# JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE
# (AUTONOMOUS)
# OOTY ROAD, MYSORE – 25.

## CURRICULUM FOR

## For B.Sc., (Basic/ Hons.) Degree

## BIOTECHNOLOGY

## (As per NEP-2020 Model Curriculum)

## Implementation Year 2021-22

**2021-22**

# B.Sc., (Basic/ Hons.) Degree

## Scheme of study for B.Sc. Biotechnology As per NEP-2020 Model from 2021-22

| YEAR | SEMESTER | CORE COURSE | COURSE CODE | TITLE OF THE PAPER | NO. OF CREDITS | LECTURE/ PRACTICAL/ HOUR/WEEK | TOTAL TEACHING HOURS |
|---|---|---|---|---|---|---|---|
| I BSc | I | **DSC -I:Theory** | | **Cell biology & genetics** | **4** | **4** | **56** |
| | | **DSC -I:Pract** | | **Cell biology & genetics** | **2** | **4** | **56** |
| | | **OE:Theory** | | **Biotechnology for human welfare** | **3** | **3** | **42** |
| | | **SEC-: Theory** | | **Biotechnological Skills and Analytical Techniques** | **1** | **1** | **14** |
| | II | **DSC-II:Theory** | | **Microbiological Methods and Techniques** | **4** | **4** | **56** |
| | | **DSC-II: Pract** | | **Microbiological Methods and Techniques** | **2** | **4** | **56** |
| | | **OE:Theory** | | **Applications of Biotechnology in Agriculture** | **3** | **3** | **42** |
| | | | | | | | |

**JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE, OOTY ROAD, MYSORE**
**Scheme of Examination for B.Sc. Biotechnology As per NEP-2020 Model from 2021-22**

| Year | Semester | Core course | Course code | Title of the paper | credits | Maximum Marks in exam/Assessment | | | | Exam Duration | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L:T:P | IA | | | Total | Th | Pr |
| | | | | | | C-1 | C-2 | C-3 | | | |
| I B.Sc | I | DSC - I:Theory | | Cell biology & genetics | 4: 0: 0 | 20 | 20 | 60 | 100 | 3h | 3h |
| | | DSC -I:Pract | | Cell biology & genetics | 0: 0: 2 | 10 | 15 | 25 | 50 | | |
| | | OE:Theory | | Biotechnology for human welfare | 3:0:0 | 20 | 20 | 60 | 100 | 3h | 3h |
| | | SEC-: Theory | | Biotechnological Skills and Analytical Techniques | 0:0:1 | | | | | | |
| | II | DSC- II:Theory | | Microbiological Methods and Techniques | 4: 0: 0 | 20 | 20 | 60 | 100 | 3h | 3h |
| | | DSC-II: Pract | | Microbiological Methods and Techniques | 0: 0: 2 | 10 | 15 | 25 | 50 | | |
| | | OE:Theory | | Applications of Biotechnology in Agriculture | 3:0:0 | 20 | 20 | 60 | 100 | 3h | 3h |

## JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE, OOTY ROAD, MYSORE
## Scheme of Examination Programme – B.Sc., BMBt ; Programme code –BSC

