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UNIVERSITY OF MYSORE

Estd. 1916

VishwavidyanilayaKaryasoudha
Crawford Hall, Mysuru- 570 005

No.AC2(S)/151/2020-21

Dated: 26-10-2021

Notification

Sub:- Syllabus and Examination Pattern of Bio-Technology (UG) with effective from the Academic year 2021-22 as per NEP-2020.

Ref:- 1. Decision of Board of Studies in Bio-Technology (UG) meeting held on 28-09-2021.
2. Decision of the Faculty of Science & Technology Meeting held on 16-10-2021.
3. Decision of the Academic Council meeting held on 22-10-2021.

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The Board of studies in Bio-Technology (UG) which met on 28-09-2021 has recommended & approved the syllabus and pattern of Examination of Bio-Technology Programme with effective from the Academic year 2021-22 as per NEP -2020.

The Faculty of Science & Technology and Academic Council at their meetings held on 16-10-2021 and 22-10-2021 respectively have also approved the above said proposal and it is hereby notified.

The syllabus and Examination pattern is annexed herewith and the contents may be downloaded from the University Website i.e., www.uni-mysore.ac.in.

Registrar
Registrar
University of Mysore
Mysore

To:-

1. All the Principal of affiliated Colleges of University of Mysore, Mysore. Those who are running B.Sc Courses.
2. The Registrar (Evaluation), University of Mysore, Mysuru.
3. The Chairman, BOS/DOS, in Bio-Technology, Manasagangothri, Mysore.
4. The Dean, Faculty of Science & Technology, DoS in Psychology, MGM.
5. The Director, Distance Education Programme, Moulya Bhavan, Manasagangotri, Mysuru.
6. The Director, PMEB, Manasagangothri, Mysore.
7. Director, College Development Council , Manasagangothri, Mysore.
8. The Deputy Registrar/Assistant Registrar/Superintendent, Administrative Branch and Examination Branch, University of Mysore, Mysuru.
9. The PA to Vice-Chancellor/ Registrar/ Registrar (Evaluation), University of

UNIVERSITY OF MYSORE

CURRICULUM FOR

B.Sc (Basic/ Hons.) Degree

BIOTECHNOLOGY
(As per NEP-2020 Model Curriculum)

Implementation Year 2021-22

Approved by
BOS in Biotechnology (UG)
DEPARTMENT OF STUDIES IN BIOTECHNOLOGY
MANASAGANGOTRI, MYSURE – 570 006

September 2021

MODEL CURRICULUM

Name of the Degree Program : B.Sc. (Basic/Hons.)
Discipline Core : Biotechnology
Total Credits for the Program : B.Sc. Basic - 136 and B.Sc. Hons. - 176
Starting year of implementation: 2021-22

Program Outcomes:
Competencies need to be acquired by the candidate
securing B.Sc. (Basic) or B.Sc. (Hons)

By the end of the program the students will be able to:
Competencies need to be acquired by a candidate securing B.Sc. (Basic) or B.Sc. (Hons) degree in Biotechnology.

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

2. Demonstrating the Laboratory skills in cell biology, basic and applied microbiology with an emphasis on technological aspects

3. Competent to 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.

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

5. Demonstrate comprehensive innovations and skills in the fields of biomolecules, cell and organelles, molecular biology, bioprocess engineering and genetic engineering of plants, microbes, and animals with respect to applications for human welfare.

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

7. Critically analyze, interpret data, and apply tools of bioinformatics and multi omics in various sectors of biotechnology including health and Food.

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

9. Learning and practicing 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.

10. Exploring the biotechnological practices and demonstrating innovative thinking in addressing the current day and future challenges with respect to food, health, and environment.

11. Thorough knowledge and application of good laboratory and good manufacturing practices in biotech industries

12. Understanding and application of molecular biology techniques and principles in forensic and clinical biotechnology.

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

Continuous Formative Evaluation/ Internal Assessment

Total Marks for each course = 100%
Continuous assessment (C1) = 20% marks
Continuous assessment (C2) = 20% marks
Semester End Examination (C3) = 60% marks.

a) The first component (C1) of assessment is for 20% marks. This shall be based on test, assignment, seminar, case study, field work, project work etc. This assessment and score process should be completed after completing 50% of syllabus of the course/s and within 45 working days of semester program.

b) The second component (C2) of assessment is for 20% marks. This shall be based on test, assignment, seminar, case study, field work, internship / industrial practicum / project work etc. This assessment and score process should be based on completion of remaining 50 percent of syllabus of the courses of the semester.

c) During the 17th – 19th week of the semester, a semester end examination shall be conducted by the University for each course. This forms the third and final component of assessment (C3) and the maximum marks for the final component will be 60%.

d) The outline for continuous assessment activities for Component-I (C1) and Component-II (C2) of a course shall be as under.

