# MAHENDRA ARTS & SCIENCE COLLEGE
## (Autonomous)
Affiliated to Periyar University, Salem.
Accredited by NAAC with 'A' Grade & Recognized u/s 2(f) and 12(B) of the UGC Act 1956
Kalippatti – 637 501, Namakkal (Dt), Tamil Nadu.

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## DEPARTMENT OF BIOTECHNOLOGY

### Number of Courses Focusing on Employability/ Entrepreneurship/ Skill Development

**Programme: B.Sc. Biotechnology**

| S.No. | Year | Total No. of Courses | Employability (1) | Entrepreneurship (2) | Skill development (3) | Total No. of Courses (1+2+3) |
|---|---|---|---|---|---|---|
| 1. | 2020-2021 | 55 | 4 | 3 | 11 | 18 |
| 2. | 2019-2020 | 53 | 4 | 2 | 13 | 19 |
| 3. | 2018-2019 | 54 | 3 | 2 | 15 | 20 |
| 4. | 2017-2018 | 33 | - | 1 | 8 | 9 |
| 5. | 2016-2017 | 15 | - | - | 1 | 1 |

Head of the Department

HEAD OF THE DEPARTMENT
Department of Biotechnology,
Mahendra Arts & Science College (Autonomous),
Kalippatti (Po) - 637 501. Tiruchengode (Tk),
Namakkal (Dt). Tamil Nadu. India.

Principal

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## DEPARTMENT OF BIOTECHNOLOGY

### List of Courses Focusing on Employability/ Entrepreneurship/ Skill Development (Regulations – 2019)

**Programme : B.Sc. Biotechnology**

| S.No. | Course Name | Course Code | Employability | Entrepreneurship | Skill development |
|---|---|---|---|---|---|
| 1. | Applied Microbiology | M19UMBA02 | | | ✓ |
| 2. | Biophysics & Bioinstrumentation | M19UBTS01 | | | ✓ |
| 3. | Bioinformatics | M19UBTS02 | | | ✓ |
| 4. | Health and Hygiene | M19NBT01 | | | ✓ |
| 5. | Food and Nutrition | M19NBT02 | | | ✓ |
| 6. | Entrepreneurship in Biotechnology | M19NBT03 | | ✓ | |
| 7. | Agricultural Biotechnology | M19NBT04 | | ✓ | |
| 8. | Immunology | M19UBT05 | | | ✓ |
| 9. | rDNA Technology | M19UBT06 | | | ✓ |
| 10. | Bioprocess Technology | M19UBT07 | | | ✓ |
| 11. | Bioethics and Biosafety | M19UBTE01 | | | ✓ |
| 12. | Nursery and gardening | M19UBTE03 | | ✓ | |
| 13. | Herbal Technology | M19UBTE04 | ✓ | | |
| 14. | Industrial Safety | M19UBTE08 | | | ✓ |
| 15. | Industrial Biotechnology and IPR | M19UBTS03 | ✓ | | |
| 16. | Environmental Biotechnology | M19UBT09 | | | ✓ |
| 17. | Food Biotechnology | M19UBTE05 | ✓ | | |
| 18. | Microbial Disease and Control | M19UBTE06 | | | ✓ |
| 19. | Pharmaceutical Biotechnology | M19UBTE07 | ✓ | | |

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| S.No. | Course Name | Course Code | Employability | Entrepreneurship | Skill development |
|---|---|---|---|---|---|
| 20. | Nano-Biotechnology | M19UBTS04 | | | ✓ |
| 21. | Diagnostics Biotechnology | M19UBTJ01 | ✓ | | |
| 22. | Food Process Technology | M19UBTJ02 | ✓ | | |

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## DEPARTMENT OF BIOTECHNOLOGY

### List of Courses Focusing on Employability/ Entrepreneurship/ Skill Development (Regulations – 2019)

**Programme : B.Sc. Biotechnology**

| S.No. | Name of the Course | Course Code | Employability/ Entrepreneurship/ Skill development | Year of introduction (during the last five years) |
|---|---|---|---|---|
| 1. | Applied Microbiology | M19UMBA02 | Skill development | 2020 - 2021 |
| 2. | Biophysics & Bioinstrumentation | M19UBTS01 | Skill development | 2020 - 2021 |
| 3. | Bioinformatics | M19UBTS02 | Skill development | 2020 - 2021 |
| 4. | Health and Hygiene | M19NBT01 | Skill development | 2020 - 2021 |
| 5. | Food and Nutrition | M19NBT02 | Skill development | 2020 - 2021 |
| 6. | Entrepreneurship in Biotechnology | M19NBT03 | Entrepreneurship | 2020 - 2021 |
| 7. | Agricultural Biotechnology | M19NBT04 | Entrepreneurship | 2020 - 2021 |
| 8. | Immunology | M19UBT05 | Skill development | 2020 - 2021 |
| 9. | rDNA Technology | M19UBT06 | Skill development | 2020 - 2021 |
| 10. | Bioprocess Technology | M19UBT07 | Skill development | 2020 - 2021 |
| 11. | Bioethics and Biosafety | M19UBTE01 | Skill development | 2020 - 2021 |
| 12. | Nursery and gardening | M19UBTE03 | Entrepreneurship | 2020 - 2021 |
| 13. | Herbal Technology | M19UBTE04 | Employability | 2020 - 2021 |
| 14. | Industrial Safety | M19UBTE08 | Skill development | 2020 - 2021 |
| 15. | Industrial Biotechnology and IPR | M19UBTS03 | Employability | 2020 - 2021 |
| 16. | Environmental Biotechnology | M19UBT09 | Skill development | 2020 - 2021 |
| 17. | Food Biotechnology | M19UBTE05 | Employability | 2020 - 2021 |
| 18. | Microbial Disease and Control | M19UBTE06 | Skill development | 2020 - 2021 |

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| S.No. | Name of the Course | Course Code | Employability/ Entrepreneurship/ Skill development | 2020 - 2021 |
|---|---|---|---|---|
| 19. | Pharmaceutical Biotechnology | M19UBTE07 | Employability | 2020 - 2021 |
| 20. | Nano-Biotechnology | M19UBTS04 | Skill development | 2020 - 2021 |
| 21. | Diagnostics Biotechnology | M19UBTJ01 | Employability | 2020 - 2021 |
| 22. | Food Process Technology | M19UBTJ02 | Employability | 2020 - 2021 |

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## BACHELOR OF SCIENCE

## SYLLABUS FOR B.Sc. BIOTECHNOLOGY

## OUTCOME BASED EDUCATION - CHOICE BASED CREDIT SYSTEM

**For the students admitted from the Academic Year 2019-2020 onwards**

PRINCIPAL
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## I. PREAMBLE

The Biotechnology programme has the linkage between basic and applied research and new discoveries and innovations can find direct applications in agriculture, human health and environment. The breakthroughs in modern biotechnology mainly include our ability to produce useful organisms through genetic engineering and cell fusion techniques and improve bioprocess technology to purify novel molecules generated by such processes. It also involves targeting drugs, development of delivery systems and vaccines. Considering this background, the syllabus document is essentially to be formulated which focused on diverse areas from Cell Biology, Biochemistry, Immunology, Plant Biotechnology, Animal Biotechnology, Genetic Engineering and Bioinformatics with significant laboratory practices which will enable the students to have hands on experience in doing experiments themselves.

## II. PROGRAMME OBJECTIVE

- To empower students to excel in various research fields of Life Sciences
- To inculcate sense of scientific responsibilities and social and environment awareness
- To help students build-up a progressive and successful career
- To contribute the field of biotechnology and allied industries designing, developing and providing solutions for product development

## III. PROGRAMME OUTCOMES

1 Graduates will gain basic knowledge of Biotechnology, Science and Technology concepts.

2 Graduates will be able to understand appropriate tools and techniques in biotechnological manipulation.

3 Graduates will be able to apply biotechnological practices in health and environmental issues.

4 Graduates to analyze the biological products/concepts usingbiotechnological tools.

## IV. REGULATIONS

These regulations shall take effect from the academic year 2019-2020, i.e, for students who are to be admitted to the first year of the course during the academic year 2019-2020 and thereafter.

### 1. Eligibility for Admission:

Candidate for admission to the first year of the Bachelor of Science programme shall be required to have passed the Higher secondary examination (Academic or Vocational Stream) conducted by the Government of Tamil Nadu or an Examination accepted by the Syndicate, Subject to such conditions may be prescribed therefore shall be permitted to appear and qualify for B.Sc. programme examination in Biotechnology.

### 2. Duration of the Programme:

The programme of study of Bachelor of Science in Biotechnology shall consist of three academic years divided into six semesters with 143 credits. Each Semester consists of 90 working days.

### 3. Programme of Study:

The programme of study for the UG degree has been divided into the following five categories:

Part I : Tamil / Other Languages.

Part II : English Language.

Part III : Core Courses, Elective Courses and Allied Courses.

Part IV : Skill Enhancement Courses, Non-Major Elective Course, Enhancement Compulsory Courses.

Part V : Value added Courses, Extension Activity, etc.

### 4. Examinations:

The programme of study shall be based on semester pattern with Internal Assessment under Choice Based Credit System.

The examinations for all the papers consist of both Internal (Continuous Internal Assessment - CIA) and External (End Semester) theory examinations. The theory examinations shall be conducted for three hours duration at the end of each semester. The candidates failing in any subjects(s) will be permitted to reappear for the same in the subsequent semester examinations.

