ST ALOYSIUS
(DEEMED TO BE UNIVERSITY)
MANGALURU 575003-INDIA
ESTD : 1880

Course structure and syllabus of

B.Sc.
BIOTECHNOLOGY

Semester I and II

Under NEP Regulations

2024 ONWARDS

ST ALOYSIUS

(DEEMED TO BE UNIVERSITY)

MANGALURU 575003 – INDIA

School of Life Sciences BOS MEETING

BOS meeting of School of Life Sciences was held on 22th April 2024, at 9.30 am in Applied Biology Laboratory

LIST OF MEMBERS OF THE BOS IN LIFE SCIENCES

Sl no	Members with Address	Designation
1.	Dr Hemachandra hemachandra_amin@staloysius.edu.in 9035961509	Dean, School of Life Sciences
2.	Dr Renita Maria Dsouza renita@staloysius.edu.in 9945923172	Associate Dean, School of Life Sciences
3.	Dr Lyned Dafny Lasrado lyneddafny@staloysius.edu.in 9686021928	Assistant Dean, School of Life Sciences
4.	Dr Jyothi Miranda Department of Botany jyothi@staloysius.edu.in 7022560938	Professor
5.	Dr Asha Abraham Department of Post Graduate Studies & Research in Biotechnology drashaabraham@staloysius.edu.in 9449555802	Associate Professor
6.	Dr Hariprasad Shetty Department of Zoology shettyhariprasad@staloysius.edu.in 9945886947	Associate Professor
7.	Dr S N Raghavendra Department of Post Graduate Studies & Research in Food Science raghavendra_sn@staloysius.edu.in 9945888845	Assistant Professor

8.	Dr Santhosh Wilson Goveas Department of Post Graduate Studies & Research in Biotechnology santhoshgoveas@staloysius.edu.in 9448724682	Assistant Professor
9.	Dr Chandrashekara G Joshi Chairperson Department of Biochemistry Mangalore University josheejoshee@gmail.com 9448446641	Subject expert in Biochemistry
10.	Dr Shyama Prasad Sajankila Department of Biotechnology NMAMIT, Nitte, Karkala shyama.sajankila@nitte.edu.in 9611202842	Subject expert in Biotechnology & Microbiology
11.	Dr Smitha Hegde Professor & Deputy Director NUCSER, Nitte University Deralakatte smitha.hegde@nitte.edu.in 9886036077	Subject expert in Biotechnology & Zoology
12.	Dr Archana Prabhat Professor & Coordinator Department of PG Studies in Food Science & Nutrition Alva's College (Autonomous), Moodbidri drarchanaprabhat@gmail.com 9986665759	Subject expert in Food Science
13.	Dr Giby Kuriakose Assistant Professor PG Department of Botany, Sacred Heart College Kochi, Kerala-670106 giby.kuriakose@shcollege.ac.in 7012608038	Subject expert in Botany
14.	Dr Shreelalitha Suvarna Assistant Professor shreelalitha_suvarna@staloysius.edu.in 9964215205	HOD UG & PG Biotechnology
15.	Dr Swarnalatha Assistant Professor swarnalatha@staloysius.edu.in 9900284662	HOD UG & PG Biochemistry
16.	Ms Shilpa B Assistant Professor shilpa_botany@staloysius.edu.in 9535887279	HOD Botany
17.	Dr Daniella Ann L Chyne Assistant Professor	HOD

	daniella_chyne@staloysius.edu.in 9676389466	UG & PG Food Science
18.	Dr Vaishali Rai Assistant Professor vaishali_rai@staloysius.edu.in 9980313361	HOD Microbiology