Outline for continuous assessment activities for C1 and C2 (Theory)

Activities	C1 (% marks)	C2 (% marks)	C1 + C2 (% marks)	C3 (% marks)
Session Test	10	10	20	-
Seminars/Presentations/Activity	10	-	10	-
Case study /Assignment / Field work / Project work etc	-	10	10	-
Semester end Examination (2 Hours duration)	-	-	-	60
Total	20	20	**40**	**60**

- For practical course of full credits, Seminar shall not be compulsory. In its place, marks shall be awarded for Practical Record Maintenance (the ratio is 50% : 50%)
- For practical courses the IA and Semester End examinations will have 50:50 weightage respectively

Outline for continuous assessment activities for C1 and C2 (Practicals)

Activities	C1 (% marks)	C2 (% marks)	C1 + C2 (% marks)	C3 (% marks)
Practical record maintenance/ test	25	25	50	-
Semester end exam (3 Hours duration)	-	-	-	50
Total	25	25	**50**	**50**

- Conduct of Seminar, Case study / Assignment, etc. can be either in C1 or in C2 component at the convenience of the concerned teacher.

- The teachers concerned shall conduct test / seminar / case study, etc. The students should be informed about the modalities well in advance. The evaluated courses/assignments during component I (C1) and component II (C2) of assessment are immediately provided to the candidates after obtaining acknowledgement in the register by the concerned teachers(s) and maintained by the Chairman in the case of a University Post-Graduate Department and the Principal / Director in the case of affiliated institutions. Before commencement of the semester end examination, the evaluated test, assignment etc. of C1 and C2 shall be obtained back to maintain them till the announcement of the results of the examination of the concerned semester.

e) The marks of the internal assessment shall be published on the notice board of the department / college for information of the students.

f) The Internal assessment marks shall be communicated to the Registrar (Evaluation) at least 10 days before the commencement of the University examinations and the Registrar (E) shall have access to the records of such periodical assessments.

g) There shall be no minimum in respect of internal assessment marks.

h) Internal assessment marks may be recorded separately. A candidate who has failed or rejected the result, shall retain the internal assessment marks.

Curriculum Structure for the Undergraduate Degree Program
B.Sc. (Basic / Hons.)

Total Credits for the Program : 176
Starting year of implementation: 2021-22
Name of the Degree Program : B.Sc. (Basic/Hons.)BIOTECHNOLOGY

Program Articulation Matrix:

Curriculum Structure for the Undergraduate Degree Program - BSc

Total Credits for the Program: 176 Starting year of implementation:

2021-22 Name of the Degree Program: B.Sc. Discipline/Subject:

Biotechnology

Program Articulation Matrix:

This matrix lists only the core courses. Core courses are essential to earn the degree in that discipline/subject. They include courses such as theory, laboratory, project, internships etc. Elective courses may be listed separately

Semester	Title /Name of the course	Program outcomes that the course addresses (not more than 3 per course)	Pre-requisite course(s)	Pedagogy##	Assessments
1	DSC: 1T BTC 101 Cell Biology and Genetics 4 Credits 100 Marks	Understanding concepts of Biotechnology and demonstrate knowledge acquired in interdisciplinary skills in cell biology, genetics,	PUC or +2 (Life sciences as one of the core disciplines)	The general pedagogy to be followed for theory and practical are as under. Lecturing, Tutorials, Group/Individual	

		biochemistry, microbiology, and molecular biology		Discussions, Seminars, Assignments, Counseling, Remedial Coaching. Field/Institution/Industrial visits, Hands on training, Case observations, Models/charts preparations, Problem solving mechanism, Demonstrations, Project presentations, Experiential documentation, and Innovative methods. Active learning as per LSSSDC (NSDC) LFS/Q0509 guidelines, at skill trainingLevel 3. Case studies about application of microbial biomolecules in various industries. Seminar on topics of microbial biochemistry	
	DSC-1P BTC 101 Cell Biology and Genetics 2 Credits 50 Marks				