## V. STRUCTURE OF THE PROGRAMME

### SEMESTER: I

| Part | Course Category | Title of the Course | Course Code | Hrs/ Week | | No. of Credits | Max. Mark | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | L | P | | Int. | Ext. | Total |
| I | LANGUAGE COURSE-I | Tamil - I / French - I / Hindi - I | M19UFA01 | 5 | - | 3 | 25 | 75 | 100 |
| II | LANGUAGE COURSE-II | English - I | M19UFEN01 | 5 | - | 3 | 25 | 75 | 100 |
| III | CORE COURSE-I | Cell Biology | M19UBT01 | 6 | - | 4 | 25 | 75 | 100 |
| III | ALLIED COURSE-I | Biochemistry - I | M19UBCA01 | 6 | - | 4 | 25 | 75 | 100 |
| III | CORE PRACTICAL –I | Practical-I-Cell Biology | M19UBTP01 | - | 3 | 3 | 40 | 60 | 100 |
| III | ALLIED PRACTICAL –I | Allied Practical-I-Biochemistry-I | M19UBCAP01 | - | 3 | 3 | 40 | 60 | 100 |
| V | ENHANCEMENT COMPULSORY COURSE | Value Education - Yoga | M19UVE01 | 2 | - | 2 | 25 | 75 | 100 |
| | **Total** | | | **24** | **6** | **22** | **205** | **495** | **700** |

### SEMESTER: II

| Part | Course Category | Title of the Course | Course Code | Hrs/ Week | | No. of Credits | Max. Mark | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | L | P | | Int. | Ext. | Total |
| I | LANGUAGE COURSE-I | Tamil - II / French - II / Hindi - II | M19UFA02 | 5 | - | 3 | 25 | 75 | 100 |
| II | LANGUAGE COURSE-II | English - II | M19UFEN02 | 5 | - | 3 | 25 | 75 | 100 |
| III | CORE COURSE-II | Plant Biology | M19UBT02 | 6 | - | 4 | 25 | 75 | 100 |
| III | ALLIED COURSE-II | Biochemistry - II | M19UBCA02 | 6 | - | 4 | 25 | 75 | 100 |
| III | CORE PRACTICAL –II | Practical-II-Plant Biology | M19UBTP02 | - | 3 | 3 | 40 | 60 | 100 |
| III | ALLIED PRACTICAL –II | Allied Practical-II-Biochemistry-II | M19UBCAP02 | - | 3 | 3 | 40 | 60 | 100 |
| V | ENHANCEMENT COMPULSORY COURSE | Environmental studies | M19UES01 | 2 | - | 2 | 25 | 75 | 100 |
| | **Total** | | | **24** | **6** | **22** | **205** | **495** | **700** |

**SEMESTER: III**

| Part | Course Category | Title of the Course | Course Code | Hrs/ Week | | No. of Credits | Max. Mark | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | L | P | | Int. | Ext. | Total |
| I | LANGUAGE COURSE-I | Tamil - III / French - III / Hindi - III | M19UFA03 | 5 | - | 3 | 25 | 75 | 100 |
| II | LANGUAGE COURSE-II | English - III | M19UFEN03 | 5 | - | 3 | 25 | 75 | 100 |
| III | CORE COURSE-III | Animal Science | M19UBT03 | 5 | - | 4 | 25 | 75 | 100 |
| III | ALLIED COURSE-III | Basic Microbiology | M19UMBA01 | 5 | - | 4 | 25 | 75 | 100 |
| III | CORE PRACTICAL –III | Practical-III-Animal Science | M19UBTP03 | - | 3 | 3 | 40 | 60 | 100 |
| III | ALLIED PRACTICAL –III | Allied Practical-III-Basic Microbiology | M19UMBAP01 | - | 3 | 3 | 40 | 60 | 100 |
| IV | SEC- I | SEC-I-Biophysics and Bioinstrumentation | M19UBTS01 | 2 | - | 2 | 25 | 75 | 100 |
| IV | NMEC-I | | | 2 | - | 2 | 25 | 75 | 100 |
| | **Total** | | | **24** | **6** | **24** | **230** | **570** | **800** |

**SEMESTER: IV**

| Part | Course Category | Title of the Course | Course Code | Hrs/ Week | | No. of Credits | Max. Mark | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | L | P | | Int. | Ext. | Total |
| I | LANGUAGE COURSE-I | Tamil - IV / French - IV / Hindi - IV | M19UFA04 | 5 | - | 3 | 25 | 75 | 100 |
| II | LANGUAGE COURSE-II | English - IV | M19UFEN04 | 5 | - | 3 | 25 | 75 | 100 |
| III | CORE COURSE-IV | Genetics and Molecular Biology | M19UBT04 | 5 | - | 4 | 25 | 75 | 100 |
| III | ALLIED COURSE-IV | Applied Microbiology | M19UMBA02 | 5 | - | 4 | 25 | 75 | 100 |
| III | CORE PRACTICAL –IV | Practical-IV-Genetics and Molecular biology | M19UBTP04 | - | 3 | 3 | 40 | 60 | 100 |
| III | ALLIED PRACTICAL –IV | Allied Practical-IV-Applied Microbiology | M19UMBAP02 | - | 3 | 3 | 40 | 60 | 100 |
| IV | SEC- II | SEC-II-Bioinformatics | M19UBTS02 | 2 | - | 2 | 25 | 75 | 100 |
| IV | NMEC-II | | | 2 | - | 2 | 25 | 75 | 100 |
| V | EXTENSION ACTIVITIES | Extension Activities | M19UEX01 | - | - | 1 | - | - | - |
| | **Total** | | | **24** | **6** | **25** | **230** | **570** | **800** |

**SEMESTER: V**

| Part | Course Category | Title of the Course | Course Code | Hrs/ Week | | No. of Credits | Max. Mark | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | L | P | | Int. | Ext. | Total |
| III | CORE COURSE-V | Immunology | M19UBT05 | 6 | - | 4 | 25 | 75 | 100 |
| III | CORE COURSE-VI | rDNA Technology | M19UBT06 | 6 | - | 4 | 25 | 75 | 100 |
| III | CORE COURSE-VII | Bioprocess Technology | M19UBT07 | 5 | - | 4 | 25 | 75 | 100 |
| III | ELECTIVE COURSE | Elective – I | - | 5 | - | 4 | 25 | 75 | 100 |
| III | CORE PRACTICAL –V | Practical-V-Immunology and rDNA Technology | M19UBTP05 | - | 3 | 3 | 40 | 60 | 100 |
| III | CORE PRACTICAL –VI | Practical-VI-Bioprocess Technology | M19UBTP06 | - | 3 | 3 | 40 | 60 | 100 |
| IV | SEC- III | Industrial Biotechnology and IPR | M19UBTS03 | 2 | - | 2 | 25 | 75 | 100 |
| | **Total** | | | **24** | **6** | **24** | **205** | **495** | **700** |

**SEMESTER: VI**

| Part | Course Category | Title of the Course | Course Code | Hrs/ Week | | No. of Credits | Max. Mark | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | L | P | | Int. | Ext. | Total |
| III | CORE COURSE-VIII | Plant and Animal Biotechnology | M19UBT08 | 4 | - | 4 | 25 | 75 | 100 |
| III | CORE COURSE-IX | Environmental Biotechnology | M19UBT09 | 4 | - | 4 | 25 | 75 | 100 |
| III | ELECTIVE COURSE | Elective – II | - | 4 | - | 4 | 25 | 75 | 100 |
| III | CORE PRACTICAL –VII | Practical-VII-Plant and Animal Biotechnology | M19UBTP07 | - | 4 | 3 | 40 | 60 | 100 |
| III | CORE PRACTICAL –VIII | Practical-VIII-Environmental Biotechnology | M19UBTP08 | - | 4 | 3 | 40 | 60 | 100 |
| III | CORE PROJECT | Project | M19UBTPR1 | - | 4 | 3 | 40 | 60 | 100 |
| IV | SEC- IV | Nano-biotechnology | M19UBTS04 | 2 | - | 2 | 25 | 75 | 100 |
| V | SC-I-JOC | Self Employment Courses | - | 4 | - | 3 | 25 | 75 | 100 |
| V | Swayam | MOOC | | - | - | - | - | - | - |
| | | **Total** | | **18** | **12** | **26** | **245** | **555** | **800** |
| | | **TOTAL** | | **138** | **42** | **143*** | **1320** | **3180** | **4500** |

*The students will gain extra credits for successful completion of online courses from SWAYAM / MOOC.

**Summary of Credits, Hours and Mark Distribution**

| Part | Course Name | No. of Credits | | | | | | Total Credits | Total Hours | No. of Courses | Max. Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI | | | | |
| I | Language – I | 3 | 3 | 3 | 3 | - | - | 12 | 20 | 4 | 400 |
| II | Language – II | 3 | 3 | 3 | 3 | - | - | 12 | 20 | 4 | 400 |
| III | Core | 4 | 4 | 4 | 4 | 12 | 8 | 36 | 47 | 9 | 900 |
| | Core Practical | 3 | 3 | 3 | 3 | 6 | 6 | 24 | 26 | 8 | 800 |
| | Elective | - | - | - | - | 4 | 4 | 8 | 9 | 2 | 200 |
| | Project | - | - | - | - | - | 3 | 3 | 4 | 1 | 100 |
| | Allied | 4 | 4 | 4 | 4 | - | - | 16 | 22 | 4 | 400 |
| | Allied Practical | 3 | 3 | 3 | 3 | - | - | 12 | 12 | 4 | 400 |
| IV | SEC | - | - | 2 | 2 | 2 | 2 | 8 | 8 | 4 | 400 |
| | NMEC | - | - | 2 | 2 | - | - | 4 | 4 | 2 | 200 |
| | Enhancement Compulsory Courses | 2 | 2 | - | - | - | - | 4 | 4 | 2 | 200 |
| V | Self Employment Courses | - | - | - | - | - | 3 | 3 | 4 | 1 | 100 |
| | Extension Activities | - | - | - | 1 | - | - | 1 | - | 1 | - |
| **Total** | | **22** | **22** | **24** | **25** | **24** | **26** | **143*** | **180** | **46** | **4500** |

*The students will gain one extra credit for successful completion of online courses from SWAYAM / MOOC.

## ALLIED SUBJECTS FOR B.Sc., BIOTECHNOLOGY STUDENTS

| Semester | Subject | Course Code |
|---|---|---|
| I | Biochemistry – I | M19UBCA01 |
| II | Biochemistry – II | M19UBCA02 |
| III | Basic Microbiology | M19UMBA01 |
| IV | Applied Microbiology | M19UMBA02 |

## ALLIED SUBJECTS OFFERED FOR OTHER MAJOR STUDENTS

| Semester | Subject | Course Code |
|---|---|---|
| I | Biochemistry – I | M19UBCA01 |
| II | Biochemistry – II | M19UBCA02 |

## ELECTIVE SUBJECTS FOR B.Sc. BIOTECHNOLOGY STUDENTS

| Semester | ELECTIVE - I | |
|---|---|---|
| V | **Course Title** | **Course Code** |
| | Bioethics and Bio-safety | M19UBTE01 |
| | Developmental Biology | M19UBTE02 |
| | Nursery and gardening | M19UBTE03 |
| | Herbal Technology | M19UBTE04 |
| **ELECTIVE – II** | | |
| VI | **Course Title** | **Course Code** |
| | Food Biotechnology | M19UBTE05 |
| | Microbial Disease and Control | M19UBTE06 |
| | Pharmaceutical Biotechnology | M19UBTE07 |
| | Industrial Safety | M19UBTE08 |

## SKILL ENCHANCEMENT COURSES

| Semester | Course Title | Course Code |
|---|---|---|
| III | Biophysics and Bioinstrumentation | M19UBTS01 |
| IV | Bioinformatics | M19UBTS02 |
| V | Industrial Biotechnology and IPR | M19UBTS03 |
| VI | Nano-biotechnology | M19UBTS04 |

## SELF EMPLOYMENT COURSES

| Semester | Course Title | Course Code |
|---|---|---|
| VI | Diagnostic Biotechnology | M19UBTJ01 |
| | Food process Technology | M19UBTJ02 |