| Year | Semester | Core course | Course code | Title of the paper | credits | Maximum Marks in exam/Assessment | | | | Exam Duration | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L:T:P | IA(Theory) | | | Total | Th | Pr |
| | | | | | | C-1 | C-2 | C-3 | | | |
| I B.Sc | I | DSC-I :Theory | DMA22006 | Cell Biology and Genetics | 4: 0: 0 | 15 | 15 | 70 | 100 | 3h | 3h |
| | | DSC-I: Pract | DMA22106 | Cell Biology and Genetics | 0: 0: 2 | 7.5 | 7.5 | 35 | 50 | | |
| | II | DSC-II:Theory | DMB22006 | Biomolecules and Bio-analytical techniques | 4:0:0 | 15 | 15 | 70 | 100 | 3h | 3h |
| | | DSC-II: Pract | DMB22106 | Biomolecules and Bio-analytical techniques | 0:0:2 | 7.5 | 7.5 | 35 | 50 | | |
| II B.Sc | III | DSC-III:Theory | DMC22006 | Molecular biology and Genetic engineering | 4:0:0 | 15 | 15 | 70 | 100 | 3h | 3h |
| | | DSC-III: Pract | DMC22106 | Molecular biology and Genetic engineering | 0:0:2 | 7.5 | 7.5 | 35 | 50 | | |
| | IV | DSC-IV: Theory | DMD22006 | Plant Tissue culture and Animal Cell culture | 4:0:0 | 15 | 15 | 70 | 100 | 3h | 3h |
| | | DSC-IV: Pract | DMD22106 | Plant Tissue culture and Animal Cell culture | 0:0:2 | 7.5 | 7.5 | 35 | 50 | | |
| III B.Sc. | V | DSE: Elective 1:Theory | DME22006 | Elective 1: Immunology and Medical Biotechnology | 4:0:0 | 15 | 15 | 70 | 100 | 3h | 3h |
| | | Elective 1: Pract | DME22106 | Elective 1: Immunology and Medical Biotechnology | 0:0:2 | 7.5 | 7.5 | 35 | 50 | | |
| | | Elective 2: Theory | DME22206 | Elective 2: Microbial technology and Agricultural Biotechnology | 4:0:0 | 15 | 15 | 70 | 100 | | |
| | | Elective 2: Pract | DME22306 | Elective 2: Microbial technology and Agricultural Biotechnology | 0:0:2 | 7.5 | 7.5 | 35 | 50 | | |
| | | SEC 1: Theory | DME22406 | SEC 1:Microbial Techniques | 2:0:0 | 7.5 | 7.5 | 35 | 50 | 2h | - |
| | | SEC 2: Theory | DME22506 | SEC 2:Enzymology | 2:0:0 | 7.5 | 7.5 | 35 | 50 | 2h | - |
| | VI | DSE: Elective 1:Theory | DMF22006 | Elective 1: Environmental Biotechnology and Biostatistics | 4:0:0 | 15 | 15 | 70 | 100 | 3h | 3h |
| | | Elective 1: Pract | DMF22106 | Elective 1: Environmental Biotechnology and Biostatistics | 4:0:0 | 15 | 15 | 70 | 100 | | |
| | | Elective 2: Theory | DMF22206 | Elective 2: Bioinformatics and Bioprocess technology | 4:0:0 | 15 | 15 | 70 | 100 | | |
| | | Elective 2: Pract | DMF22306 | Elective 2: Bioinformatics and Bioprocess technology | 4:0:0 | 15 | 15 | 70 | 100 | | |

# MODEL CURRICULUM

| | | |
|---|---|---|
| **Name of theDegreeProgram** | **:** | **B.Sc. (Basic/Hons.)** |
| **DisciplineCore** | **:** | **Biotechnology** |
| **Total Credits for theProgram** | **:** | **B.Sc. Basic - 136 and B.Sc. Hons. - 176** |
| **Starting yearofimplementation** | **:** | **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 andFood.

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 principlesin forensic and clinicalbiotechnology.

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

**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**

| **Activities** | **C1 (% marks)** | **C2 (% marks)** | **C1 + C2 (% marks)** | **C3 (% marks)** |
|---|---|---|---|---|
| Session Test | 10 | 10 | 20 | - |
| Seminars/Presentations/Assignment /Activity | 10 | 10 | 20 | - |
| Semester end Examination | - | - | - | 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%)

- 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

## 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: **3 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 itsorganelles
2. *Can explain the organization of genes and chromosomes, chromosome morphology and itsaberrations

**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 distinguishbetween 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, Cell Biology and Genetics**
**Course 2 : OE 1T, Biotechnology for human welfare**
**Course 3 : SEC 1T, 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 (Nuclearenvelope 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'ssyndrome), 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 - Barrbodies
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

## Text Books / References

**Reference:**


1. Molecular Biology of Cell - Bruce Alberts et al, Garlandpublications.
2. Animal Cytology and Evolution- MJD, White Cambridge UniversityPublications
3. Molecular Cell Biology-Daniel, Scientific AmericanBooks
4. Cell Biology - Jack d Bruke, The William TwilkinsCompany
5. Principles of Gene Manipulations- Old & Primrose, Black Well Scientific Publications
6. Cell Biology-Ambrose &Dorothy M Easty, ELBSPublications
7. Fundamentals of Cytology- L. W. Sharp, McGraw HillCompany
8. Cytology-Willson&Marrison, ReinformPublications
9. Molecular Biology- Christopher Smith, Faber & FaberPublications
10. Cell Biology & Molecular Biology – EDP De Robertis& EMF Robertis, Saunder College.
11. Cell Biology- C.B Powar, HimalayaPublications
12. Basic Genetics- Daniel L. Hartl, Jones &Barlett PublishersUSA
13. Human Genetics and Medicine lark Edward Arnold PLondon
14. Genetics – Monroe W Strickberger, Macmillain Publishers, NewYork
15. Genes V - Benjamin Lewin, Oxford UniversityPress.
16. Genes I - Benjamin Lewin, Wiley Eastern Ltd.,Delhi
17. Genes II - Benjamin Lewin, Wiley & SonsPublications
18. Genes III- Benjamin Lewin, Wiley & SonsPublications
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 & SonPublications
22. Genetics- P.K.Gupta, Rastogi Publication, Meert,India