2	DSC-2T BTC 102 4 Credits 100 Marks Microbiological Methods and Techniques	Demonstrating the Laboratory skills in basic and applied microbiology with reference to technological aspects. Thorough knowledge and application of good laboratory and good manufacturing practices in biotech industries			
	DSC -2P BTC 102 2 Credits 50Marks Microbiological Methods and Techniques				
3	DSC-3T BTC 103 4 Credits 100 Marks Biomolecules				
	DSC-3P BTC 103 2 Credits 50 Marks Biomolecules				
4	DSC-4T BTC 104 4 Credits 100 Marks Molecular biology				

	DSC:-4P BTC 104 2 Credits 50 Marks Molecular Biology				
5.	DSC-5T BTC 105 4 Credits 100 Marks Genetic Engineering				
	DSC-5P BTC 105 2 Credits 50 Marks Genetic Engineering				
	DSC-6T BTC 106 4 Credits 100 Marks Plant Biotechnology				
	DSC-6P BTC 106 2 Credits 50 Marks Plant Biotechnology				
6.	DSC-7T BTC 107 4 Credits 100 Marks Immunology and Medical Biotechnology				

	DSC-7P BTC 107 2 Credits 50 Marks Immunology and Medical Biotechnology				
	DSC-8T BTC 108 4 Credits 100 Marks Bioprocess technology				
	DSC-8P BTC 108 2 Credits 50 Marks Bioprocess technology				
7.	DSC-9T BTC 109 4 Credits 100 Marks Environmental Biotechnology				
	DSC-9P BTC 109 2 Credits 50 Marks Environmental Biotechnology				
	DSC-10T BTC 110 4 Credits 100 Marks Enzyme technology				

	DSC-10P BTC 110 2 Credits				
	50 Marks Enzyme technology				
	DSC-11T BTC 111 4 Credits 100 Marks Food Biotechnology				
8.	DSC -12T BTC 112 4 Credits 100 Marks Animal Biotechnology				
	DSC - 13T BTC 113 4 Credits 100 Marks Genomics and Proteomics				
	DSC-14T BTC 114 4 Credits 100 Marks Biosafety, Bioethics and IPR				

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Pedagogy for student engagement is predominantly lectures. However, other pedagogies enhancing better student engagement to be recommended for each course. The list includes active learning/ course projects/ problem or project-based learning/ case studies/self-study like seminar, term paper or MOOC

$ Every course needs to include assessment for higher order thinking skills (Applying/ Analyzing/ Evaluating/ Creating). However, this column may contain alternate assessment methods that help formative assessment (i.e. assessment for learning).

BSc Biotechnology (Basic / Hons.)
Semester 1

Course Title: DSC-1T, BTC 101, Cell Biology and Genetics	
Total Contact Hours: **56**	Course Credits: **4+2**
Formative Assessment Marks: **40%**	Duration of ESA/Exam: **2 Hrs**
Model Syllabus Authors: **Curriculum Committee**	Summative Assessment Marks: **60%**

Course Pre-requisite(s): *Mention only course titles from the curriculum that are needed to be taken by the students before registering for this course.*

Course Outcomes (COs):
At the end of the course the student should be able to:
(Write 3-7 course outcomes. Course outcomes are statements of observable student actions that serve as evidence of knowledge, skills and values acquired in this course)

1. Would be able to comprehend the structure of a cell with its organelles
2. *Can explain the organization of genes and chromosomes, chromosome morphology and its aberrations

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12
1. Would be able to comprehend the structure of a cell with its organelles	*	*			*							
2. Can distinguish between the structure of prokaryotic and eukaryotic cell.	*	*			*							
3. Can explain the organization of genes and chromosomes, chromosome morphology and its aberrations	*	*			*							

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark ‘X’ in the intersection cell if a course outcome addresses a particular program outcome.

BSc Biotechnology (Basic / Hons.)