## NON - MAJOR ELECTIVE COURSES: [FOR OTHER DEPARTMENTS]

| Semester | Course Title | Course Code |
|---|---|---|
| III | 1. Health and Hygiene | M19NBT01 |
| | 2. Food and Nutrition | M19NBT02 |
| IV | 1.Entrepreneurship in Biotechnology | M19NBT03 |
| | 2.Agricultural Biotechnology | M19NBT04 |

## VI. SCHEME OF EXAMINATION

### 1. Question Paper Pattern for Theory Examination

Time: Three Hours Maximum Marks: 75

**Part A: (10 x 1 = 10)**
Answer ALL Questions
(Objective Type - Two Questions from each unit)

**Part B: (5 x 2 = 10)**
Answer ALL Questions
(One Question from each unit)

**Part C: (5 x 5 = 25)**
Answer ALL Questions
(One Question from each unit with internal choice)

**Part D: (3 x 10 = 30)**
Answer Any Three out of Five Questions
(One Question from each unit)

### 2. Question Paper Pattern for Practical Examination

Time: Six Hours Maximum Marks: 60

**QUESTION PATTERN**

| | | |
|---|---|---|
| **Major Practical** | **=** | **20 Marks** |
| **Minor Practical** | **=** | **10 Marks** |
| **Spotters (5X4=20)** | **=** | **20 Marks** |
| **Viva Voce** | **=** | **05 Marks** |
| **Record** | **=** | **05 Marks** |
| **Total** | **=** | **60 Marks** |

### 3. Distribution of Marks:

The following are the distribution of marks for external and internal for End Semester Examinations and continuous internal assessment and passing minimum marks for Theory / Practical / Mini project / Project papers of UG programmes.

| EndSE | EA Total | Passing Minimum for EA | CIA Total | Passing Minimum for CIA | Total Marks Allotted | Passing Minimum (ESE) |
|---|---|---|---|---|---|---|
| **Theory** | 75 | 30 | 25 | 10 | 100 | 40 |
| **Practical** | 60 | 24 | 40 | 16 | 100 | 40 |
| **Project** | 60 | 24 | 40 | 16 | 100 | 40 |

The following are the Distribution of marks for the Continuous Internal Assessment in Theory / Practical papers of UG programmes.

**THEORY**

EVALUATION OF INTERNAL ASSESSMENT

| | |
|---|---|
| Test | : 15 Marks |
| Assignment | : 05 Marks |
| Attendance | : 05 Marks |
| Total | : 25 Marks |

The Passing minimum shall be 40% out of 25 marks (10 marks)

**PRACTICAL**

EVALUATION OF INTERNAL ASSESSMENT

| | |
|---|---|
| Test 1 | : 15 Marks |
| Attendance | : 15 Marks |
| Observation | : 10 Marks |
| Total | : 40 Marks |

The Passing minimum shall be 40% out of 40 marks (16 marks)

**PROJECT**

EVALUATION OF INTERNAL ASSESSMENT

| | |
|---|---|
| Review 1 | : 10 Marks |
| Review 2 | : 10 Marks |
| Review 3 | : 10 Marks |
| Pre-Viva | : 10 Marks |
| Total | : 40 Marks |

The Passing minimum shall be 40% out of 40 marks (16 marks)

**4. Passing Minimum:**

The Candidates shall be declared to have passed the examination if he/she secures not less than 40 marks in total (CIA mark + Theory Exam mark) with minimum of 30 marks in the End Semester Theory Examinations.

The Candidates shall be declared to have passed the examination if he/she secures not less than 40 marks in total (CIA mark + Practical Exam mark) with minimum of 24 marks in the End Semester Practical Examinations.

**5. Submission of Record Note Books for Practical Examinations**

Candidates appearing for practical examinations should submit a bonafide record note books prescribed for practical examinations. The candidates failed to submit the record book shall not be permitted to appear for the practical examinations.

**6. Project**

The following guidelines to be followed for the Project with Viva-voce:

1. The project should be valued for 60 marks by an external examiner; however the Viva-Voce examination should be conducted by both the external examiner appointed by the College and the internal examiner/supervisor/teacher concerned.
2. The Project Report may consist of minimum of 60 pages.
3. The candidate has to submit the Project Report 20 days before the commencement of the VI Semester Examinations.
4. A candidate who fails in the Project/Dissertation or is absent may resubmit the report, on the same topic, with necessary modification / correction / improvements in the subsequent Even Semester Examinations for evaluation and shall undergo viva-voce Examination.

**VII. NOTE**

**SWAYAM / MOOC – Free Online Education**

SWAYAM / MOOC is an instrument for self-actualization providing opportunities for a life-long learning. Here the student can choose from hundreds of courses, virtually every course taught at the college level, offered by the best teachers in India and elsewhere.

The students can choose an online SWAYAM / MOOC course during their period of study which will earn an extra credit and it will be transferred to the academic records of the students.

## SEMESTER I

| Core - I | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBT01 | CELL BIOLOGY | |
| Credit: 4 | | |

**Objectives**

To understand the structure and the functions of prokaryotic and eukaryotic cells.

To study about specialized cells and cell organelles.

To impart knowledge about cell division and structural organization of chromosomes.

To study about the cell signaling pathways.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the fundamental principles of cell structure, organization, cell division and signaling. | K1 |
| CO2 | Understand the structure and function of cellular components, organelles, chromosome, cell signaling pathway. | K2 |
| CO3 | Explain the process events of cell Division, cell cycle and cell adhesions. | K3 |
| CO4 | Classify prokaryotic and eukaryotic cell structure and its functions with suitable examples. | K4 |

**UNIT- I**

Introduction and history of cell biology. Ultra-structure of plant, animal and bacterial cell. Difference between prokaryotes and eukaryotes. Difference between Plant and Animal cells

**UNIT -II**

Structure and function of cell organelles: Cell wall, cell membrane, Chloroplast, mitochondria.

**UNIT –III**

Structure and function of Endoplasmic reticulum, Golgi complex, Peroxisomes, lysosome and vacuoles. Specialized cell organelles: cilia and flagella.

**UNIT- IV**

Structure and function of Nucleus, ribosome, Chromosomes and cell division: Morphology, Structural organization, ultra-structure of chromosome, specialized chromosomes. Cell cycle, Mitosis and Meiosis.

**UNIT- V**

Cell-Cell adhesion, Cell signaling- types- G Protein Ras, Raf pathway. Cell staining methods.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | A Text Book of Cell Biology | Aminul Islam | Books and Allied (P) Ltd, Kolkatta. | 2011 |
| 2. | Cell Biology First edition | Powar. C.B | Himalaya publishing house, New Delhi. | 1983 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Cell Biology, Genetics, Molecular Biology, Evolution and Ecology | Verma P S and Agarwal V K | S Chand | 2006 |
| 2 | Cell Biology | Kimball T W | Brown (William C.) Co U.S. | 1994 |
| 3 | Cell Biology | T Devasena | Oxford University Press, | 2012 |
| 4 | Cell Biology and Molecular Biology | N Arumugam | Saras Publication | 2011 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | S | M | M | M |
| **CO2** | S | M | M | S |
| **CO3** | M | S | S | S |
| **CO4** | S | S | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER I**

| Allied - I | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBCA01 | BIOCHEMISTRY - I | |
| Credit: 4 | | |

**Objectives**

To study the structure and function of biomolecules (proteins, lipids, and carbohydrates) found in living cells.

To provide fundamental knowledge and overview about enzymes and nucleic acids.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the structures of Carbohydrates, amino acids and enzymes. | K1 |
| CO2 | Understand the biological functions and properties of bio-molecules. | K2 |
| CO3 | Explain the bio chemical compounds in the cells and organelles. | K3 |
| CO4 | Classify the significance of essential and non essential amino acids, fatty acids and it's applications in living systems. | K4 |

**UNIT-I**

Introduction to Biochemistry: Concept of acids and bases. Buffers - Definition and determination of pH, Henderson Hasselbach Equation, Lab Solutions Preparation (Molarity, Molality, Normality and percentage solutions).

**UNIT-II**

Carbohydrates: Introduction, classification, monosaccharide-structure, stereoisomers and structural isomers, mutarotation, and chemical reactions. Oligosaccharides – Dissaccharides - structure and importance of sucrose, Lactose, maltose. Polysaccharides - structure and importance of homopolysaccharides and heteropolysaccharides.

**UNIT-III**

Amino acids: Classification, Essential & Non-essential amino acids, structure and properties. Protein: Definition, classification and functions – structural levels of organization.

**UNIT –IV**

Enzymes – Definition, classification with example, active site, lock & key model, induced fit hypothesis. Enzyme units – kinetics- factors affecting enzyme activity.

**UNIT-V**

Classification of Lipids and fatty acids, physical & Chemical properties of fatty acids. Components of nucleic acid - Nitrogenous bases, pentose sugar and phosphoric acid. Nucleoside and nucleotides.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Fundamentals of Biochemistry | J L Jain, Sunjay Jain, Nitin Jain | S. Chand publications | 2016 |
| 2. | Essentials of Biochemistry | U. Sathyanarayanan | Books and allied (p) Ltd. | 2002 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Harper's Biochemistry | Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell | Prentice Hall International. Inc | 2006 |
| 2. | Fundamentals of Biochemistry | Donald Voet, Judith G.Voet and Charlotte W Pratt | John Wiley & Sons, NY | 1999 |
| 3. | Biochemistry | Jeremy M. Berg, Lubert Stryer, John L. Tymoczko, Gregory J. Gatto | WH Freeman | 2015 |
| 4. | Lehninger Principles of Biochemistry | David L. Nelson, Michael Cox | A John Wiley, In. | 1997 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | M | M | S |
| **CO2** | M | M | S | S |
| **CO3** | S | S | M | M |
| **CO4** | S | S | S | S |
| **CO5** | S | M | S | S |

**S**- Strong; **M**-Medium.

**SEMESTER I**

| Core: Practical-I | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBTP01 | PRACTICAL - I - CELL BIOLOGY | |
| Credit: 3 | | |

**Objectives**

To provide better practical knowledge and training on microscopes, cell counting methods, and staining of macromolecule in plant and animal cells.

1. Microscopes and its parts.
2. Micrometry - Stage and Ocular Micrometer
3. Cell Counting - Haemocytometer.
4. Mounting buccal epithelium and observing living cells using vital staining.
5. Mitosis in Onion root tip squash.
6. Meiosis grasshopper testis squash/Anther of *Tradescantia* sp. flower.
7. Salivary gland squash preparation in Chironomous larvae for identification of giant Chromosome.
8. Staining of storage molecules - Carbohydrates and Lipids
9. Observation of slides (Cardiac muscle, Sperm cell, Muscle cell)
10. Microtomy (Demo).

