**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 2022-23**

 **2022-23**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **YEAR** | **SEMESTER** | **CORE COURSE** | **COURSE CODE** | **TITLE OF THE PAPER** | **NO. OF CREDITS** | **LECTURE/ PRACTICAL/ HOUR/WEEK** | **TOTAL TEACHING HOURS** |
| I BSc | I | **DSC -1:Theory** | **FSA460** | **Cell biology & genetics** | **4** | **4** | **56** |
| **DSC -1:Pract** | **FSA460** | **Cell biology & genetics** | **2** | **4** | **56** |
| **OE-1:Theory** | **FSA900** | **Biotechnology for human welfare** | **3** | **3** | **42** |
| **SEC-1: Theory** |  | **Biotechnological Skills and Analytical Techniques** | **1** | **1** | **14** |
| II | **DSC-2:Theory** | **FSB460** | **Microbiological Methods and Techniques** | **4** | **4** | **56** |
| **DSC-2: Pract** | **FSB460** | **Microbiological Methods and Techniques** | **2** | **4** | **56** |
| **OE-2:Theory** | **FSB900** | **Applications of Biotechnology in Agriculture** | **3** | **3** | **42** |
| II BSc | III | **DSC -3:Theory** | **FSC460** | **Biomolecules** | **4** | **4** | **56** |
| **DSC -3:Pract** | **FSC460** | **Biomolecules** | **2** | **4** | **56** |
| **OE-3:Theory** | **FSC900** | **Nutrition and Health** | **3** | **3** | **42** |
|  IV | **DSC -4:Theory** | **FSD460** | **Molecular Biology** | **4** | **4** | **56** |
| **DSC -4:Pract** | **FSD460** | **Molecular Biology** | **2** | **4** | **56** |
| **OE-4:Theory** | **FSD900** | **Intellectual Property Rights** | **3** | **3** | **42** |

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

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

**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 -1:Theory** | **FSA460** | **Cell biology & genetics** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC -1:Pract** | **FSA460** | **Cell biology & genetics** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE -1:Theory** | **FSA900** | **Biotechnology for human welfare** | 3:0:0 | 20 | 20 | 60 | 100 | 2h |  - |
| **II** | **DSC-2:Theory** | **FSB460** | **Microbiological Methods and Techniques** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC-2: Pract** | **FSB460** | **Microbiological Methods and Techniques** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE-2:Theory** | **FSB900** | **Applications of Biotechnology in Agriculture** | 3:0:0 | 20 | 20 | 60 | 100 | 2h | - |
| **II B.Sc** | **III** | **DSC-3:Theory** | **FSC460** | **Biomolecules** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC-3: Pract** | **FSC460** | **Biomolecules** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE-3:Theory** | **FSC900** | **Nutrition and Health** | 3:0:0 | 20 | 20 | 60 | 100 | 2h | - |
| **IV** | **DSC-4:Theory** | **FSD460** | **Molecular Biology** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC-4: Pract** | **FSD460** | **Molecular Biology** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE-4:Theory** | **FSD900** | **Intellectual Property Rights** | 3:0:0 | 20 | 20 | 60 | 100 | 2h | - |

**JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE, OOTY ROAD, MYSORE Scheme of Examination Programme – B.Sc., ZBt ; Programme code –BScBtZo36**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **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 -1:Theory** | **FSA460** | **Cell biology & genetics** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC -1:Pract** | **FSA460** | **Cell biology & genetics** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE -1:Theory** | **FSA900** | **Biotechnology for human welfare** | 3:0:0 | 20 | 20 | 60 | 100 | 2h |  - |
| **II** | **DSC-2:Theory** | **FSB460** | **Microbiological Methods and Techniques** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC-2: Pract** | **FSB460** | **Microbiological Methods and Techniques** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE-2:Theory** | **FSB900** | **Applications of Biotechnology in Agriculture** | 3:0:0 | 20 | 20 | 60 | 100 | 2h | - |
| **II B.Sc** | **III** | **DSC-3:Theory** | **FSC460** | **Biomolecules** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC-3: Pract** | **FSC460** | **Biomolecules** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE-3:Theory** | **FSC900** | **Nutrition and Health** | 3:0:0 | 20 | 20 | 60 | 100 | 2h | - |
| **IV** | **DSC-4:Theory** | **FSD460** | **Molecular Biology** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC-4: Pract** | **FSD460** | **Molecular Biology** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE-4:Theory** | **FSD900** | **Intellectual Property Rights** | 3:0:0 | 20 | 20 | 60 | 100 | 2h | - |

**JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE, OOTY ROAD, MYSORE Scheme of Examination Programme – B.Sc., CBt ; Programme code –BScChBt37**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **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 -1:Theory** | **FSA460** | **Cell biology & genetics** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC -1:Pract** | **FSA460** | **Cell biology & genetics** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE -1:Theory** | **FSA900** | **Biotechnology for human welfare** | 3:0:0 | 20 | 20 | 60 | 100 | 2h |  - |
| **II** | **DSC-2:Theory** | **FSB460** | **Microbiological Methods and Techniques** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC-2: Pract** | **FSB460** | **Microbiological Methods and Techniques** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE-2:Theory** | **FSB900** | **Applications of Biotechnology in Agriculture** | 3:0:0 | 20 | 20 | 60 | 100 | 2h | - |
| **II B.Sc** | **III** | **DSC-3:Theory** | **FSC460** | **Biomolecules** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC-3: Pract** | **FSC460** | **Biomolecules** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE-3:Theory** | **FSC900** | **Nutrition and Health** | 3:0:0 | 20 | 20 | 60 | 100 | 2h | - |
| **IV** | **DSC-4:Theory** | **FSD460** | **Molecular Biology** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC-4: Pract** | **FSD460** | **Molecular Biology** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE-4:Theory** | **FSD900** | **Intellectual Property Rights** | 3:0:0 | 20 | 20 | 60 | 100 | 2h | - |

**JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE, OOTY ROAD, MYSORE Scheme of Examination Programme – B.Sc., BcBt ; Programme code –BScBtBc40**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **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 -1:Theory** | **FSA460** | **Cell biology & genetics** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC -1:Pract** | **FSA460** | **Cell biology & genetics** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE -1:Theory** | **FSA900** | **Biotechnology for human welfare** | 3:0:0 | 20 | 20 | 60 | 100 | 2h |  - |
| **II** | **DSC-2:Theory** | **FSB460** | **Microbiological Methods and Techniques** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC-2: Pract** | **FSB460** | **Microbiological Methods and Techniques** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE-2:Theory** | **FSB900** | **Applications of Biotechnology in Agriculture** | 3:0:0 | 20 | 20 | 60 | 100 | 2h | - |
| **II B.Sc** | **III** | **DSC-3:Theory** | **FSC460** | **Biomolecules** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC-3: Pract** | **FSC460** | **Biomolecules** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE-3:Theory** | **FSC900** | **Nutrition and Health** | 3:0:0 | 20 | 20 | 60 | 100 | 2h | - |
| **IV** | **DSC-4:Theory** | **FSD460** | **Molecular Biology** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC-4: Pract** | **FSD460** | **Molecular Biology** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE-4:Theory** | **FSD900** | **Intellectual Property Rights** | 3:0:0 | 20 | 20 | 60 | 100 | 2h | - |

**JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE, OOTY ROAD, MYSORE Scheme of Examination Programme – B.Sc., MbBt ; Programme code –BScMbBt41**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **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 -1:Theory** | **FSA460** | **Cell biology & genetics** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC -1:Pract** | **FSA460** | **Cell biology & genetics** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE -1:Theory** | **FSA900** | **Biotechnology for human welfare** | 3:0:0 | 20 | 20 | 60 | 100 | 2h |  - |
| **II** | **DSC-2:Theory** | **FSB460** | **Microbiological Methods and Techniques** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC-2: Pract** | **FSB460** | **Microbiological Methods and Techniques** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE-2:Theory** | **FSB900** | **Applications of Biotechnology in Agriculture** | 3:0:0 | 20 | 20 | 60 | 100 | 2h | - |
| **II B.Sc** | **III** | **DSC-3:Theory** | **FSC460** | **Biomolecules** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC-3: Pract** | **FSC460** | **Biomolecules** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE-3:Theory** | **FSC900** | **Nutrition and Health** | 3:0:0 | 20 | 20 | 60 | 100 | 2h | - |
| **IV** | **DSC-4:Theory** | **FSD460** | **Molecular Biology** | 4: 0: 0 | 20 | 20 | 60 | 100 | 2h | 3h |
| **DSC-4: Pract** | **FSD460** | **Molecular Biology** | 0: 0: 2 | 10 | 15 | 25 | 50 |
| **OE-4:Theory** | **FSD900** | **Intellectual Property Rights** | 3:0:0 | 20 | 20 | 60 | 100 | 2h | - |

# 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 analyse, 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 principlesin 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.