Scheme and Syllabus for B.Sc. (Basic / Hons.) Biotechnology

Semester	Course Category	Course Code	Title of Courses	Instruction hrs/ week	Marks			Credits
					IA	SA	Total	
I	Discipline Specific Courses	G 511 DC1.1	Cell Biology and Genetics	4	40	60	100	4
		G 511 DC2.1P	Cell Biology and Genetics Practical	3	25	25	50	2
	Open Elective Courses*	G 511 OE1.1	Biotechnology for human welfare	3	40	60	100	3
II	Discipline Specific Courses	G 511 DC1.2	Microbiological methods and techniques	4	40	60	100	4
		G 511 DC2.2P	Microbiological methods and techniques Practical	3	25	25	50	2
	Open Elective Courses*	G 511 OE1.2	Applications of Biotechnology in agriculture	3	40	60	100	3

Program Outcomes:

By the end of the program the students will be able to:

PO 1. Understand concepts of Biotechnology and demonstrate interdisciplinary skills acquired in cell biology, genetics, biochemistry, microbiology, and molecular biology.

PO 2. Apply the knowledge and skills gained in the fields of plant biotechnology, animal biotechnology and microbial technology in pharma, food, agriculture, beverages, herbal and nutraceutical industries.

PO 3. Critically analyze environmental issues and apply the biotechnology knowledge gained for conserving the environment and resolving environmental problems.

PO 4. Demonstrate comprehensive innovations and skills in the fields of biomolecules, molecular biology, enzyme technology, bioprocess engineering and genetic engineering of plants, microbes, and animals with respect to applications for human

welfare.

PO 5. Apply the knowledge and skills of immunology, bioinformatics, computational modelling of proteins, drug design and simulations to test models and aid in drug discovery.

PO 6. Critically analyze, interpret data, and apply tools of bioinformatics and multi-omics in various sectors of biotechnology including health and food.

PO 7. Demonstrate communication skills, scientific writing, data collection and interpretation abilities in all the fields of biotechnology.

PO 8. Learn and practice professional skills in handling microbes, animals and plants and demonstrate the ability to identify ethical issues related to recombinant DNA technology, genetic engineering, animals handling, intellectual property rights, biosafety, and biohazards.

PO 9. Explore the biotechnological practices and demonstrate innovative thinking in addressing the current day and future challenges with respect to food, health, and environment.

PO 10. Demonstrate thorough knowledge and application of good laboratory and good manufacturing practices in biotech industries.

PO 11. Apply the molecular biology principles and techniques in forensic and clinical biotechnology.

PO 12. Demonstrate entrepreneurship abilities, innovative thinking, planning, and setting up of small-scale enterprises or CROs.

Syllabus for B.Sc. (Basic / Hons.)

Syllabus for B.Sc. (Basic / Hons.)

SEMESTER – I

Discipline Specific Course .1

Course Title	**CELL BIOLOGY AND GENETICS**		
Course Code	**G 511 DC1.1**		
Number of credits	**4**	**Contact Hours**	**56**

Course Outcomes:

After successful completion of this course, students will be able to:

CO 1. Acquire a deep insight on the concepts of cell biology and describe the ultrastructure of cells, structure and function of organelles, cytosol and cytoskeleton.

CO 2. Illustrate the phases of cell cycle, cell division, reductional division in gametes.

CO 3. Comprehend the organization and structure of chromosomes, laws of inheritance, and gene interaction.

CO 4. Describe mutations and its types, chromosomal disorders and prenatal screening of genetic disorders.

Unit 1. Cell as a basic unit of living systems and cellular organelles **(14 hours)**

Historical perspectives - Discovery of cell, the cell theory, Ultrastructure of prokaryotic and eukaryotic cell (Both plant and animal cells). Structural organization and functions of plasma membrane and cell wall of eukaryotes.

Structure and functions of cell organelles – Endoplasmic reticulum, Golgi complex, Mitochondria, Chloroplast, Ribosomes, Lysosomes, Peroxisomes, Nucleus (Nuclear envelope with nuclear pore complex, Nucleolus, Nucleoplasm and Chromatin). Vacuole, Cytosol and Cytoskeleton structures (Microtubules, Microfilaments, and Intermediate filaments).

