V ed. Conn and Stumpf, John Willey and sons.
2. Biochemistry S.C. Rastogi, Tata Mograw Hill pub. Co, New Delhi.
3. Cell and molecular biology- Arumugham.
4. Cell and molecular biology- De Robertis
5. Cytology genetics and evolution- Agarwal and varma

Course code	BTOP-113
Course title	Lab course 1 Microbiology and Biomolecules & Cell biology (based on BTO-111 and BTO-112)
MARKS-	50
Credits	1.5 Cr
Time Duration	<u>3 hours /week.BATCH</u>
Contact hours	45

1. Basic staining techniques-Monochrome staining, NEGATIVE STAINING
2. Differential staining Grams staining.,**COMPULSORY** QUESTION IN EXAMINATION
(each student must perform this technique in regular laboratory. Instructor should make it sure that each of the student is well prepared with gram staining. Every student must be able to demonstrate this technique in examination)
3. Preparation of nutrient media-Nutrient broth, Nutrient agar, Mac Conkey's agar.
4. Isolation technique for bacteria- streak plate, pour plate and spread plate.
5. Effect of pH and temperature on growth of bacteria.
6. Enumeration of bacteria by Breed's count method /serial dilution method/McFarland scale .
7. Estimation of amino acid by ninhydrin method.
8. Estimation of protein by Biuret method / Lowry method.
9. Estimation of glucose by DNS method,
10. Isolation of egg albumin from egg white./ Isolation of cholesterol from egg yolk./Isolation of starch from potatoes./Isolation of casein from milk.
11. Separation of amino acids by paper chromatography./Separation of serum proteins by paper electrophoresis./Separation of plant pigments by TLC.
12. Study of Mitosis and Meiosis (using onion root tips and buds respectively)
13. Study of Floral structure of pea plant and Maize/Arabidopsis
14. Study of Giant Chromosomes

12. Curriculum for Semester II

Course code	BTO-211
Course title	Genetics
MARKS-	50
Credits	2 Cr
Time Duration	<u>2 hours /week.BATCH</u>
Contact hours	30

Unit: 1

Introduction to genetics: Genotype and Phenotype. A brief overview of Mendel's Laws of Inheritance. DNA as Genetic material- Experimental proof. Structure and types of DNA and RNA. Properties of nucleic acids. Physical Basis of inheritance: Chromosome theory of inheritance. Eukaryotic Chromosome – Macro- molecular Organization. Chromosome types –primary and secondary constrictions. Sat – bodies, Telomeres. Heterochromatin and Euchromatin and its significance. Ultrastructure of Chromosome – Karyotype and Idiogram. Special types of chromosomes Polytene chromosomes – Salivary gland chromosomes in *Drosophila*, Lampbrush Chromosomes in amphibian Oocytes & B Chromosomes.

Unit: 2

Sex Linkage: Meiotic behaviour of chromosomes and non-disjunction. Bridges theories of non-disjunction. Sex-linkage in *Drosophila*. Sex linked genes in Poultry and Moths. Sex related genes in maize. Attached X-chromosome. Linkage: Coupling and repulsion hypothesis. Linkage in maize and *Drosophila*, Linkage groups, Complete linkage, incomplete linkage, factors affecting linkage – distance, age, temperature, X-rays, etc. Theories of linkage, differential multiplication theory and chromosome theory. Measurement of linkage from T2 Bacteriophage. Cis-Trans arrangement. Linkage maps in Maize and *Drosophila*.

Unit: 3

Crossing over: Mechanism of crossing over. Cytological theories of crossing over. Germinal and Somatic crossing over. Crossing over in *Drosophila*, absence of crossing over in male *Drosophila*. Frequency and percentage of crossing over. Tetrad analysis in *Neurospora*. Interference and Coincidence. Construction of genetic maps (*Drosophila* and Maize)

Unit: 4

Chromosomal aberrations: Numerical: Euploidy (Monoploidy, Haploidy and Polyploidy) Polyploidy – autopolyploidy and allopolyploidy Aneuploidy – Monosomes, Nullisomes, & Trisomes. Structural: Deletions, Duplications, Translocations and Inversions. Evolutionary significance of chromosomal aberrations.

References:

1. Genetics Peter J Russel, The Benjamin/ Qummin publishing Co.
2. Principles of Genetics by Gardner, Siemens.
3. Molecular Genetics by Friefeder.
4. Molecular biology laboratory manual 6th Edn, Cappuccino.
5. Molecular biology and the gene Watson.
6. Genetics. Strickberger M.W.
7. Genetics Goodenough U

Course code	BTO-212
Course title	Biomathematics & Biostatistics
MARKS-	50
Credits	2 Cr
Time Duration	<u>2 hours /week.BATCH</u>
Contact hours	30

Unit: 1

Sets: Definition, Subset, Union, intersection, Venn Diagrams, Complement of a Set, Universal Set, Distributive laws & De Morgan's Law (Verification by simple examples no proof is expected product of Sets)

Functions:- Definition Graphs of 1) Linear function 2) Power function 3) Quadratic function 4) Periodic function 5) Exponential function.

Use of Logarithms for simple problems (with and without log tables)

Binomial Theorem (Without proof) – Simple Examples

Unit: 2

Limits of a function: Concept of limit, Limit of function at a point, Simple algebraic limits. Derivative/ Differentiation- Derivative of simple algebraic functions. Derivatives of standard Trigonometric & Logarithmic functions (without proof) Addition rules, Subtraction rules, Product rule (Treatments only) Integration:- Integration as antidifferentiation, Problems involving simple polynomial functions.

Unit: 3

Biostatistics:

Probability: Random Experiment, Sample space, Event, Probability of an Event, Axioms of probability. Measures of central Tendencies: Mean, Calculation of Mean of ungrouped & grouped data Mode & Median of ungrouped data.

Unit: 4

Measures of deviation, Mean deviation & Standard deviation (For Ungrouped Data) Sampling: Types of Sampling- Purposive sampling, Random sampling, Simple sampling & Stratified sampling.

References:

1. Introduction to Mathematics for Life Science-E.Batschelet, Narosa Publishing house New Delhi, 1975 (II Edition)
2. Fundamentals of Mathematical Statistics-S.C.Gupta & V.K.Kapur, S. Chand Publication