1. 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.
2. 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.
3. 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%.
4. 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  | 10 | 10 | 20 | - |
| Semester end Examination | - | - | - | 60 |
| **Total** | 20 | 20 | **40** | **60** |

**Practical assessment**

|  |
| --- |
| **Assessment** |
| **Formative assessment** | **Summative Assessment** | **Total Marks** **50** |
| **Assessment Occasion / type** | **Weightage in Marks** | **Practical Exam** |
| Test C1 | 10 |  |
| Test C2 | 10 |
| Record | 5 |
| **Total** | **25** | **25** |

* 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.
1. The marks of the internal assessment shall be published on the notice board of the department / college for information of the students.
2. 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.
3. There shall be no minimum in respect of internal assessment marks.
4. 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 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:  **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 theStructure 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 TheoryCredits | Number of lecture hours/semester | Number of TheoryCredits | 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’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

1. Isolation and staining of Mitochondria
2. Isolation and staining of Chloroplast
3. RBC cell count by Haemocytometer
4. 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. Principles of Genetics- Sinnott, L.C. Dunn, Dobzhansky,McGraw-Hill.
18. Genetics – Edgar Altenburg Oxford & IBH publications
19. Principles of Genetics – E.J. Gardener, M.J. Simmons and D.P. Snustad, John Wiley & SonPublications
20. Genetics- P.K.Gupta, Rastogi Publication, Meert,India

# Course 2: Theory: OE 1T, Biotechnology 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.

|  |
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| Summative Assessment = 60 Marks |
| Formative Assessment Occasion / type | Weightage in Marks |
| Attendance | 10 |
| Seminar | 10 |
| Debates and Quiz | 10 |
| Test | 10 |
| Total | 60 marks + 40 marks = 100 marks |

## 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).

* 1. M.K. Bhasin and S. Nath, Role of Forensic Science in the NewMillennium, University of Delhi, Delhi(2002).
	2. S.H. James and J.J. Nordby, Forensic Science: An Introduction toScientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton(2005).
	3. 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 industry standards.
* 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 and benefits.

1. **Industry professional skills to be acquired:**

Planning and organising skills, decision-making, problem-solving skills, analytical thinking, critical thinking, team management, risk assessment.

1. **Interpersonal skills:**

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

1. **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, 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

1. **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

1. **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.

1. **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.

1. **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.

1. **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.
2. **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.

1. **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.

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

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

1. **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

1. **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

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

 **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, **Microbiological Methods and Techniques** | Course 2: OE- 2T, **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- UVrays

**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-2 P, 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 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 their cultivation.
	6. Plating techniques: Spread plate, pour plate and streak plate.
	7. Isolation of bacteria and fungi from soil, water andair
	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. Bacterial cell motility Water analysis - MPNtest
	12. Biochemical Tests – IMViC, Starch hydrolysis, Catalase test, Gelatin hydrolysis
	13. - 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 bio enterprises: 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 bio factories for molecular pharming: edible vaccines, plant bodies, 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.

 **BSc Biotechnology (Basic / Hons.) Semester 3**

**Title of the Courses:**

## Course 1 : DSC-3T, Biomolecules

**Course 2 : OE- 3T, Nutrition and Health**

|  |  |  |  |
| --- | --- | --- | --- |
| Program Name | **BSc Biotechnology** | Semester | **Third Sem** |
| Course Title | **Biomolecules** |
| Course code | **FSC460** | **DSC -3T** | No. of Theory Credits | **4** |
| Contact hours | **56 hrs** | Duration of ESA/Exam | **2 Hours** |
| Formative Assessment Marks | **40** | Summative Assessment Marks | **60** |