Unit II. Chromosomes and cell division (14 hours)

General Introduction, Discovery, Morphology, and structural organization – Centromere, Secondary constriction, Telomere, Chromonema, Euchromatin and Heterochromatin, Chemical composition (molecular organization of chromosome and nucleosome model), Classification of chromosomes based on centromere position and Karyotyping.

Special types of chromosomes- Salivary gland and Lamp brush chromosomes.

Cell Division: Cell cycle, phases of cell division, Stages and significance of mitosis and meiosis, achromatic apparatus, synaptonemal complex.

Unit III. Laws of inheritance and gene interaction (14 hours)

History of Genetics, Terminologies in genetics: alleles, gene, genome, Genotype, Phenotype, character, traits, homozygous and heterozygous.

Mendelian Genetics - Mendelian Laws of inheritance, monohybrid and dihybrid inheritance, test cross, back cross, law of segregation & independent assortment.

Gene interactions: Supplementary genes - Comb patterns in fowls, Complementary genes - Flower colour in sweet peas. Epistasis- Plumage colour in poultry.

Chromosome theory of inheritance- Sex-linked inheritance (Haemophilia, Colour blindness), Multiple allelism - Blood groups in Human beings.

Unit IV Linkage and Mutations (14 hours)

General introduction, Linkage –Maize and Drosophila, mechanism of crossing over and its importance.

Mutations: Types of mutation (somatic and germline mutation, Spontaneous: Point Mutations- Silent mutations, Missense mutations, Nonsense mutations, Frame shift mutation, transition and transversion.

Aneuploidy - A general account of structural and numerical aberrations, inherited disorders – Allosomal (Klinefelter syndrome and Turner's syndrome), Autosomal (Down's syndrome and Cri-Du-Chat Syndrome). Prenatal screening for genetic disorder- Noninvasive methods - Maternal serum screening, Ultrasonography and Fetal echocardiography, Invasive methods-, Amniocentesis, Chorionic villus sampling. Genetic counselling.

References

1. Alberts, B., Hopkin, K., Johnson, A., Morgan, D., Lewis J., Raff M., Roberts, K., & Walter, P., (2019). Essential Cell Biology, International student edition 5th ed., WW Norton & Co.
2. Brooker, R.J., (2017). Genetic analysis and principle, 6th ed., Mc Graw Hill.
3. Cooper & Sinauer G.M., (2019). The Cell: A Molecular Approach, International 8th ed., Oxford University Press.
4. Hardin, J. & Bertoni, G P., (2018). Becker's World of The Cell, 9th ed., Pearson Education Ltd, USA.
5. Karp, G., Iwasa, J. & Marshall W., (2016). Cell and Molecular Biology: Concepts and Experiments, 8th ed., Wiley & sons. New York.
6. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. & Martin, K., (2016). Molecular Cell Biology, 8th ed., W.H. Freeman & Co., New York.
7. Powar C.B(2019). Cell Biology 3rd edition. Himalaya Publishing House, Mumbai.
8. Gupta, P.K. (2019) Genetics, 5th Ed., Rastogi Publication, Meerut, India
9. Krebs, J.E., Goldstein, E.S. & Kilpartick, S.T., (2017). Lewin genes- XII, Jones and Bartlett Publishers.
10. Tamarin, R.., (2017). Principles of Genetics, 7th ed., Mc-Graw – Hill Publication.

SEMESTER – I

Discipline Specific Course.2

Course Title	**CELL BIOLOGY AND GENETICS PRACTICAL**		
Course Code	**G 511 DC2.1P**		
Number of credits	**4**	**Contact Hours**	**56**

Course Outcomes:

After successful completion of this Course, students will be able to:

CO 1. Interpret the different stages of cell division and to calculate the mitotic index.