**TEXT BOOK:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Cell Biology : Practical Manual | Renu Gupta, SeemaMakhija, Dr. Ravi Toteja | Prestige | 2018 |

**REFERENCE BOOK:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Cell Biology, Genetics, Molecular Biology, Evolution and Ecology | Verma P S and Agarwal V K | S Chand | 2006 |
| 2. | Cell Biology | Kimball T W | Brown (William C.) Co ,U.S. | 1994 |
| 3. | Cell Biology | T Devasena | Oxford University Press, | 2012 |
| 4. | Cell Biology and Molecular Biology | N Arumugam | Saras Publication | 2011 |

**SEMESTER – I**

| Allied Practical- I | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBCAP01 | ALLIED PRACTICAL - I - BIOCHEMISTRY-I | |
| Credit: 3 | | |

**Objectives**

To provide practical knowledge on extraction of starch, casein, and lecithin from biological samples.

To perform the qualitative analysis carbohydrate and protein samples.

To determine the acid and saponification number of fat and salivary amylase enzyme activity.

1. Preparation of buffer solution (Phosphate, Acetate and Citrate) and determination of pH.
2. Estimation of starch from potato.
3. Preparation of casein from milk.
4. Determination of Acid number.
5. Determination of specific activity of salivary amylase enzyme
6. Estimation of ascorbic acid by 2,6 Dichloro phenol Indophenol method

**SPOTTERS**

1. pH Meter
2. pH Paper
3. Monosaccharides – Glucose, Fructose, Galactose, Ribose
4. Disaccharides – Sucrose, Lactose, Maltose
5. Polysaccharide – Starch, Cellulose
6. Aminoacids – Glycine, Serine, Cysteine, Histidine, Aspartic acid, Tyrosine
7. Nitrogenous Bases – Adenine, Guanine, Thymine, Cytosine, Uracil
8. Lipids – Lecithin, Cephalin, Plasmalogen, Ganglioside.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Introductory Practical Biochemistry | S.K. Sawhney, R. Singh | Alpha Science International Ltd | 2005 |

**REFERENCE BOOKS:-**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | An Introduction To Practical Biochemistry | David Plummer | Tata McGraw Hill Education | 2006 |
| 2. | Laboratory Manual For Practical Biochemistry | Shivaraja Shankara | Jaypee Brothers Medical Publishers | 2013 |
| 3. | Practical Biochemistry | Damodaran Geetha K | Jaypee Brothers Medical Publishers | 2016 |

## SEMESTER – I

| Value Education | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UVE01 | kdtsf;fiy Nahfh | |
| Credit: 2 | | |

**பாடநோக்கம்**

இளம் வயது முதல், உடல், மனம் இரண்டையும் பக்குவமாக வைத்துக் கொள்ள வேண்டியதன் அவசியத்தை மாணவர்களுக்கு உணரச் செய்தல்.

**அலகு 1**

**யோகமும் உடல்நலமும்**

உடலமைப்பு – எளியமுறை உடற்பயிற்சி – மகராசனம் - யோகாசனங்கள்

**அலகு 2**

இளமைகாத்தல் - பாலுணர்வும் ஆன்மீகமும் - மனதின் 10 படிநிலைகள் - மன அலைச்சுழல்.

**அலகு 3**

**குணநலப்பேறு**

வாழ்வின் நோக்கம் - எண்மை ஆராய்தல் - ஆசை சீரமைத்தல் - சினம் தவிர்த்தல்.

**அலகு 4**

கவலை ஒழித்தல் - வாழ்த்தும் பயனும் - நட்பு நலம் - தனிமனித அமைதி.

**அலகு 5**

செயல்விளைவுத் தத்துவம் - மனத்தூய்மை, வினைத்தூய்மை – அன்பும் கருணையும் - பண்பாட்டுக் கல்வி.

**பாடநூல்:** 'மனவளக்கலை யோகா'
உலக சமுதாய சேவா சங்கம்
வேதாத்திரி பதிப்பகம்
156, காந்திஜி ரோடு
ஈரோடு – 638 001.
போன்: 0424 – 2263845.

**பார்வை நூல்கள்:**

மனவளக்கலை யோகா –I - உலக சமுதாய சேவா சங்கம்
மனவளக்கலை யோகா –II- வேதாத்திரி பதிப்பகம்
மனவளக்கலை யோகா –III-156, காந்திஜி ரோடு
எளிமுறை உடற்பயிற்சி - ஈரோடு – 638 001.
யோகப்பயிற்சிகள் - போன்: 0422-2263845

**SEMESTER II**

| Core - II | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBT02 | PLANT BIOLOGY | |
| Credit: 4 | | |

**Objectives**

To understand classification systems of plants, structure and modifications of root, stem, leaf and flowers.

To impart specific knowledge on pathways involved in plant systems and fertilization takes place in plants.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the fundamental principles plant biology and classification systems up to class level. | K1 |
| CO2 | Understand the structure, modifications of root, stem, leaf and types of flowers, fruits, seeds. | K2 |
| CO3 | Apply the concepts of fertilization and methods of pollinations. | K3 |
| CO4 | Analyze the taxonomy structure, plant microbial interactions, and the role of electrons in photosynthesis. | K4 |

**UNIT-I**

History and Classification of Plant taxonomy: Natural & Artificial (Linnaeus) – Two Kingdom and Five Kingdom System of classification. General outlines of Bentham and Hooker's classification. Economic importance of following families: Anonaceae, Fabaceae, Apocynaceae, Euphorbiaceae and Musaceae.

**UNIT-II**

Structure and modifications of Root, Stem and Leaf, Phyllotaxy - Structure and types of Inflorescences - Structure and types of flowers, fruits and seeds.

**UNIT- III**

Tissue and tissue systems – Meristem: types of meristem- Shoot and root apical meristem - anatomy of monocot and dicot roots, stems and leaves. Plant - Microbe interaction – Endophytic fungi.

**UNIT-IV**

Absorption of Water and movement - Diffusion, Osmosis, Plasmolysis, Mechanism of Stomatal opening and closing. Photosynthesis – significance – electron transport system – cyclic and non-cyclic photophosphorylation – C3 and C4 pathways.

**UNIT-V**

Modes of Reproduction in Angiosperms - Vegetative propagation - Sexual Reproduction: Structure of mature anther, Structure of mature Ovule and its types. Pollination: types – Double fertilization - Development of male and female gametophytes - Development of Dicot Embryo.

**REFERENCES BOOKS:**


| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Plant Physiology | Pandey, S.N. | Tata McGraw Hill Publishers (P) Ltd., New Delhi. | 1991 |
| 2. | A Text Book of Plant Physiology | Verma, V., | Emkay Publications, New Delhi | 1991 |
| 3. | Introduction to Principles of Plant Taxonomy | Sivarajan, V.V | Oxford & IBH Publishing Co., New Delhi. | 1993 |
| 4. | Economic Botany | Sen, S | New Central Book Agency,Calcutta. | 1992 |
| 5. | Morphology of Lower Vascular Plants. | Earnes, A.J | Tata McGraw Hill Publishing Co., New Delhi | 1936 |
| 6. | Plant Anatomy | Esau, K | Wiley Eastern Private | 1960 |

Limited. New Delhi.

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | S | S | M |
| **CO2** | S | M | M | M |
| **CO3** | M | M | S | S |
| **CO4** | S | M | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER II**

| Allied - II | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBCA02 | Allied - II - BIOCHEMISTRY – II | |
| Credit: 4 | | |

**Objectives**

To provide knowledge about the synthesis and metabolisms of bio-molecules, metabolic pathways and their regulations in living cells.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the concepts of thermodynamics and metabolism | K1 |
| CO2 | Understand the thermodynamic principles and mechanisms in respiration. | K2 |
| CO3 | Apply various metabolic pathways and their control mechanisms. Role of vitamins and hormones in cell metabolisms | K3 |
| CO4 | Analyze the nature of the carbohydrate, protein, lipids and vitamins cell metabolisms | K4 |

**UNIT-I**

Bioenergetics- Laws of Thermodynamics, Redox potential, Respiratory chain, Oxidative phosphorylation (Theories and Mechanism).

**UNIT-II**

Carbohydrate metabolism - Glycolysis, Pyruvate Oxidation and Citric acid cycle HMP shunt, Gluconeogenesis, Glycogenesis, Glycogenolysis.

**UNIT-III**

Protein metabolism - Transamination, oxidative and non-oxidative deamination, decarboxylation - urea cycle. Nucleic acid metabolism - Denova and salvage pathway.

**UNIT-IV**

Lipid metabolism- Biosynthesis of fatty acids and Oxidation of fatty acids (alpha, beta and omega oxidation). Cholesterol Biosynthesis.

**UNIT-V**

Vitamins: Classification, occurrence, deficiency symptoms, and biochemical functions of fat soluble and water soluble Vitamins. Hormones – Definition, Classification of Hormones, Biological function and disorders of Hormones - Insulin, thyroxine, adrenaline and nor-adrenaline.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Fundamentals of Biochemistry | J.L. Jain | S.Chand publications | 2004. |
| 2. | Schaum's Outline of Biochemistry | Philip W Kuchel | Schaum's Outlines | 1997 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Harper's Biochemistry | Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell | Prentice Hall International. Inc | 2006 |
| 2. | Fundamentals of Biochemistry | Donald Voet, Judith G.Voet and Charlotte W Pratt | John Wiley & Sons, NY | 1999 |
| 3. | Lehninger Principles of Biochemistry | David L. Nelson, Michael M. Cox | W H Freeman & Co | 2017 |
| 4. | Biochemistry | Christopher K. Mathews, K. E. Van Holde , Dean R. Appling | Pearson College Div | 2012 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | M | M | S |
| **CO2** | S | M | M | S |
| **CO3** | M | S | M | M |
| **CO4** | M | M | S | S |

**S**- Strong; **M**-Medium.

**SEMESTER II**

| Core Practical-II | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBTP02 | PRACTICAL - II - PLANT BIOLOGY | |
| Credit: 3 | | |

**Objectives**

To understand different plant families description on its morphology, and LS and CS of monocot, dicot. the concept of osmosis and photosynthesis of oxygen evolution by hands on training.

1. Description of plant family - Anonaceae, Fabaceae, Apocynaceae, Euphorbiaceae & Musaceae.
2. Observation of Plant Morphology.
3. Primary T.S of Monocot and Dicot stem, root, leaf.
4. Osmosis, Plasmolysis and Photosynthesis by $O_2$ evolution.
5. Dissection of embryo.

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Plant biology laboratory manual | Graham, wilcox | Benjamin Cummings | 2006 |
| 2. | Plant biology laboratory manual | Dr. Peter LEE | Lakehead University | 2014 |
| 3. | Laboratory Manual for Stern's Introductory Plant Biology | James Bidlack and Shelley Jansky and Kingsley Stern | McGraw-Hill Education | 2018 |

**SEMESTER II**

| Allied Practical - II | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBCAP02 | ALLIED PRACTICAL - II - BIOCHEMISTRY - II | |
| Credit: 3 | | |

**Objectives**

To give hands on training on qualitative analysis of biomolecules, paper chromatography, thin layer chromatography and quantitative titration and colorimetric methods to determine the amount of biomolecules in the sample.