**Course Pre-requisite (s):**

**Course Outcomes (COs**): At the end of the course the student should be able to:

1. Acquire knowledge about types of biomolecules, structure, and their functions

2. Will be able to demonstrate the skills to perform bioanalytical techniques

 3. Apply comprehensive innovations and skills of biomolecules to biotechnology field

 **Content Hrs**

**Unit–I 14**

**Carbohydrates:** Introduction, sources, classification of carbohydrates. Structure, function and properties of carbohydrates. Monosaccharides – Isomerism and ring structure, Sugar derivatives

– amino sugars and ascorbic acid Disaccharides – Maltose, Lactose and Sucrose

Polysaccharides – Classification as homo and heteropolysaccharides, Homopolysaccharides - storage polysaccharides (starch and glycogen- structure, reaction, properties), structural polysaccharides (cellulose and chitin-structure, properties), Heteropolysaccharides - glycoproteins and proteoglycans. Metabolism: Glycolysis and gluconeogenesis, Kreb’s cycle, ETC- oxidative phosphorylation.

**Amino Acids, Peptides and Proteins:** Introduction, classification and structure of amino acids; Zwitterion, isoelectric point, pK values. Essential and nonessential amino acids. Peptide bond and peptide, Structural organization of proteins - primary, secondary (α helix,  sheets) tertiary and quaternary. Fibrous and globular proteins, Denaturation and renaturation of proteins. General aspects of amino acid metabolism: Transamination, deamination, decarboxylation and urea cycle.

**Unit–II 14** Hrs

**Lipids:** Classification and function of lipids, Saturated and unsaturated fatty acids, properties (saponification value, acid value, iodine number, rancidity), Hydrogenation of fats and oils. General structure and biological functions of phospholipids, sphingolipids, glycolipids, lipoproteins, prostaglandins, cholesterol, ergosterol. Metabolism:  oxidation of fatty acids. Biosynthesis of palmitate.

**Enzymes:** Introduction, nomenclature and classification, enzyme kinetics, factors influencing enzyme activity, metalloenzymes, activation energy and transition state, enzyme activity, specific activity. Coenzymes, cofactors and their functions (one reaction involving TPP, FAD, NAD). Enzyme inhibition- Irreversible and reversible (competitive, non-competitive and uncompetitive inhibition with an example each) Zymogens (trypsinogen, chymotrypsinogen and pepsinogen),

Isozymes (LDH, Creatine kinase and their clinical significance).

**Unit–III 14** Hrs

**Vitamins:** Water- and fat-soluble vitamins, dietary source and biological role of vitamins Deficiency manifestation of vitamin A, B, C, D, E and K

**Nucleic acids:** Structure of nucleosides, nucleotides in DNA and RNA. Structure and functions of DNA and RNA, Watson and Crick model of DNA and other forms of DNA (A and Z). Types of RNA (rRNA, tRNA, mRNA, snRNA, hnRNA, miRNA), ribozymes. Metabolism- Overview of biosynthesis and degradation of purine and pyrimidine, salvage pathway.

**Hormones:** Classification of hormones based on chemical nature and mechanism of action. Chemical structure and functions of the following hormones: Glucagon, insulin, Epinephrine ,Testosterone and Estradiol.

**Unit–IV 14** Hrs

**Electrophoresis:** Principle, procedure and applications of electrophoresis (paper electrophoresis, gel electrophoresis -PAGE, SDS- PAGE & agarose electrophoresis) and isoelectric focusing.

**Spectroscopy:** Colorimetry**,** UV-Vis spectrophotometry, Spectrofluorimetry, IR and NMR spectroscopy, atomic absorption spectroscopy, mass spectroscopy

**Radioisotope techniques:** Radioactivity, half life, radioisotopes, GM counter, scintillating counting, autoradiography, applications, biosafety.