Semester 1

Title of the Courses:

Course 1 : DSC-1T, BTC 101, Cell Biology and Genetics
Course 2 : OE 1T, BTC 301, Biotechnology for human welfare
Course 3 : SEC 1T, BTC 701, Biotechnological Skills and Analytical Techniques

Course 1 : DSC-1T, BTC 101, **Cell Biology and Genetics**		Course 2 : OE 1T, BTC 301, **Biotechnology for human welfare**		Course 3 : SEC 1T, BTC 701, **Biotechnological Skills and Analytical Techniques**	
Number of Theory Credits	Number of lecture hours/semester	Number of Theory Credits	Number of lecture hours/semester	Number of Theory Credits	Number of lecture hours/semester
4	**56**	**3**	**42**	**1**	**14**

Content of Course 1: Theory: DSC-1T, BTC 101, Cell Biology and Genetics	**56 Hrs**
Unit – 1:Cell as a Basic unit of Living Systems and Cellular Organelles	14Hrs
Concept, Development and Scope of Biotechnology. Historical perspectives. Discovery of cell, the cell Theory, Ultra structure of prokaryotic and eukaryotic cell- (Both plant and animal cells), **Surface Architecture:** Structural organization and functions of plasma membrane and cell wall of bacteria and plants. **Cellular Organelles:** 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- 2. Chromosomes and Cell Division	14Hrs
General Introduction, Discovery, Morphology and structural organization – Centromere, Secondary constriction, Telomere, Chromonema, Euchromatin and Heterochromatin, Chemical composition and Karyotype. Single-stranded and multi-stranded hypothesis, folded- fibre and nucleosome models. Special type of chromosomes: Salivary gland and Lampbrush chromosmes. **Cell Division**: Cell cycle, phases of cell cycle, Regulation of cell cycle-, checkpoints and enzymes involved. Significance of cell cycle, interphase nucleus, stages of mitosis and meiosis, achromatic apparatus, synaptonemal complex. Cell Senescence and programmed cell death.	

Unit-3. Genetics:	14Hrs
Mendelian Genetics: Introduction and brief history of genetics. Mendelian theory: Laws of inheritance- dominance, segregation, incomplete dominance, codominance with an example. Law of independent assortment, test cross, back cross. **Gene interaction:** Deviations to Mendelian inheritance- Supplementary factors: comb pattern in fowls, Complementary genes- Flower colour in sweet peas, Multiple factors–Skin colour in human beings, Epistasis– Plumage colour in poultry (13:3), Multiple allelism: Blood groups in Humans- ABO and Rh. **Maternal Inheritance:** Plastid inheritance in Mirabilis, Petite characters in yeast and Kappa particles in Paramecium. Sex-linked inheritance- Colour blindness, hemophilia, Y-linked traits.	
Unit-4.Linkage and Crossing Over	14Hrs
Introduction, Chromosome theory of inheritance, Coupling and repulsion hypothesis, Linkage in maize and Drosophila, Mechanism of crossing over and its importance, chromosome mapping-linkage map in maize. **Chromosomal variations:** A general account of structural and numerical aberrations, chromosomal evolution of wheat and cotton. **Mutations:** Types of mutations, Spontaneous and induced, Mutagens: Physical and chemical, Mutation at the molecular level, Applications of mutations- plants, animals and microbes. **Sex Determination in Plants and animals:** Concept of allosomes and autosomes, XX- XY, XX-XO, ZW-ZZ, ZO-ZZ types. **Human Genetics:** Karyotype in man, inherited disorders – Allosomal (Klinefelter syndrome and Turner's syndrome), Autosomal (Down syndrome and Cri-Du-Chat Syndrome). **Epigenetics:** Plant and humans	

Course 1: Practical: DSC-1P, BTC 101, Cell Biology and Genetics

1) Study and maintenance of simple and compound microscope
2) Use of Micrometer and calibration, measurement of onion epidermal cells and yeast
3) Study of stages in mitosis from onion root tips
4) Study of stages in meiosis in grasshopper testes/onion or Rhoeo flower buds.
5) Mounting of polytene chromosomes
6) Buccal smear - Barr bodies
7) Karyotype analysis - Human and Onion
   Human – Normal and Abnormal – Down and Turner's syndromes
8) Isolation and staining of Mitochondria
9) Isolation and staining of Chloroplast
10) RBC cell count by Haemocytometer
11) Simple genetic problems based on theory

- Each student is required to submit 2 permanent slides each of mitosis & meiosis

Text Books / References

Reference:

1. Molecular Biology of Cell - Bruce Alberts et al, Garland publications.
2. Animal Cytology and Evolution- MJD, White Cambridge University Publications
3. Molecular Cell Biology-Daniel, Scientific American Books
4. Cell Biology - Jack d Bruke, The William Twilkins Company
5. Principles of Gene Manipulations- Old & Primrose, Black Well Scientific Publications
6. Cell Biology-Ambrose &Dorothy M Easty, ELBS Publications
7. Fundamentals of Cytology- L. W. Sharp, McGraw Hill Company
8. Cytology-Willson&Marrison, Reinform Publications
9. Molecular Biology- Christopher Smith, Faber & Faber Publications
10. Cell Biology & Molecular Biology – EDP De Robertis& EMF Robertis, Saunder College.
11. Cell Biology- C.B Powar, Himalaya Publications
12. Basic Genetics- Daniel L. Hartl, Jones &Barlett Publishers USA
13. Human Genetics and Medicine lark Edward Arnold P London
14. Genetics – Monroe W Strickberger, Macmillain Publishers, New York
15. Genes V - Benjamin Lewin, Oxford University Press.
16. Genes I - Benjamin Lewin, Wiley Eastern Ltd., Delhi
17. Genes II - Benjamin Lewin, Wiley & Sons Publications
18. Genes III- Benjamin Lewin, Wiley & Sons Publications
19. Principles of Genetics- Sinnott, L.C. Dunn, Dobzhansky, McGraw-Hill.
20. Genetics – Edgar Altenburg Oxford & IBH publications
21. Principles of Genetics – E.J. Gardener, M.J. Simmons and D.P. Snustad, John Wiley & Son Publications
22. Genetics- P.K.Gupta, Rastogi Publication, Meert, India

Course 2: Theory: OE 1T, BTC 301, Biotechnology for Human Welfare

Course 2: OE 1T, BTC 301, Microbial Technology for Human Welfare	**42Hrs**
Unit – 1: Industry	14Hrs
Introduction, Scope, branches and applications of Biotechnology. Biotechnology in industry: Industrial production of alcoholic beverage (wine), antibiotic (Penicillin), enzyme (lipase) Applications of biotechnology in food, detergent and pharmaceutical industries	
Unit – 2: Environment	14Hrs
Application of biotechnology in environmental aspects : Bioremediation: Degradation organic pollutants, hydrocarbons and agricultural wastes, Superbug Bioplastics and Biofuels.	

Unit – 3: Forensic and Health Sciences	14Hrs
Application of biotechnology in forensic science: Solving crimes of murder and rape, paternity testing and theft using DNA finger printing techniques Application of biotechnology in health: Genetically engineered insulin, recombinant vaccines, gene therapy, diagnostics-ELISA and PCR, human genome project	

References:

1. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology.2nd edition. Panima Publishing Co. New Delhi.
2. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
3. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
4. Environmental Biotechnology, Pradipta Kumar Mohapatra
5. Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening andJesef Winter
6. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First
   Century, Select Publishers, New Delhi (2001).
7. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).
8. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
9. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G.Eckert (ED.), CRC Press, Boca Raton (1997).

Course 3: Theory: SEC 1T, BTC 701, Biotechnological Skills and Analytical Techniques

LEARNING OUTCOMES

- Skill enhancement as per National Occupational Standards (NOS) of "Lab Technician/ Assistant" Qualification Pack issued by Life Sciences Sector Skill Development Council - LFS/Q0509, Level 3.
- Knowledge about major activities of biotech industry, regulations, and compliance, environment, health, and safety (EHS), good laboratory practices (GLP), standard operating procedures (SOP) and GMP as per the industry standards.
- Demonstrate soft skills, such as decision making, planning, organizing, problem solving, analytical thinking, critical thinking, and documentation.