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

**Course 2: OE 1T, 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 ofIndustrial Microbiology.2nd edition. Panima Publishing Co. NewDelhi.
2. Patel AH. (1996). Industrial Microbiology. 1st edition, MacmillanIndia Limited.
3. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles ofFermentation Technology. 2nd edition, Elsevier ScienceLtd.
4. Environmental Biotechnology, Pradipta KumarMohapatra
5. Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening andJesefWinter
6. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the TwentyFirst Century, Select Publishers, New Delhi (2001).
7. M.K. Bhasin and S. Nath, Role of Forensic Science in the NewMillennium, University of Delhi, Delhi(2002).
8. S.H. James and J.J. Nordby, Forensic Science: An Introduction toScientific 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, 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 industrystandards.
- Demonstrate soft skills, such as decision making, planning, organizing, problem solving, analytical thinking, critical thinking, and documentation.

## Course 3: Theory: SEC 1T, 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 andbenefits.

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. **Interpersonalskills:**

   Writing skills, reading skills, oral communication, conflict-resolution techniques, interpretation of research data, trouble shooting in workplace

4. **Digitalskills:**

   Basic Computer Skills (MS Office, Excel, Powerpoint, Internet) for Workplace. Professional Email drafting skills and Powerpoint presentation skills

**Analytical Skills inlaboratory:**

**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 bottlelabel reading and precautions

**Course 3 :Practicals: SEC 1P, 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 Lab ware:**

   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 power point 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, Microbiological Methods and Techniques**
**Course 2 : OE- 2T, 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-$\gamma$ rays and non ionizing radiation- UVrays

**Chemical methods:** Alcohol, aldehydes, phenols, halogen, metallic salts, Quaternary ammoniumcompounds 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 enrichmentmedia

**Pure culture methods**: Serial dilution and plating methods (pour, spread, streak); cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobicbacteria

**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, 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 Biotechnologylaboratory.
2. Sterilization of medium using Autoclave and assessment forsterility
3. Sterilization of glassware using Hot Air Oven and assessment forsterility
4. Sterilization of heat sensitive material by membrane filtration and assessment for sterility
5. Preparation of culture media for bacteria, fungi and theircultivation.
6. Plating techniques: Spread plate, pour plate andstreakplate.
7. Isolation of bacteria and fungi from soil, water andair
8. Study of Rhizopus, Penicillium, Aspergillus using temporarymounts
9. Colony characteristics study of bacteria from air exposureplate
10. Staining techniques: Bacteria– Gram, Negative, Capsule, Endospore staining Fungi – Lactophenol cotton bluestaining
11. Water analysis - MPNtest
12. Biochemical Tests – IMViC, Starch hydrolysis, Catalase test, Gelatinhydrolysis
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
3. Madigan MT, and Martinko JM. (2014). Brock Biology of Micro-organisms. 14th edition. Parker J. Prentice Hall International,Inc.
4. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004).Microbiology.
5. 5th edition Tata McGraw Hill.
6. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers,Dordrecht
7. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th editionMcMillan.
8. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition PearsonEducation.
9. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill HigherEducation.
10. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson EducationLimited
11. Microbiology- Concepts and applications by Paul A. Ketchum, WileyPublications
12. Fundamentals of Microbiology –Frobisher, Saunders & ToppanPublications
13. Introductory Biotechnology-R.B Singh C.B.D. India(1990)
14. Fundamentals of Bacteriology -Salley
15. Frontiers in Microbial technology-P.S. Bison, CBSPublishers.
16. Biotechnology, International Trends of perspectives A. T. Bull,G.
17. General Microbiology –C.B. Powar