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

|  |  |
| --- | --- |
| **Course Outcomes (COs) / Program Outcomes (POs)** | **Program Outcomes (POs)** |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| Acquire knowledge about types of biomolecules, structure, and their functions |  |  |  |  |  |  |  |  |  |  |  |  |
| Will be able to demonstrate the skills to perform bioanalytical techniques |  |  |  |  |  |  |  |  |  |  |  |  |
| Apply comprehensive innovations and skills of biomolecules to biotechnology field |  |  |  |  |  |  |  |  |  |  |  |  |

**Pedagogy:** Lectures, Seminars, Industry Visits and Assignment.

|  |  |  |  |
| --- | --- | --- | --- |
| Course Title | **Biomolecules** | Practical Credits | **2** |
| Course No. | **DSC-3P** | Contact hours | 48 h |

 **Content**

1. Introduction to basic instruments (Principle, standard operating procedure) with demonstration.
2. Definitions and calculations: 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.
3. Preparation of standard buffers by Henderson-Hasselbalch equation – Acetate, phosphate, Tris and determination of pH of solution using pH meter.
4. Estimation of glucose by DNS method
5. Determination of α-amylase activity by DNS method
6. Estimation of proteins by Biuret method
7. Estimation of amino acid by Ninhydrin method
8. Extraction of protein from soaked/sprouted green gram by salting out method
9. Separation of amino acids by circular paper chromatography
10. Demonstration of PAGE
11. Determination of iodine number of lipids

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| **References** |
| An Introduction to Practical Biochemistry, 3rd Edition, (2001), David Plummer; Tata McGraw Hill Edu.Pvt.Ltd. New Delhi, India |
| Biochemical Methods,1st Edition, (1995), S.Sadashivam, A.Manickam; New Age International Publishers, India |
| Introductory Practical biochemistry, S. K. Sawhney&Randhir Singh (eds) Narosa Publishing. House, New Delhi, ISBN 81-7319-302-9 |
| Experimental Biochemistry: A Student Companion, BeeduSasidharRao& Vijay Despande(ed).I.KInternational Pvt. LTD, NewDelhi. ISBN 81-88237-41-8 |
| Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067 |

|  |  |  |  |
| --- | --- | --- | --- |
| Program Name | **BSc Biotechnology** | Semester | **Third Sem** |
| Course Title | **Nutrition and Health** |
| Course Code |  **FSC900** | **OE-3** | No. of Theory Credits | **3** |
| Contact hours | **Lecture** | 42 h | Duration of ESA/Exam | **2 Hours** |
| **Practical** | - |
| Formative Assessment Marks | 40 | Summative Assessment Marks | 60 |

**Course Pre-requisite(s):**

**Course Outcomes (COs**): At the end of the course the student should be able to:

1. Study the concepts of food, nutrition, diet and health
2. To apply the best practices of food intake and dietary requirements
3. Acquire knowledge about various sources of nutrients and good cooking practices

 **Content 42 Hrs**

**Unit–I – Introduction 14** Hrs

Concepts of nutrition and health. Definition of Food, Diet and nutrition, Food groups. Food pyramids. Functions of food. Balanced diet. Meal planning. Eat right concept. Functional foods, Prebiotics, Probiotics, and antioxidants

**Unit -II – Nutrients 14** Hrs

Macro and Micronutrients - Sources, functions and deficiency. Carbohydrates, Proteins, Fats – Sources and calories. Minerals –Calcium, Iron, Iodine.

Vitamins – Fat soluble vitamins –A, D, E & K. Water soluble vitamins – vitamin C, Thiamine, Riboflavin, Niacin. Water–Functions and water balance. Fibre –Functions and sources. Recommended Dietary Allowance, Body Mass Index and Basal Metabolic Rate.

**Unit -III – Nutrition and Health 14** Hrs

Methods of cooking affecting nutritional value. Advantages and disadvantages. Boiling, steaming, pressure cooking. Oil/Fat – Shallow frying, deep frying. Baking. Nutrition through lifecycle. Nutritional requirement, dietary guidelines: Adulthood, Pregnancy, Lactation, Infancy- Complementary feeding, Pre-school, Adolescence, geriatric. Nutrition related

metabolic disorders- diabetes and cardiovascular disease.

**Pedagogy:** Lectures, Seminars, Industry Visits and Assignments

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| --- |
| **References** |
| 1 | Sri Lakshmi B, (2007), Dietetics. New Age International publishers. New Delhi |
| 2 | Sri Lakshmi B, (2002), Nutrition Science. New Age International publishers. New Delhi |
| 3 | Swaminathan M. (2002), Advanced text book on food and Nutrition. Volume I. Bappco |
| 4 | Gopalan.C., RamaSastry B.V., and S.C.Balasubramanian (2009), Nutritive value of IndianFoods.NIN.ICMR.Hyderabad. |
| 5 | Mudambi S R and Rajagopal M V, (2008), Fundamentals of Foods, Nutrition & diet therapy by New AgeInternational Publishers, New Delhi |