CO.2. Measure the size of cells, count the number of cells using haemocytometer and perform the karyotyping analysis and solve various genetics problems.

CO 3. Demonstrate the handling of Drosophila melanogaster, the model organism for

genetic studies.

CO 4. Describe the principles and procedures of genetic techniques in biological experiments

List of Practical

1. Handling and maintenance of simple and compound microscope
2. Use of Micrometry and calibration, measurement of onion epidermal cells.
3. Cell counting using haemocytometer (yeast cell).
4. Study of divisional stages in mitosis from onion root tips and mitotic index.
5. Study of Plasmolysis in Rheo leaves.
6. Study of divisional stages in meiosis in onion.
7. Buccal epithelial – Barr bodies.
8. Mounting of the Sex Comb in *Drosophila melanogaster*.
9. Study of mutants in *Drosophila melanogaster*.
10. Separation of eye pigments of *Drosophila melanogaster*.
11. Karyotype analysis – Human – Normal and Abnormal (Down and Turner's syndromes).
12. Problems in Genetics (based on theory).

References

1. Vilas Parmar (2018). Practicals of Cell Biology & Genetics. LAP Lambert Academic Publishing.
2. Debarati D. (2017). Essential Practical Handbook of Cell Biology & Genetics, Biometry & Microbiology: A Laboratory Manual. Academic Publishers.
3. Amit Gupta and Bipin Kumar Sati (2019). Practical laboratory manual- Cell Biology. Lambert Academic Publishing.
4. Rina M. and Rama S. (2018). Laboratory Manual of Cell Biology. Prestige Publishers.

Unit 1. Environment (14 hours)

Application of biotechnology in environmental aspects: waste management, biodegradation of heavy metals, water cleaning, removing oil spills, air and soil pollution, bioremediation, biomining.

Unit II. Industry (14 hours)

Enzymes for textile industry, breweries, food supplements – single cell protein, vitamins, food processing – cheese, yogurt making, biodegradable plastics, biofuels.

Unit III. Application of Biotechnology in health and livestock (14 hours)

Applications in Human Health: Antibiotic production, molecular diagnostics, vaccines and vaccine delivery, recombinant therapeutics – insulin, gene therapy, forensics.

Applications in Livestock Improvement: Transgenic animals, animal vaccine production, increased milk production, artificial insemination, poultry and fisheries.

References:

1. Chawla, H. S. (2020). Introduction to Plant Biotechnology, 2nd ed., India:

Oxford and IBH Publishing.
2. De, A. K., (2019). Environmental Chemistry, 9th ed., New Delhi: New Age International Limited.
3. Delves, P. J., Martin, S. J., Burton, D. R., & Roitt, I. M. (2017). Roitt's Essential Immunology, 13th ed., United Kingdom: Wiley-Blackwell.
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8. Joseph, B.,
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SEMESTER – II

Discipline Specific Course.1

Course Title	**MICROBIOLOGICAL METHODS AND TECHNIQUES**		
Course Code	**G 511 DC1.2**		
Number of credits	**4**	**Contact Hours**	**56**

Course Outcomes:

After successful completion of this course, students will be able to:

CO 1. Employ the principles of microscopy to study microorganisms.

CO 2. Apply various methods of sterilization in microbiological work.

CO 3. Delineate the formulation of media, culture methods and staining techniques for isolation, characterization of microbes.

CO 4. Analyse the mode of action of antimicrobial agents and assess the drug resistance.

Unit 1. Introduction to microbes and microscopy (14 hours)

History of microbiology, Definition and Classification of major groups of microorganisms- Bacteria, Fungi, Algae and viruses. Ultrastructure of bacteria, types, reproduction. Introduction to Bergey's manual.

Microscopy: Principles of Microscopy- Magnification, resolving power, numerical aperture, working principle and applications and limitations of Compound microscope.