1. Qualitative analysis of carbohydrates
2. Qualitative analysis of amino acids
3. Estimation of amino acid by formal titration method
4. Estimation of reducing sugar by DNS method
5. Estimation of protein by Biuret method
6. Estimation of cholesterol by Zak's method
7. Separation of amino acid by paper and thin layer chromatography

**SPOTTERS**

1. Paper Chromatography – Ascending, Descending, Radial
2. Thin Layer Chromatography
3. Column Chromatography
4. Endocrine Glands – Pituitary, Thyroid, Adrenal, Pancrease
5. Thyroid Hormone Disorders – Goiter, Graves Disease, Myxedema
6. Growth Hormone Disorder – Gigantism, Acromegaly

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Practical Clinical Biochemistry | Harold Varley | CBS publications | 2005 |

**REFERENCE BOOKS:-**

| S. No. | Title of the | Author | Publishing | Year of |
|---|---|---|---|---|

| | Book | | Company | Publication |
|---|---|---|---|---|
| 1. | An Introduction To Practical Biochemistry | David Plummer | Tata McGraw Hill Education | 2006 |
| 2. | Laboratory Manual For Practical Biochemistry | Shivaraja Shankara | Jaypee Brothers Medical Publishers | 2013 |
| 3. | Practical Biochemistry | Damodaran Geetha K | Jaypee Brothers Medical Publishers | 2016 |

**SEMESTER II**

| ECC-I | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UES01 | ENVIRONMENTAL STUDIES | |
| Credit: 2 | | |

**Objectives**

This course provides the basic idea about our environment ecosystem, natural resources, pollution and environmental policies and practices.

**Course Outcomes**

After completing this course, students will be able to:

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the natural resources, conventional and non-conventional sources of energy and their advantages and disadvantages. | K1 |
| CO2 | Understand the environment in terms of ecosystem and its structural and functional aspects. | K2 |
| CO3 | Apply the knowledge about various concepts and issues in the environment including biodiversity conservation | K3 |
| CO4 | Analyze the various types of pollution, pollutants, nuclear and natural hazards. It emphasis on human health impact, mitigation measures and implementation of environmental Acts for control of pollution. | K4 |

**UNIT-I**

Environment – definition – scope – structure and function of ecosystems- producers, consumers and decomposers - energy flow in the ecosystem - ecological succession – food chain, food webs and ecological pyramids – concept of sustainable development.

**UNIT-II**

Natural resources: renewable - air, water, soil, land and wildlife resources. Non – renewable – mineral coal, oil and gas. Environmental problems related to the extraction and use of natural resources.

**UNIT-III**

Biodiversity – definition – values – consumption use, productive social, ethical, aesthetic and option values threats to bio diversity – hotspots of bio diversity – conservation of bio - diversity: *in - situ, ex - situ*. Bio – wealth - National and global level.

**UNIT-IV**

Environmental Pollution: definition – causes, effects and mitigation measures – air pollution, water pollution, soil pollution noise pollution, thermal pollution – nuclear hazards– solid wastes, acid rain – climate change and global warming. Environmental laws and regulations in India.

**UNIT-V**

Social Issues and the Environment - urban problems related to energy. Water conservation, rain water harvesting, watershed management, wasteland reclamation, Environment Protection Act- Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act, wildlife Protection Act, forest Conservation Act.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Textbook for Environmental Studies for Undergraduate Courses of all branches of higher education | Erach Bharucha | University Grants Commission and bharatividya peeth institute of environment education and research, Pune | 2004 |
| 2. | Environmental Studies | Anubha Kaushik | New Age International Publishers, NewDellhi | 2012 |
| 3. | Environmental Studies for Undergraduate Courses - As Per UGC Notified Syllabus | Sushmita Baskar and R. Baskar | Unicorn Books Publishers | 2007 |
| 4. | Textbook of Environmental Studies for Undergraduate Courses | Erach Bharucha | Second edition Orient Black Swan Publishers | 2013 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Environmental Pollution: Causes, Effects and Control. | K.C. Agarwal | Nidhi Publishers (India), Bikanir. | 2001 |
| 2. | Essentials of Ecology and Environmental Sciences | S.V.S.Rana | Prentice Hall of India Private Limited, New Delhi, India. | 2005 |
| 3. | Modern Concepts of Ecology | H.D.Kumar | Vikas Publishing House Private Ltd. | 1982 |
| 4. | Environmental Studies | Sanjay Kumar Batra, Kanchan Batra, Harpreet Kaur and Parul Pant | Taxmans publication | 2018 |
| 5. | Ecology: From Individuals to Ecosystems | Michael Begon, Colin R. Townsend, and John L. Harper | Blackwell Publishing company | 2006 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | S | S | M |
| **CO2** | S | M | M | S |
| **CO3** | M | S | M | S |
| **CO4** | S | S | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER III**

| Core - III | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBT03 | ANIMAL SCIENCE | |
| Credit: 4 | | |

**Objectives**

To understand the animal classification, taxonomy, diversity, structure and functions of the organ and organ systems.

**Course Outcomes**

After completing this course, students will be able to:

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the classification and nomenclature of invertebrates and vertebrates | K1 |
| CO2 | Understand the types, structure and functions of animal tissues | K2 |
| CO3 | Judge anatomy and physiology of different systems | K3 |
| CO4 | Categorize the reproduction and fertilization changes | K4 |

**UNIT-I**

Classification: concept of species; binomial nomenclature; Salient features, classification and detailed study of invertebrates and vertebrates up to class level.

**UNIT-II**

Animal tissue - epithelium (covering), connective (support), muscle (movement) and nervous (control).

**UNIT-III**

Anatomy and physiology of different systems - digestive, circulatory, respiratory, endocrine and excretory system of human beings.

**UNIT-IV**

Modes of reproduction-Asexual and sexual reproduction; Modes- Binary fission, sporulation, budding, gemmule, fragmentation. Gametogenesis - spermatogenesis and oogenesis; Menstrual cycle; Fertilization and post–fertilization changes.

**UNIT-V**

Concept of biodiversity; patterns of biodiversity; importance of biodiversity; loss of biodiversity; biodiversity conservation; hotspots, endangered organisms, extinction, biosphere reserves, national parks and sanctuaries.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Invertebrate Zoology | N.C Nair, S. Leelavathy, N Arumugam, N. Soundara Pandian | Saras Publications A.R. Camp Road, Periyavilai, Kottar Post, Nagercoil, Tamil Nadu 629002 | 2013 |
| 2. | Chordate Zoology | A. Thangamani, S.Prasannakumar, N.Arumugam and L.M.Narayanan | Saras Publications A.R. Camp Road, Periyavilai, Kottar Post, Nagercoil, Tamil Nadu 629002 | 2013 |
| 3. | Text book of Invertebrates | N.C Nair, S. Leelavathy, N Arumugam, N. Soundara Pandian | Saras Publications A.R. Camp Road, Periyavilai, Kottar Post, Nagercoil, Tamil Nadu 629002 | 2010 |
| 4. | Invertebrate Zoology | E.L.Jordan and P.S.Verma | S.Chand & Co., Ltd, New Delhi | 2011 |
| 5. | Animal Physiology | P.S. Verma, B.S. Tyagi and V.K. Agarwal | S. Chand & Co, New Delhi | 2000 |

| | | | | |
|---|---|---|---|---|
| 6. | Animal Physiology | Mariakuttikan A and Arumugam N, | Saras Publications A.R. Camp Road, Periyavilai, Kottar Post, Nagercoil, Tamil Nadu 629002 | 2017 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Vertebrate Life | Pough F. Harvey | Prentice Hall, Inc. | 2013 |
| 2. | Biology of Invertebrates | Pechenik | McGraw-Hill Publishing Company | 2015 |
| 3. | Biological Science | Scott Freeman | Prentice Hall, Inc. | 2014 |
| 4. | Animal Structure and Function | Starr | Brooks/Cole Publishing Co. | 2013 |
| 5. | Wildlife Biology | Raymond F. Dasmann | John Wiley & Sons, Inc. | 1981 |
| 6. | General and Comparative physiology | Hoar, W.S | PrenticeHall, Inc. | 1987 |
| 7. | Campbell Biology | Jane B. Reece, Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky and Robert B. Jackson | Pearson India Education Services Pvt. Ltd.Bengaluru, 560025. | 2013 |
| 8. | General and Comparative Animal Physiology, | WilliamS.Hoar, | Prentice Hall, India | 1975 |
| 9. | Animal Physiology, | RichardW, Gordon, A AndMargaret A. | Sinauer Associates, USA. | 2012 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | M | S | S |
| **CO2** | S | M | M | S |
| **CO3** | M | S | M | S |
| **CO4** | S | S | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER III**

| Allied -III | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UMBA01 | ALLIED - III - BASIC MICROBIOLOGY | |
| Credit: 4 | | |

**Objectives**

The main objective of the course is to provide knowledge on the understanding of the concepts and fundamental principles of microbiology and basis to face the study of the bacteriology, virology, Phycology and Mycology which includes key features of the structure, growth, physiology and behavior of bacteria, viruses, fungi, algae and protozoa.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the history, development and the basic principles of microbiology | K1 |
| CO2 | Understand the microbial diversity, Systems of Classification taxonomy and dynamics of microbes | K2 |
| CO3 | Apply the knowledge about various types of microbes and its structural aspects | K3 |
| CO4 | Identify the pathogenic microbes, pathogenesis and its prevention measures | K4 |

**UNIT-I**

Introduction and History of Microbiology. Spontaneous generation vs biogenesis. Establishment of fields of medical microbiology, immunology and environmental microbiology with special reference to the work of following scientists: Anton von Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch, Beijerinck, Sergei N. Winogradsky, Alexander Fleming, Selman A. Waksman, Elie Metchnikoff.

**UNIT–II**

General characteristics of Bacteria, Systems of classification, Numerical taxonomy, Bergey's Manual of Systematic Bacteriology (up to section level), Classification of bacteria on the basis of Nutritional types, Environmental factors. General characteristics of Archaebacteria, Rickettsia, Mycoplasma, Cyanobacteria and Actinomycetes.

**UNIT-III**

General characteristics of algae including occurrence, thallus organization, algae cell ultra-structure, pigments, flagella, eyespot, food reserves and vegetative, asexual and sexual reproduction. Different types of life cycles in algae: Haplobiontic, Haplontic, Diplontic, Diplobiontic and Diplohaplontic life cycles.

**UNIT-IV**

General characteristics of fungi including habitat, distribution, nutritional requirements. Fungal cell ultra-structure, mycelium and hypae organization and aggregation. Multicellular organization. Sexual and asexual reproduction. Yeast reproduction – budding.