Course 3: Theory: SEC 1T, BTC 701,
Biotechnological Skills and Analytical Techniques

SEC 1T, BTC 701, Biotechnological Skills and Analytical Techniques	14Hrs
1. Insights into biotechnology industry: Biotechnology Industry in Indian and Global context - organization in context of large /medium/ small enterprises, their structure and benefits. **2. Industry professional skills to be acquired :** Planning and organising skills, decision-making, problem-solving skills, analytical thinking, critical thinking, team management, risk assessment. **3. Interpersonal skills:** Writing skills, reading skills, oral communication, conflict-resolution techniques, interpretation of research data, trouble shooting in work place **4. Digital skills:** Basic Computer Skills (MS Office, Excel, Powerpoint, Internet) for Workplace. Professional Email drafting skills and Powerpoint presentation skills **Analytical Skills in laboratory:** **Solutions:** Molarity, Molality, Normality, Mass percent % (w/w), Percent by volume (% v/v), parts per million (ppm), parts per billion (ppb), Dilution of concentrated solutions. Standard solutions, stock solution, solution of acids. Reagent bottle label reading and precautions	

Course 3 : Practicals: SEC 1P, BTC 701, Biotechnological Skills and Analytical Techniques

1. Methods and practices of cleaning and management of lab

Learning and Practice of Integrated clean-in-place (CIP) and sterilize-in-place (SIP) as per industry standards, material requirements for cleaning specific area, equipment, ventilation area, personal protective requirements

2. Procedure of cleaning and storage of Labware:

Methodology for storage area, Cleaning procedure and materials to be used for various surfaces. Sign boards, labelling do's & don'ts
Knowledge about standard procedures of cleaning or glass ware, plastic ware.
Maintenance of inventory

3. **Principles and practices of lab safety:**

   Knowledge about safety symbols and hazard signs. Personal safety gears, utility, and disposal. Equipment safety protocols, chemical safety protocols. Documentation of chemical and equipment usage records. Handling hazardous chemicals.

4. **Best practices of usage and storage of chemicals:**

   Knowledge and practice in handling of chemicals, labelling and stock maintenance. SOP and material handling. Procedures to maintain chemicals, labelling, storage, and disposal.

5. **Record maintenance as per SOPs**

   Labelling of samples and reagents as per SOPs.

   Recording detail of work done for research experiments. Importance of study of manuals, health and safety instructions.

6. **Usage and maintenance of basic equipment of biotechnology lab**: Principles, calibrations, and SOPs of weighing balances, pH meters, autoclaves , laminar flows and biosafety cabinets (levels), basic microscopes, homogenizers, stirrers, colorimeters, UV, and Visible spectrophotometers.

7. **Preparation of solutions and standards -** Properties and uses of chemicals commonly used in life sciences laboratories. Maintaining safety standards for handling various solutions and chemicals. Preparation of test reagents and buffers,
   Protocols for proper mixing of chemicals. Safety precautions while preparation and storage of incompatible chemicals and reagents.

8. **Preparation of media**: Maintenance and storage of purified water for media (Plant Tissue culture media, Microbiological media, and Animal cell culture media) preparation. Preparation and storage of concentrated stock solutions. Documentation and disposal of expired stocks.
   Collection of indents of media requirement, preparation, and storage. Media coding, documentation, and purpose of usage.

9. **Practical methods for decontamination and disposal**:

   Decontamination methods, Safe disposal practices of decontaminated media or materials.

10. **Laboratory record writing**

    Method of record writing , data collection and recording , reporting of result, discussion of result , summary writing, effective powerpoint presentation taking any experiment as example

11. **Industry visit or Analytical laboratory visit**

Pedagogy:

The general pedagogy to be followed for theory and practicals are as under. Lecturing, Tutorials, Group/Individual, Discussions, Seminars, Assignments, Counseling, Remedial Coaching. Field/Institution/Industrial visits, Hands on training, Case observations, Models/charts preparations, Problem solving mechanism, Demonstrations, Project presentations, Experiential documentation, and Innovative methods.

Active learning as per LSSSDC (NSDC) LFS/Q0509 guidelines, at skill training Level

3. Case studies about application of microbial biomolecules in various industries. Seminar on topics of microbial biochemistry

BSc Biotechnology (Basic / Hons.) Semester 2

Title of the Courses:

Course 1 : DSC-2T, BTC 102, Microbiological Methods and Techniques
Course 2 : OE- 2T, BTC 302, Applications of Biotechnology in Agriculture

Course 1: DSC-2T, BTC 102, **Microbiological Methods and Techniques**		Course 2: OE- 2T, BTC 302, **Applications of Biotechnology in Agriculture**	
Number of Theory Credits	Number of lecture hours/semester	Number of Theory Credits	Number of lecture hours/semester
4	**56**	**3**	**42**