Unit II. Sterilization techniques (14 hours)

Definition of terms-sterilization, disinfectant, antiseptic, sanitizer, germicide, microbicidal agents, microbiostatic agent and antimicrobial agent.

Physical methods of sterilization: Principle, construction, and applications of moist heat sterilization- autoclave, Pasteurization, types and Fractional sterilization-Tyndallization. Dry heat sterilization- hot air oven. Incineration. Filter sterilization- membrane filter and HEPA. Radiation- Ionizing radiation-γ rays and non-ionizing radiation- UV rays.

Chemical methods- Alcohol, aldehydes, phenols, halogen, metallic salts, Quaternary ammonium compounds and sterilizing gases as antimicrobial agents.

Unit III. Culturing and Staining methods (14 hours)

Culture Media: Components of media, Culture media types (natural and synthetic media, differential, enrichment and selective media).

Pure culture methods: Serial dilution and plating methods (pour, spread, streak).

Cultivation and maintenance of aerobic and anaerobic bacteria. Preservation/stocking of pure cultures: Agar slant cultures, agar slant culture covered with oil (Paraffin method), very low temperature (glycerol), Freeze Drying (lyophilization). Culture Collection Centres-MTCC, ATCC.

Stains and staining techniques: Principles of staining, Types of stains-simple stains, structural stains and differential stains.

Unit IV. Antimicrobial agents and Antibiotic resistance (14 hours)

Antibacterial agents: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism.

Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin.

Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine.

Antimicrobial Drug Resistance: MDR, XDR, MRSA.

Antibiotic sensitivity testing methods: Kirby-Bauer method, Agar well diffusion techniques, and E-test, MIC.

References

1. Black, J. G., & Black, L. J. (2017). Microbiology: Principles and Explorations, 10th ed., United States of America: John Wiley & sons, Inc.
2. Cann, A. J. (2016). Principles of Molecular Virology, 6th ed., London: Academic Press.
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5. Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., & Stahl, D. A. (2019). Brock Biology of Microorganisms, 15th ed., Harlow, United Kingdom: Pearson.
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9. Dubey R. C. and Maheshwari D. K. (2010). A Textbook of Microbiology. S Chand & Company
10. Ananthanarayan R, Jayaram Paniker CK and Reba Kanungo (2020). Textbook of Microbiology.11th Ed. Universities Press (India) Pvt. Ltd.

SEMESTER – II

Discipline Specific Course.2

Course Title	**MICROBIOLOGICAL METHODS AND TECHNIQUES PRACTICAL**		
Course Code	**G 511 DC2.2P**		
Number of credits	**4**	**Contact Hours**	**56**

Course Outcomes:

After successful completion of this course, students will be able to:

CO 1. Handle and use instruments used in microbiology and

biotechnology laboratories.

CO 2. Experiment with various methods of sterilization in microbiological work.

CO 3. Prepare different types of media, perform culture methods and staining techniques for isolation, characterization of microbes.

CO 4. Handle and use antimicrobial agents and perform anti-microbial assays.

List of Practical

1. Study the principle and applications of important instruments

(biological safety cabinets, autoclave, incubator, hot air oven, compound microscope, pH meter) used in the microbiology laboratory.

2. Preparation of culture media for bacteria, fungi and their cultivation.
3. Isolation of bacteria and fungi from soil, water and air.
4. Enumeration techniques – Serial

dilution and CFU calculation,

5. Plating techniques - Standard plate count technique (pour plate, streak plate).
6. Study of colony characters of isolated microbes.
7. Staining techniques: -Simple staining, Negative Staining, Gram's staining, Spore Staining - Schaeffer Fulton Method, Capsule staining.

8. Study of Bacterial motility by hanging drop technique.
9. Biochemical Tests for Bacterial Identification - IMViC test, catalase test, oxidase test
10. Antibiotic sensitivity test by disc diffusion method.
11. Study of Rhizopus, Penicillium, Aspergillus using temporary mounts.