**UNIT-V**

General introduction, characteristics and life cycle of viruses with special reference to the structure of the following: TMV, poliovirus, T4 and λ-phage, lytic and lysogenic cycles.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Microbiology 5th Edition | Pelzer, Chan and Kreig. | McGraw-Hil. | 1986 |
| 2. | Microbiology. 5th Edition | Prescott, Harley, Klein. | McGraw Hill Publ. | 2003 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Microbial Physiology | S.Meenakumari. | . MJP Publishers. | 2004 |
| 2. | General Microbiology. | Powar and Daginawala. | Himalaya Publishing House | 2010 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | M | S | S |
| **CO2** | S | M | M | S |
| **CO3** | M | S | M | S |
| **CO4** | S | S | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER III**

| Core Practical-III | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBTP03 | PRACTICAL - III - ANIMAL SCIENCE | |
| Credit: 3 | | |

**Objectives**

To give hands on training to study anatomy of the animals and provide technical skills in microscopic observation of museum specimens mounting, spotters and dissections.

1. Cockroach – Digestive system and Reproductive systems.
2. Mounting - Mouth parts of Cockroach and Honey bee.
3. Collection and handling of Blood specimen
4. Collection and handling of Urine specimen
5. Qualitative analysis of Urine sample
6. Estimation of hemoglobin
7. Estimation of sugar in Urine
8. Estimation of sugar in Blood
9. Observation of Amoeba, paramecium, Plasmodium, Tapeworm – Scolex, Earth worm, Starfish
10. Observation of Chick embryos (24, 33 & 48 Hours).
11. Observation of Frog post-fertilization stages- 2, 4 & 8 cell stages.
12. Observation of Transverse section of Ovum, ovary, testis, kidney Pancreas, pituitary thymus and thyroid gland.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Advanced Practical Zoology | P S Verma and P C Srivastava | S Chand Publishing | 2012 |
| 2. | Practical Zoology Volume 1 Invertebrata, | N. Arumugam, N.C Nair, S. Leelavathy, N. SoundaraPandian, T. Murugan and Jayasurya | Saras Publication | 2012 |

| | | | | |
|---|---|---|---|---|
| 3. | Practical Zoology Volume 2 Chordata, | N. Arumugam, A. Thangamani, S. Prasannakumar, L.M. Narayanan, Jayasurya, | Saras Publication | 2012 |
| 4. | A Manual of Practical Zoology: Chordates | P.S.Verma | S. Chand Publishing, company, New Delhi. | 2000 |
| 5. | A Manual of Practical Zoology: Invertebrates | P S Verma | S. Chand Publishing, Company, New Delhi. | 1971 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Practical Zoology For Advanced Level and Intermediate Students | C.J. Wallis | 6th Edition, Butterworth-Heinemann, Elsevier Ltd. | 1974 |
| 2. | Practical Zoology | Robert William Hegner | Andesite Press | 2015 |

**SEMESTER III**

| Allied Practical-III | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UMBAP01 | ALLIED PRACTICAL - III - BASIC MICROBIOLOGY | |
| Credit: 3 | | |

**Objectives**

To provide good laboratory practices about basics of microbiology techniques.

1. Cleaning and Preparation of glassware.
2. Preparation of Microbiological media.
3. Sterilization – glassware and media – wet, dry and filtration.
4. Isolation of microorganisms from various samples.
5. Counting of microbes – Use of haemocytometer, colony counting.
6. Identification of microbes – Microscopy & Macroscopy.
7. Motility of Bacteria by Hanging drop method.
8. Staining of bacteria – Simple & differentia staining - Gram, spore, capsule, flagella.
9. Culture Techniques - Pure culture - slant, stab, streak etc.
10. Maintenance and storage of bacterial strains.
11. Staining of fungi.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Practical Microbiology - A Laboratory Manual | B. Senthilkumar, Zothanzanga, D. Senbagam, N. Senthilkumar, G. Gurusubramanium | Panima Publishing Corp | 2014 |
| 2. | Experimental procedures in Life Sciences | S. Rajan and R. Selvi Christy | Anjanaa Book house, Chennai | 2012 |
| 3. | Manual for Medical Laboratory Technology | S. Rajan | Anjanaa Book house, Chennai | 2012 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Laboratory Manuel in Microbiology | Gunesekaran P | New Age international, India | 1996 |
| 2. | Experiments in Microbiology, Plant pathology and Biotechnology. 4th Edition | Aneja KR | New Age International Publishers, Chennai. | 2005 |

**SEMESTER III**

**SKILL ENCHANCEMENT COURSES - I**

| SEC - I | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code:M19UBTS01 | SEC - I - BIOPHYSICS AND BIOINSTRUMENTATION | |
| Credit: 2 | | |

**Objectives**

To provide the basic knowledge about basic principles and working mechanism of bioinstrumentation techniques involved in separation, identification and purification of biological substances.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the basic concepts of chemical bonds and instrumentation principles | K1 |
| CO2 | Understand the various types of microscope | K2 |
| CO3 | Apply various physical laws depending upon their applications and properties | K3 |
| CO4 | Analyze the various sample using biological instruments | K4 |

**UNIT-I**

Nature of chemical bond, Bonds in biological system. Laws of thermodynamics and concept of free energy, Biophysics of Water.

**UNIT-II**

Spectroscopy – Beer-Lamberts law, Colorimetry, IR spectrophotometer, Atomic Absorption spectrophotometer. Flame photometer.

**UNIT–III**

Microscopes - Principles, applications and types – Bright & Dark-field, Phase-contrast, fluorescence and Electron microscopy – SEM and TEM.

**UNIT–IV**

Centrifugation – Principle, preparative and analytical centrifugation, differential centrifugation, density gradient centrifugation – Rate zonal and Isopycnic. Rotor and its types. Chromatography – Principle, gas liquid chromatography, HPLC, Ion exchange chromatography, affinity chromatography and gel permeation chromatography.

**UNIT–V**

Electrophoresis – Agarose gel electrophoresis and PAGE. Methods of Imaging – X-ray, CT Scan, ECG, EEG, Concept of Radioactivity, methods for measuring radioactivity – GM counter.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | General Biophysics, vol. I & II | H.V. Volkones | Academic Press | 1983 |
| 2. | Biophysics | S. Mahesh | New Age International (P), Ltd | 2003 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Microbial genetics | David Freifelder David M. Freifelder and John E. Cronan | Jones & Bartlett Publishers | 1994 |
| 2. | Biophysical chemistry | Upadhyay | Himalaya Publication | 2005 |
| 3. | Techniques and methods in Biology | K.L Ghatak | PHI Learning Private Limited | 2001 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | S | S | M | S |
| **CO2** | M | S | M | M |
| **CO3** | M | M | S | S |
| **CO4** | M | S | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER IV**

| Core - IV | B.Sc. Biotechnology | 2019 – 2020 |
|---|---|---|
| Code:M19UBT04 | GENETICS AND MOLECULAR BIOLOGY | |
| Credit: 4 | | |

**Objectives**

To understand the central theories and methodologies that define the field of genetics and molecular biology.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the fundamental principles of Mendelian, non-Mendelian and extended inheritance with example | K1 |
| CO2 | Understand the chromosomal aberrations, genetics disorders and genome organization in bacteria, plant and animal | K2 |
| CO3 | Apply the structure, formation and function of DNA, RNA and describe the prokaryotic and eukaryotic cells replication, different types of mutations and DNA-repair system | K3 |
| CO4 | Analyze the microbial genetics, biology of $N_2$ fixation and molecular marker techniques | K4 |

**UNIT-I**

Mendelian laws of inheritance, Non-Mendelian inheritance; Linkage and Crossing-over. Chromosomal theory of inheritance. Cytoplasmic inheritance - Snail coiling, kappa particle in paramecium; Haemophilia, Color blindness.

**UNIT-II**

Chromosome aberrations – Numeral (Euploid, Aneuploid) and Structural aberration. Albinism, Sickle Cell Anemia, Phenyl Ketonuria.

**UNIT-III**

Structure, types, forms & functions of DNA and RNA. DNA replication in Prokaryotes and Eukaryotes. Mutations: Spontaneous and induced mutations. Mutagens and its types. DNA Repair.

**UNIT-IV**

Central dogma of Molecular Biology – Transcription and Translation, Genetic code. Regulation of gene expression-lac and trp operons.

**UNIT-V**

Microbial genetics – Conjugation, Transformation and Transduction, Two-component regulatory system. Molecular biology of $N_2$ fixation. Molecular marker techniques - RFLP, RAPD, AFLP and QTL.

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Molecular genetics of Photosynthesis | Anderson B, Salter H | IRL press, Oxford | 1996 |
| 2. | Cell and Molecular Biology | Robertis *et al*. | Waverly publication, edition 8 | 1995 |
| 3. | Genetics | Strickberger | M.W.Printice hall, edition 4 | 1997 |
| 4. | Molecular Biology of the Cell | Alberts | Garland publication, edition 4 | 2002 |
| 5. | Principles of Genetics | E.J.Gardener, M.J.Simmons and D.P.Snustad | John Wiley & Sons Publications | 1997 |

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Plant biochemistry and Molecular biology | Lea P.J & Leegood | John Wiley & sons | 1993 |
| 2. | Text Book of Cell and Molecular Biology | Ajay Paul | Books and Allied (P) Ltd, 2 edition | 2007 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | S | M | S | M |
| **CO2** | S | S | S | M |
| **CO3** | M | S | M | S |
| **CO4** | S | S | S | M |

**S**- Strong; **M**-Medium

**SEMESTER IV**

| Allied- IV | B.Sc. Biotechnology | 2019 – 2020 |
|---|---|---|
| Code: M19UMBA02 | ALLIED- IV - APPLIED MICROBIOLOGY | |
| Credit: 4 | | |

**Objectives**

To understand the basic principles of Microbiology and their applications.

To create awareness of microbial diseases and causes of human beings.

To understand the application of microbes involved in food, environment and industries.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the principles of sterilization, antibiotics mode of action and culture techniques | K1 |
| CO2 | Understand the Morphology, culture, biochemical, pathogenicity, laboratory diagnosis of microbial diseases | K2 |
| CO3 | Explain the various factors affecting food and dairy industry | K3 |
| CO4 | Analyze microorganisms in biodegradation and bioconversion | K4 |

**UNIT-I**

Sterilization techniques - Physical and chemical Methods. Media and its types. Culture techniques – Pure culture, anaerobic culture – preservation of cultures. Growth of bacteria – multiplication – growth curve – Determination of growth. Collection and transport of clinical specimens for microbiological examinations.