Content of Course: DSC-2T, BTC 102, Microbiological Methods and Techniques	**56 Hrs**
Unit - 1 General Microbiology and Instrumentation	14Hrs
General Introduction to Microbiology: Scope and relevance of microbiology, important contributions by Robert Koch, Leeuwenhoek, Jenner, Pasteur, Flemming, Ivanowsky General account on structure, classification and reproduction of bacteria, virus and fungi **Microscopy**: Principles and applications of Compound microscope, Dark field microscope, Phase contrast microscope, Fluorescence Microscope, Confocal microscope, Electron Microscopes- TEM and SEM. **Analytical techniques:** Working principles and applications: Centrifuge, Ultracentrifuge, Spectrophotometer, Chromatography: Paper, TLC, Column (adsorption, gel-filtration, ion exchange, affinity), HPLC, GC.	
Unit - 2 Sterilization techniques	14Hrs
Definition of terms-sterilization, disinfectant, antiseptic, sanitizer, germicide, microbicidal agents, microbiostatic agent and antimicrobial agent. **Physical methods of control:** Principle, construction and applications of moist heat sterilization- Pasteurization, Boiling, Fractional sterilization-Tyndallization and autoclave. Dry heat sterilization-Incineration and hot air oven. Filtration – Diatomaceous earth filter, seitz filter, 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 – 3 Microbiological techniques	14Hrs
Culture Media: Components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media **Pure culture methods**: Serial dilution and plating methods (pour, spread, streak); cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria **Microbial growth and its measurements:** Growth curve, enumeration methods (turbidity, cell counting, colony counting) **Stains and staining techniques:** Principles of staining, Types of stains- simple stains, structural stains, negative stain and differential stains.	
Unit – 4: Antimicrobial agents	14Hrs
Antibiotic sensitivity testing methods: Disc and Agar well diffusion techniques **Five modes of action with one example each:** 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 Antibiotic resistance, MDR, XDR, MRSA, NDM-1	

Course 1: Practicals: DSC-2P, BTC 102, Microbiological Methods and Techniques

1. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology and Biotechnology laboratory.
2. Sterilization of medium using Autoclave and assessment for sterility
3. Sterilization of glassware using Hot Air Oven and assessment for sterility
4. Sterilization of heat sensitive material by membrane filtration and assessment for sterility
5. Preparation of culture media for bacteria, fungi and their cultivation.
6. Plating techniques: Spread plate, pour plate and streak plate.
7. Isolation of bacteria and fungi from soil, water and air
8. Study of Rhizopus, Penicillium, Aspergillus using temporary mounts
9. Colony characteristics study of bacteria from air exposure plate
10. Staining techniques: Bacteria– Gram, Negative, Capsule, Endospore staining Fungi – Lactophenol cotton blue staining
11. Water analysis - MPN test
12. Biochemical Tests – IMViC, Starch hydrolysis, Catalase test, Gelatin hydrolysis
13. Bacterial cell motility - hanging drop technique

Text Books / References

1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T. Brown Publishers.
2. Black JG. (2008). Microbiology: Principles and Explorations. 7th edition. Prentice Hall
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Course 2 :Theory: OE- 2T, BTC 302, Applications of Biotechnology in Agriculture

Course 2 :Theory: OE- 2T, BTC 302, Applications of Biotechnology in Agriculture	**42 Hrs**
Unit – 1: Agricultural Biotechnology	14 Hrs
Concepts and scope of biotechnology in Agriculture. Plant tissue culture, micro propagation, entrepreneurship in commercial plant tissue culture. Banana tissue culture - primary and secondary commercial setups, Small scale bioenterprises: Mushroom cultivation	
Unit – 2: Transgenic plants	14 Hrs
The GM crop debate – safety, ethics, perception and acceptance of GM crops GM crops case study :Bt cotton, Bt brinjal,	

Biopesticides: Baculovirus pesticides, Mycopesticides Genetic Engineering for quality improvement: Golden rice, Seed storage proteins, Flavours– capsaicin, vanillin	
Unit – 3: Molecular pharming and post harvest protection	14 Hrs
Plants as biofactories for molecular pharming: edible vaccines, plantibodies, nutraceuticals Post-harvest Protection: Antisense RNA technology for extending shelf life of fruits and shelf life of flowers. Biosafety, bioethics and IPR	

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