References

1. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual, 9th Ed., Pearson Education Limited.
2. Saha, Rumpa Das and Shukla (2021). Microbiology Practical Manual, 2nd Ed. CBS.
3. Mukesh Kumar (2018). Practical Manual for Undergraduates Microbiol

ogy, Jain Brothers.
4. Maheshwari D.K. and Dubey R.C. (2010) Practical Microbiology, S Chand & Company

SEMESTER – II

OPEN ELECTIVE COURSE

Course Title	**APPLICATIONS OF BIOTECHNOLOGY IN AGRICULTURE**		
Course Code	**G 511 OE1.2**		
Number of credits	**3**	**Contact Hours**	**42**

After successful completion of the course, the student will be able to **(14 hours)**

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ics **Unit II- Transgenic plants (14 hours)**

. Introduction to transgenic plants, case study: Bt cotton, Bt brinjal, Golden rice. The GM crop debate – safety, ethics, perception, and acceptance of GM crops. Plants as bio-factories for molecular pharming: edible vaccines, plantibodies, nutraceuticals.

Unit III- Biofertilizers and biopesticides (14 hours)

BT based pesticides: Baculovirus pesticides (NPV), Mycopesticides (Metarrhizobium), Biofertilizers - Rhizobium. mycorrhiza, phosphate solubilizers, vermicomposting,

References

1. Venkataram, V., Hefferon, K. (2023). Agricultural Biotechnology: Genetic Engineering for a Food Cause. Netherlands: Elsevier Science.
2. Chawla, H. S. (2020). Introduction to Plant Biotechnology, 2nd ed., India: Oxford and IBH Publishing.
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9. Young, M. M. (2019). Comprehensive Biotechnology, 3rd ed., United Kingdom: Pergamon Press.
10. Halford, N. G. (2018). Crop Biotechnology: Genetic Modification and Genome Editing. Singapore: World Scientific Publishing Company.

Question Paper Pattern for End Semester Theory Examination
(Same scheme to be followed for all Semesters)
Program: B.Sc. Biotechnology
Name of Course:
Course code:

Time: 2.5 Hours **Max. Marks: 60**

Note: Draw neat, labelled diagrams wherever necessary

Part –A

I Answer any **FIVE** of the following. **(5x 2=10)**
(Short answer questions any **FIVE** to be answered out of **eight**)

Part-B

II Answer any **SIX** of the following (any **SIX** to be answered out of **Eight**) **(6 x 5 = 30)**

Part-C

III Answer any **TWO** of the following (any **TWO** to be answered out of **Four**) **(02x10=20)**

Part A: Short answer questions shall be based on basic, conceptual, understanding etc.
Part B: Critical notes / Descriptive questions shall be based on deeper understanding, analytical, problem-solving skills etc.
Part C: Essay type questions shall be on critical thinking, higher order thinking skills etc.

Continuous Internal Assessment for theory (40 Marks)

Components:	**IA Marks**
Continuous Internal Assessment (Two internal tests 10 x 2)	20 marks
Assignment	05 marks
Attendance/Regularity	05 marks
Surprise test/ Open book exam/ Unit wise test (Objective/MCQ)/Seminar.	05 marks
Group Project work/ MOOC course/ Poster or Paper presentation	05 marks

Continuous Internal Assessment for Practical (25 Marks)

Assessment Occasion / Components	**IA Marks**
Continuous Internal Assessment of all practical experiments	05 marks
Test	10 marks
Record	05 marks
Attendance	05 marks

Question paper Pattern for practical examination.
(Same scheme to be followed for all Semesters)

End semester Practical exam.
Program: B.Sc. Biotechnology
Name of Course:
Course code:

Time: 3 Hrs		**Total marks: 25**
I	Major experiment	12 marks
II	Minor experiment	8 marks
III	Spotters A, B, C (3 x 1 marks)	3 marks
IV	Viva	2 Marks

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