**UNIT-II**

Morphology, culture, biochemical, pathogenicity, laboratory diagnosis and prevention of microbial disease - *Staphylococcus aureus*, *Mycobacterium tuberculosis*, *Salmonella typhi*, *Escherichia coli*, Dengue virus, Nipah virus, H1N1 virus, *Aspergillosis, Candidiasis*, Malaria parasite.

**UNIT–III**

Importance of studying food and dairy microbiology. Primary sources of microorganisms in foods. Factors influencing microbial growth in foods - extrinsic and intrinsic. Principles of food preservation - preservation methods - irradations - drying, heat processing, chilling and freezing, high pressure, modification of atmosphere and chemical preservatives. Nutritional value of fermented foods. Microbiology of milk, Cheese, Yogurt (curd), Idli, Kinema.

**UNIT–IV**

Biodegradation of oil, bio-deterioration of materials – paint, paper, wood and leather– mode of deterioration – organism involved. Tannery technology- Treatment of tannery effluents by microbes. Bioconversions – Biomining and bioleaching of ores (Use of microorganisms in Bio-gas production, Bio-leaching and Bio-diesel.

**UNIT–V**

Environmental Microbiology: Microbiology of air - composition of air, number and types of organisms in air. Distribution and sources of air borne organisms. Enumeration of bacteria in air - Air sampling devices. Air sanitation. Air borne diseases and their control. Microbiology of water – determination of water quality – bacteriological examination of water – indicator organisms – water borne pathogens.

**REFERENCES BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Chemical Microbiology – An introduction to microbial physiology | AH Rose. | Butterworth, London. | 1976 |
| 2. | Brock Biology of Microorganisms | MT Madigan, JM Martinko & Jack Parker | 10th Edition – Pearson and Education Inc., New Jersey. | 2002 |
| 3. | Microbiology | Prescott, Harley, Klein. | 5th Edition. McGraw Hill Publ | 2003 |
| 4. | Molecular Biotechnology | Bernard R. Glick & Jack J. Pasternak, | Indian edition. Panima Publishing Corporation. | 2002 |
| 5. | Microbiology | Pelzer, Chan and Kreig. | 5th Edition. McGraw-Hill | 1986 |
| 6. | Microbial Physiology | S.Meenakumari | MJP Publishers | 2009 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | S | S | S | M |
| **CO2** | S | M | S | M |
| **CO3** | M | M | S | S |
| **CO4** | S | S | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER IV**

| Core Practical- IV | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBTP04 | PRACTICAL - IV - GENETICS AND MOLECULAR BIOLOGY | |
| Credit: 3 | | |

**Objectives**

To give hands on training in theoretical and practical introduction to important methods and techniques in genetics and molecular biology.

1. Karyotype analysis: Man– Normal and Abnormal– Down and Turner's Syndromes.
2. Mendel's laws of genetics-Mono and Dihybrid crosses.
3. Rearing morphology of drosophila.
4. Observation of Genetic model organisms (*Arabidopsis thaliana* and *Coenorrabditis elegans*)
5. Isolation and purification of plasmid DNA.
6. Observation of DNA – Agarose gel electrophoresis
7. Quantification of nucleic acids – DNA & RNA – Chemical and UV method.
8. Bacterial mutagenesis – physical & chemical.
9. Preparation of *E. coli* competent cells.
10. Transformation of bacteria– $CaCl_2$ method.
11. Bacterial conjugation.
12. Transduction

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Plant biochemistry and Molecular biology | Lea P.J &Leegood | John Wiley & sons | 1993 |
| 2. | Text Book of Cell and Molecular Biology | Ajay Paul | Books and Allied (P) Ltd, 2 edi | 2007 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Molecular genetics of Photosynthesis | Anderson B, Salter H | IRL press, Oxford | 1996 |
| 2. | Cell and Molecular Biology | Robertis *et al*. | 3Waverly publication, edition 8 | 1995 |
| 3. | Genetics | Strickberger | M.W. Printice hall, edition 4 | 1997 |
| 4. | Molecular Biology of the Cell | Alberts | Garland publication, edition 4 | 2002 |

**SEMESTER IV**

| Allied Practical-IV | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UMBAP02 | PRACTICAL - IV - APPLIED MICROBIOLOGY | |
| Credit: 3 | | |

**Objectives**

To give hands on training on applied microbiological techniques. It includes identification of bacteria, culture characterization on different media, growth pattern and determination of water portability.

1. Biochemical characterization of Bacteria – Catalse test, oxidase test, Sugar fermentation, IMVIC, urease test, TSI test, Starch hydrolysis.
2. Cultural characteristics of microorganisms on Basal medium, Selective medium,
3. Differential medium, Enriched medium, Enrichment medium.
4. Growth - Growth curve
5. Antibiotic sensitivity test by Kirby- Bauer disc diffusion method.
6. Determination of portability of water by MPN method.
7. Isolation of Lactobacilli from curd.
8. Methylene blue reductase test.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Practical Microbiology - A Laboratory Manual | B. Senthilkumar, Zothanzanga, D. Senbagam, N. Senthilkumar, G. Gurusubramanium | Panima Publishing Corp | 2014 |
| 2. | Experimental procedures in Life Sciences | S. Rajan and R. Selvi Christy | Anjanaa Book house, Chennai | 2012 |
| 3. | Manual for Medical Laboratory Technology | S. Rajan | Anjanaa Book house, Chennai | 2012 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Laboratory Manuel in Microbiology | Gunesekaran P | New Age international, India | 1996 |
| 2. | Experiments in Microbiology, Plant pathology and Biotechnology. 4th Edition | Aneja KR | New Age International Publishers, Chennai. | 2005 |

**SEMESTER IV**

**SKILL ENCHANCEMENT COURSES - II**

| SEC - II | B.Sc. Biotechnology | 2019 – 2020 |
|---|---|---|
| Code: M19UBTS02 | SEC - II - BIOINFORMATICS | |
| Credit: 2 | | |

**Objectives**

To understand the creation and development of databases, software, computational, statistical techniques and also solving problems generated from the management and analysis of biological data.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the fundamental principles bioinformatics and understand the concept of website and its application | K1 |
| CO2 | Understand the useful and application of database search both sequence and structural databases | K2 |
| CO3 | Apply the tools and algorithms for phylogenetic tree | K3 |
| CO4 | Analyze structure of nucleotide using gene prediction tools | K4 |

**UNIT-I**

Introduction to Bioinformatics - Databasaes - Data Storage System – DBMS - Scope and application of Bioinformatics, Important contributions in Biological aspects - aims and tasks of Bioinformatics.

**UNIT-II**

Biological Databases - structural Databases (PDB, SCOP, CATH), Sequence Databases (NCBI, EMBL, DDBJ, PIR), Specialized Database: HGP, OMIM, SNP, KEGG.

**UNIT-III**

Sequence analysis: Sequence Alignment, Pairwise alignment and multiple sequence alignment, Global and Local Alignment, computational tools: BLAST, FASTA, Clustal W, T-coffee.

**UNIT-IV**

Structural Analysis: Omic X, SCFBio, JPRED, PHD, HMMSTR and APPSP2. Visualization tools: Rasmol, Pymol and Gene Prediction Tools.

**UNIT-V**

Phylogenetic analysis tools: MEGA, MOLPHY, PAML, PHYLIP, JSTree. Drug Discovery – Docking – Autodock - HADDOCK.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Bioinformatics methods and application – Proteomics, Genomics and Drug Discovery. | S.C.Rastogi N. Mendiratta P.Rastogi | PHL Pvt Ltd | 2013 |
| 2. | Introduction to bioinformatics | Arthur M. Lesk | Oxford University Press | 2014 |
| 3. | Bioinformatics Computing | Bryan Bergeron M.D | Pearson Education India | 2015 |
| 4. | BIOS Instant Notes Bioinformatics 2nd Edn | Charlie Hodgman Andrew French David Westhead | T & F / Routledge | 2015 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | M | M | S |
| **CO2** | S | S | M | S |
| **CO3** | M | M | M | S |
| **CO4** | M | S | M | M |

**S**- Strong; **M**-Medium.

**SEMESTER V**

| Core - V | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| **Code: M19UBT05** | **IMMUNOLOGY** | |
| **Credit: 4** | | |

**Objectives**

To understand different attributes of immune system, immune mechanism and its responses in living beings.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the history, types of immune system and the organs involved | K1 |
| CO2 | Understand the antigen characteristics and its activation | K2 |
| CO3 | Discover diagnostic methods of antigen and antibody interaction and the gene expression | K3 |
| CO4 | Analyze transplantation and autoimmunity systems | K4 |

**UNIT-I**

Historical perspectives and Scope of Immunology, Innate and Acquired immunity, Cells of the Immune system, Haematopoiesis, Organs of the Immune System: Primary and Secondary Lymphoid Organs.

**UNIT-II**

Antigen – Characteristics, Classes, Factors that influence immunogenicity. Haptens, Mitogens, Adjuvants. Humoral Immune response – B cell activation and proliferation. Cell mediated Immune response – T cell receptors and its activation.

**UNIT-III**

Immunoglobulins – Structure and functions. Antigen – Antibody reactions –Agglutination, precipitation, RIA, ELISA, FACS.

**UNIT-IV**

Cytokines: Types and function, Complement – Classical and Alternative pathway. Major Histocompatability Complex (MHC), Hybridoma technology. Hypersensitivity and its types.

**UNIT-V**

Transplantation immunology. Autoimmunity, Cancer immunology, Vaccines. Immunotherapeutics. Immuno tolerance, Immunity to infectious diseases-AIDS.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Immunology | Kubey, J | Freeman and company | 1993 |
| 2. | Immuno-biology | Janeway, C.A | Paul Travers | 1994 |
| 3. | Text Book of Immunology | SeemiFarhatBasir | PHI Learning | 2012 |
| 4. | A Text Book of Immunology | MadhaveeLatha, P | S. Chand & Company Ltd | 2012 |
| 5. | Textbook of Immunology : including Immunotechnology& Immunotherapy | Ajoy Paul. | S. Chand & Company Ltd | 2015 |
| 6. | Immunology and Immunotechnology. | Rajasekarapandian M and Senthil kumar B | Panima publishing corporation | 2007 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | S | M | M | M |
| **CO2** | S | M | S | S |
| **CO3** | M | S | S | S |
| **CO4** | M | S | M | M |

**S**- Strong; **M**-Medium.

**SEMESTER V**

| Core - VI | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| **Code: M19UBT06** | **rDNA TECHNOLOGY** | |
| **Credit: 4** | | |

**Objectives**

To understand basic principles and methods of rDNA technology and to provide knowledge about enzymes and vectors involved in rDNA technology, DNA amplification, hybridization techniques, gene transfer methods and transgenic products.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the fundamental principles rDNA technology, DNA modifying enzymes | K1 |
| CO2 | Understand the various types of vectors involved in rDNA technology | K2 |
| CO3 | Explain deeper understanding DNA hybridization, sequencing methods | K3 |
| CO4 | Analyze the transgenic plants and animals and pharmaceutical products. | K4 |

**UNIT-I**

Introduction to recombinant DNA technology. Enzymes in rDNA technology – Restriction enzymes, DNA modifying enzymes - Polymerase, Transferase, alkaline phosphatase, polynucleotide kinase. Cohesive and blunt end ligation, linkers, adaptors and homopolymeric tailing.