 **BSc Biotechnology (Basic / Hons.) Semester 4**

**Title of the Courses:**

## Course 1 : DSC-4T, Molecular Biology

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| --- | --- | --- | --- |
| Program Name | **BSc Biotechnology** | Semester | **Fourth Sem** |
| Course Title | **Molecular Biology** |
| Course No. | **DSC -4T** | No. of Theory Credits | **4** |
| Contact hours | **56 hrs** | Duration of ESA/Exam | **2 Hours** |
| Formative Assessment Marks | 40 | Summative Assessment Marks | 60 |

 **Course 2 : OE- 4T, Intellectual Property Rights**

 **Course Pre-requisite (s):**

**Course Outcomes (COs**): At the end of the course the student should be able to:

1. Study the advancements in molecular biology with latest trends.
2. Will acquire the knowledge of structure, functional relationship of proteins and nucleic acids.
3. Aware about the basic cellular processes such as transcription, translation, DNA replication and repair mechanisms.

 **Content Hrs**

 **Unit–I 14** Hrs **DNA as genetic material, Replication and Repair:** Experimental proof of DNA as genetic material (Griffith’s, Avery-Mcleod-McCarty, Martha-Chase). Central dogma, Replication of DNA in prokaryotes and eukaryotes– semiconservative mode (Messelson and Stalh experiment), Theta, linear and rolling circle models. Enzymes and proteins involved in replication-DNA polymerases, helicases, gyrases, ligase, SSB proteins, RNAse H

The replication complex: Pre-primming proteins, primosome, replisome, unique aspects of eukaryotic chromosome replication, Fidelity of replication.

 DNA damage and Repair mechanism: types of damage, photo reactivation, excision repair, mismatch repair and SOS repair.

 **Unit–II 14** Hrs

**Transcription and RNA processing:** Transcription in prokaryotes- RNA polymerase, sigma factor, promoter, initiation, elongation and termination.

Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance, elongation and termination. RNA processing of pre-mRNA: 5’ cap formation, polyadenylation, splicing. Processing of rRNA

and tRNA.

**Unit–III 14** Hrs

**Translation:** Genetic code and its characteristics, Wobble hypothesis. Translation- in prokaryotes and eukaryotes- ribosomes, enzymes and factors involved in translation. Activation of amino acids, aminoacyl tRNA synthetases. Mechanism of translation- initiation, elongation and termination of polypeptide chain. Fidelity of translation, Inhibitors of translation. Post translational modifications of proteins, Protein folding and targeting- to mitochondria and lysosomes.

**Unit–IV 14** Hrs **Regulation of gene expression:** Prokaryotic gene regulation- operon concept- regulation of *lac* operon and *trp* operon, attenuation control. Eukaryotic gene regulation- Activators, repressors binding to enhancers, coordinated control (tissue specific gene expression), DNA methylation, chromatin remodeling, Translational control of gene expression-ferritin mRNA regulation, RNAi- miRNA and siRNA.

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

|  |  |
| --- | --- |
| Course Outcomes (COs) / Program Outcomes (POs) | **Program Outcomes (POs)** |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| Study the advancements in molecular biology with latest trends |  |  |  |  |  |  |  |  |  |  |  |  |
| Will acquire the knowledge of structure, functional relationship of proteins and nucleic acids |  |  |  |  |  |  |  |  |  |  |  |  |
| Aware about the basic cellular processes such astranscription, translation, DNA replication and repair mechanisms |  |  |  |  |  |  |  |  |  |  |  |  |

**Pedagogy:** Lectures, Seminars, Industry Visits, Debates, Quiz and Assignments

|  |  |  |  |
| --- | --- | --- | --- |
| Course Title | **Molecular Biology** | Practical Credits | **2** |
| Course No. | **DSC-4P** | Contact hours | 48 |

**Content**

1. Preparation of DNA model
2. Estimation of DNA by DPA method
3. Estimation of RNA by Orcinol method
4. DNA isolation from plant/ animal/ microbial sources
5. Concentration and purity of isolated DNA samples
6. Agarose gel electrophoresis of DNA
7. Charts on- DNA replication, transcription, translation, Types of DNA, RNA