## Course 2 :Theory: OE- 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.

**References**


1. Chrispeels M.J.et al. Plants, Genes and Agriculture-Jones and Bartlett Publishers, Boston.1994.
2. Gamborg O.L. and Philips G.C.Plant cell, tissue and organ culture (2nd Ed.) Narosa Publishing House. NewDelhi.1998
3. Hammound J, P McGravey&Yusibov.V. Plant Biotechnology, Springerverlag.2000
4. Heldt. Plant Biochemistry and Molecular Biology.Oxford and IBH Publishing Co. Pvt.Ltd. Delhi.1997
5. LydianeKyte and John Kleyn.Plants from test tubes. An introductionto
6. Micropropagation (3 rd. Ed.). Timber Press, Portland.1996
7. Murray D.R. Advanced methods in plant breeding and biotechnology.Panima Publishing Corporation.1996
8. NickoloffJ.A.Methods in molecular biology, Plant cell electroporation and electrofusion protocols-Humana press incorp, USA.1995.
9. Sawahel W.A. Plant genetic transformation technology.Daya Publishing House, Delhi.1997
10. Gistou, P and Klu, H.Hand book of Plant Biotechnology (Vol. I & II).John Publication.2004
11. Sateesh M.K. 2008. Biosafety and Bioethics. Oxford and IBH Publishers, New Delhi.

**Text Books / References**


1. Prescott,Harley,Klein'sMicrobiology,J.M.Willey,L.M.Sherwood,C.J.Woolverton,7th International, edition 2008, McGraw Hill.

2. Foundations in Microbiology, K. P. Talaro, 7th International edition 2009, McGrawHill.
3. A Textbook of Microbiology, R. C. Dubey and D. K. Maheshwari, 1st edition, 1999, S. Chand & CompanyLtd.
4. Brock Biology of Microorganisms, M.T.Madigan, J.M.Martinko, P. V. Dunlap, D. P. Clark- 12th edition, Pearson International edition 2009, Pearson BenjaminCummings.
5. Microbiology – An Introduction, G. J.Tortora, B. R.Funke, C. L. Case, 10th ed. 2008,PearsonEducation.
6. General Microbiology, Stanier, Ingraham et al, 4th and 5th edition 1987, Macmillan educationlimited.
7. Microbiology- Concepts and Applications, PelczarJr,Chan, Krieg, International ed, McGraw Hill.
8. Alexopoulos, C.J., Mims, C.W., and Blackwell, M. 2002. Introductory Mycology. John Wiley and Sons (Asia) Pvt. Ltd. Singapore. 869pp.
9. Atlas, R.M. 1984. Basic and practical microbiology. Mac Millan Publishers, USA.987pp.
10. Black, J.G. 2008. Microbiology principles and explorations. 7edn. John Wiley and Sons Inc., New Jersey 846pp.
11. Pommerville, J.C. Alcamo's Fundamentals of Microbiology. Jones andBartlett Pub..Sudburry, 835 pp.

12. Schlegel, H.G. 1995.General Microbiology. Cambridge University Press, Cambridge, 655 pp.
13. Toratora, G.J., Funke, B.R. and Case, C.L. 2007. Microbiology 9$^{th}$ ed. Pearson Education Pte. Ltd., San Francisco.958pp.

**GENERAL PATTERN OF THEORY EXAMINATION**

**B.Sc – BIOTECHNOLOGY**

**Theory Question Paper Pattern for DSC, DSE, and OE Courses**

**Duration: 3 Hours** **Maximum: 60 Marks**

**All questions are compulsory**
**Draw neat labeled diagrams wherever necessary**

QNo. I Answer any EIGHT of the following 2X8=16
(1)
(2)
(3)
(4)
(5)
(6)
(7)
(8)
(9)
(10)

QNo. II Answer any SIX of the following 4X6=24
(11)
(12)
(13)
(14)
(15)
(16)
(17)
(18)

QNo. III Answer any TWO of the following 10X2=20
(19)
(20)
(21)
(22)

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## PATTERN OF PRACTICAL EXAMINATION

### Practical examination – B. Sc BIOTECHNOLOGY

| **Duration: 3 hours** | **Max. Marks: 25** |
|---|---|
| Q. 1 Major question | 08 Marks |
| Q. 2 Minor question | 05 Marks |
| Q. 3 Identify and comment | 2X4 = 08Marks |
| Q. 4 Viva-voce | 04 Marks |

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## PATTERN OF FORMATIVE

| **ASSESMENT – PRACTICALS** | **Max. Marks: 25** |
|---|---|
| 1 IA 1 | 10 Marks |
| 2 IA 2 | 10 Marks |
| 3 Record | 05 Marks |

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