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| --- |
| **References** |
| Glick, B.R and Pasternak J.J (1998) Molecular biotechnology, Principles and application ofrecombinant DNA, Washington D.C. ASM press |
| Howe. C. (1995) Gene cloning and manipulation, Cambridge University Press, USA |
| Lewin, B., Gene VI New York, Oxford University Press |
| Rigby, P.W.J. (1987) Genetic Engineering Academic Press Inc. Florida, USA |
| Sambrook et al (2000) Molecular cloning Volumes I, II & III, Cold spring Harbor Laboratory Press New York, USA |
| Walker J. M. and Ging old, E.B. (1983) Molecular Biology & Biotechnology (Indian Edition) Royal Society of Chemistry U.K |
| Karp. G (2002) Cell & Molecular Biology, 3rdEdition, John Wiley & Sons; I |

**Course 2 : OE- 4T, Intellectual Property Rights**

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| --- | --- | --- | --- |
| Program Name | **BSc Biotechnology** | Semester | **Fourth Sem** |
| Course Title | **Intellectual Property Rights** |
| Course Code |  **FSD900** | **OE-4** | No. of Theory Credits | **3** |
| Contact hours | **Lecture** | 42 h | Duration of ESA/Exam | **2 Hours** |
| **Practical** | - |
| Formative Assessment Marks | 40 | Summative Assessment Marks | 60 |

**Course Pre-requisite(s):**

**Course Outcomes (COs**): At the end of the course the student should be able to:

1. Knowledge about need and scope of Intellectual property rights
2. Acquire knowledge about filing patents, process, and infringement
3. Knowledge about trademarks, industrial designs, and copyright

 **Content 42 Hrs**

 **Unit–I - Introduction to Intellectual property rights** (**IPR): 14** Hrs

Genesis and scope. Types of Intellectual property rights - Patent, Trademarks, Copyright, Design, Trade secret, Geographical indicators, Plant variety protection. National and International agencies – WIPO, World Trade Organization (WTO), Trade-Related Aspects of Intellectual Property Rights (TRIPS), General Agreement on Tariffs and Trade (GATT).

**Unit -II - Patenting, process, and infringement 14** Hrs

Basics of patents - Types of patents; Patentable and Non-Patentable inventions, Process and Product patent. Indian Patent Act 1970; Recent amendments; Patent Cooperation Treaty (PCT) and implications. Process of patenting. Types of patent applications: Provisional and complete specifications; Concept of “prior art‟, patent databases (USPTO, EPO, India). Financial assistance, schemes, and grants for patenting. Patent infringement- Case studies on patents (Basmati rice)

**Unit -III - Trademarks, Copy right, industrial Designs 14** Hrs

Trademarks- types, Purpose and function of trademarks, trademark registration, Protection of trademark. Copy right- Fundamentals of copyright law, Originality of material, rights of reproduction, industrial Designs: Protection, Kind of protection provided by industrial design.

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| References |
| Manish Arora. 2007. Universal's Guide to Patents Law (English) 4th Edition) -Publisher: Universal LawPublishing House |
| Kalyan C. Kankanala. 2012. Fundamentals of Intellectual Property. Asia Law House |
| Ganguli, P. 2001. Intellectual Property Rights: Unleashing the knowledge economy. New Delhi: Tata McGraw-Hill Pub |
| World trade organization - [http://www.wto.org](http://www.wto.org/) |
| World Intellectual Property organization – [www.wipo.int](http://www.wipo.int/)Office of the controller general of Patents, Design & Trademarks - [www.ipindia.nic.in](http://www.ipindia.nic.in/) |

**L PATTERN OF THEORY EXAMINATION**

**B.Sc – BIOTECHNOLOGY**

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

 **Duration: 2 Hours Maximum: 60 Marks**

**All questions are compulsory**

**Draw neat labeled diagrams wherever necessary**

I Answer any EIGHT of the following 2X8=16

(1)

(2)

(3)

(4)

(5)

(6)

 (7)

 (8)

 (9)

 (10)

II Answer any SIX of the following 4X6=24

(11)

 (12)

 (13)

 (14)

 (15)

 (16)

 (17)

 (18)

 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 04 Marks

 Q. 3 Identify and comment 2X4 = 08Marks

Q. 4 Viva-voce 05 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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