**UNIT-II**

Vectors - Plasmids - pBR322, PUC19, Phage vectors, Cosmids, Phagemids, lambda phage virus vectors, Shuttle vectors and expression vectors. Artificial chromosome vectors (YAC, BAC), animal virus derived vectors - SV40. Plant based vectors - Ti plasmid.

**UNIT-III**

Construction of genomic libraries and cDNA Libraries. Recombinant selection and screening, DNA amplification – Principles and application of Polymerase chain reaction (PCR).

**UNIT-IV**

Principles of DNA hybridization. Southern, Northern and Western blotting techniques. DNA Sequencing methods – sangers and maxam gilbert. Site directed mutagenesis, Chromosome jumping, DNA Microarray.

**UNIT-V**

Transgenic plants - pest resistances, herbicide tolerance and stress tolerance (cold, heat and salt). Transgenic animals – Pharmaceutical products – Insulin, Recombinant Vaccine production. Ethical issues and safety regulations in rDNA technology.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Molecular Biology of the Cell. | Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter | 4th Edition. Garland Sciences | 2002 |
| 2. | Microbial genetics | Stanley Maloy | 2nd Edition. Jones and Bartlett publisher | 1994 |
| 3. | Modern Microbial Genetics | Uldis N. Streips and Ronalad E. Yasbin. | 2nd Edition. Wiley-Blackwell. | 2002 |
| 4. | Principles of Gene Manipulation | Sandy B. Primrose, Richard M. Twyman, Robert W. Old. | 6th Edition. Blackwell Science | 2008 |
| 5. | Genomes. | Brown TA. | 3rd Edition. New York: Garland Publishing Co. New York: Garland Science. | 2008. |

| | | | | |
|---|---|---|---|---|
| 6. | Principles of Gene Manipulation: An Introduction to Genetic Engineering | Old, R.W and S.B. Primrose | 2nd Edition. Blackwell Scientific Publications, Oxford | 1996 |
| 7. | DNA Cloning: A Practical Approach | Glover, DM. and BD. Hames | 2nd Edition. IRL Press, Oxford. | 1995 |
| 8. | Recombinant DNA | Watson J.D., Gilman M., Witkowski, J. and Zoller M | 2nd Edition. Scientific American Books, New York. | 1992 |
| 9. | Analysis of Genes and Genomes | Daniel L. Hartl | Analysis of Genes and Genomes. | 2011 |
| 10. | Recombinant DNA Technology | Keya Chaudhuri | The Energy and Resources Institute, TERI | 2012. |


**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | S | S | S |
| **CO2** | M | M | S | M |
| **CO3** | M | S | S | S |
| **CO4** | S | S | M | S |

**S**- Strong; **M**-Medium.

## SEMESTER V

| Core – VII | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBT07 | BIOPROCESS TECHNOLOGY | |
| Credit: 4 | | |

**Objectives**

To understand the various fermentation techniques in Bioprocess.

To learn about the technical and biological aspect of microbial utilization for production and purification of metabolites.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the methods of involved in the microbial technology | K1 |
| CO2 | Understand the designing of bioreactors and control necessary for enhancing production | K2 |
| CO3 | Apply the knowledge about media optimization for production of microbial metabolites | K3 |
| CO4 | Analyze the production methods of industrially important enzymes, antibiotics by downstream process | K4 |

**UNIT-I**

Introduction to bioprocess technology. Isolation and screening of industrially important microbes. Primary and Secondary screening. Improvement of the strains for increased yield and other desirable characteristics.

**UNIT-II**

Fermentation types - solid state and submerged. Bioreactor design, parts and their functions. Types of fermentor - CSTR, Tower, Jet Loop, Air left, Bubble column, Packed bed. Immobilization of cells.

**UNIT- III**

Media formulation, Biological properties of medium. Sterilization - Batch and continues sterilization systems, Sterilization of air - Fibrous filters. Measurement and control of bioprocess parameters - pH, Temperature, Dissolved oxygen, Antifoam agents, Aeration and Agitation.

**UNIT-IV**

Production and application of industrial enzymes - Amylase and protease. Antibiotic production and applications – tetracycline, streptomycin. Production of probiotics – lactobacillus.

**UNIT-V**

Downstream Processing – Disruption of Microbial Cells, Precipitation, Centrifugation, Filtration, Ultra filtration, Flocculation, Liquid-Liquid Extraction. Drying and Crystallization.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publisher | Year of Publication |
|---|---|---|---|---|
| 1. | Industrial Microbiology | A.H.Patel | Macillan Publication, India Ltd. | 2008 |
| 2. | Bioprocess Technology | Kalaichelvan and Arulpandi | MJP. Publishers | 2008 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | M | S | M |
| **CO2** | S | M | M | S |
| **CO3** | S | S | S | M |
| **CO4** | S | M | M | S |

**S**- Strong; **M**-Medium.

**REFERENCE BOOKS:-**

| S. No. | Title of the Book | Author | Publisher | Year of Publication |
|---|---|---|---|---|
| 1. | Principles of Fermentation Technology | Stanbury, RF and Whitaker A | Pergamon press, Oxford | 1997 |
| 2. | Bioprocess Engineering: Basic concepts | Shuler ML and Kargi F. | Hall, Engelwood Cliffs | 2002 |
| 3. | Bioprocess Engineering Principle | Doran | Elsevier | 2007 |
| 4. | Comprehensive Biotechnology: The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine, Vol 1, 2, 3 | Young M.M | Reed Elsevier India Private Ltd, India | 2004 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | M | S | S |
| **CO2** | S | S | M | S |
| **CO3** | S | S | M | M |
| **CO4** | S | M | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER - V**

**Elective**

| Elective - I | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBTE01 | BIOETIHCS AND BIOSAFETY | |
| Credit: 4 | | |

**Objectives**

To focus on health, maintenance of body weight and dieting. To impart Knowledge about personal hygiene, food contamination and role of international control of health and role of WHO.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the basic concept of bioethics nationally and internationally | K1 |
| CO2 | Understand the principles of bioethics and ethics in molecular technology and post genomic era | K2 |
| CO3 | Judge the intellectual property rights, WIPO, GATT, and TRIP | K3 |
| CO4 | Analyze the concept bio-safety, health hazards in bio-safety | K4 |

**UNIT-I**

Bioethics–Necessity of Bioethics, different paradigms of Bioethics – National and International.

**UNIT-II**

Ethical issues against the molecular technologies. Basics of bioethics principles, international codes and guidelines in India-Ethics in post-genomic era.

**UNIT-III**

Biosafety – Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level and Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).

**UNIT-IV**

Biosafety – Risk for human health, environment and agriculture. Biosafety guidelines, regulation and operation.

**UNIT-V**

Intellectual Property Right: Introduction, intellectual property: trade secret, patent, copyright, plant variety protection, WIPO, GATT, TRIPs, plant breeder's rights.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Bioethics and biosafety | Sateesh MK | I.K. International Pvt. Ltd. | 2010 |
| 2. | Bioethics and Biosafety in Biotechnology | Sree Krishna V | New age international publishers | 2007 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | S | S | M | S |
| **CO2** | S | S | M | M |
| **CO3** | S | S | M | S |
| **CO4** | S | M | S | S |

**S**- Strong; **M**-Medium.

**SEMESTER V**

| Elective - I | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBTE02 | DEVELOPMENTAL BIOLOGY | |
| Credit: 4 | | |

**Objectives**

To provide a broad, comprehensive look at embryology with special emphasis on vertebrate models, focusing on both classical experiments and modern molecular and genetic techniques.

To understand the mechanisms involved in growth and development of complex organisms.

**Course Outcomes**

Students who successfully complete the course will be able to:

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the types and stages of sexual cycle and gametogenesis | K1 |
| CO2 | Understand the concepts and methods of assisted reproductive techniques for conservation of wild, rare or indigenous ungulates and solve the infertility problems | K2 |
| CO3 | Show the knowledge about assisted reproductive technology | K3 |
| CO4 | Analyze the embryogenesis, molecular development of plants and animals | K4 |

**UNIT-I**

Reproductive cycle in mammals, Spermatogenesis and Oogenesis in mammals, Types of eggs and Fertilization.

**UNIT-II**

Reproductive hormones, Sperm Banking, Artificial Insemination, *In vitro* Fertilization, Embryo Transfer and surrogacy.

**UNIT-III**

Types and patters of cleavage, Blastulation, Gastrulation, outline of fate maps and morphogenetic movements, Metamorphosis (Insects and amphibians) and its hormone control.

**UNIT-IV**

Plant embryogenesis- Development of Microsporangium and Megasporangium, Pollination, Embryo development and double fertilization in plants and seed formation.

**UNIT-V**

Genetic control of development- pattern determination, Bithorax complex, genes controlling the flower development and Drosophila development.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Elements of Developmental Biology | P.C. Jain | Vishal Publication, New Delhi. | 2013 |
| 2. | Developmental Biology | K. V. Sastry and Vinita Shukal | Rastogi publications | 2012 |
| 3. | Chordate embryology | Verma , P.S., Agarwal, V.K., and Tyagi., | S. Chand & Co., New Delhi. | 1995 |
| 4. | An Introduction to Embryology– | A.K. Berry | M K publications New Delhi-51 | 2016 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Developmental Biology, | Gilbert, S. F. | IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA | 2010 |
| 2. | An introduction to Embryology | Balinsky, B.I. | International Thomson Computer Press. | 2008 |
| 3. | Analysis of Biological Development | Kalthoff, | II Edition, McGraw-Hill Professional | 2000 |
| 4. | Development and Reproduction in Humans and Animal Model Species | Werner A. Mueller, Monika Hassel and Maura Grealy | Springer Berlin Heidelberg | 2015 |
| 5. | An Introduction to Developmental Biology | Chattopadhyay.S. | Books and Allied (P) Ltd, Kolkata. First Edition. | 2016 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | M | S | S |
| **CO2** | S | M | M | S |
| **CO3** | M | S | M | S |
| **CO4** | S | S | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER - V**

| Elective -I | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| **Code: M19UBTE03** | **NURSERY AND GARDENING** | |
| **Credit: 4** | | |

**Objectives**

To focus on basic principles and methods of nursery and gardening.

To provide knowledge about seed types, seed structure, vegetative propagation and various types of vegetable cultivation.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the basic concept of nursery, infrastructure and planting. | K1 |
| CO2 | Understand the basic knowledge about seeds structure, types, storage and production technology. | K2 |
| CO3 | Apply the knowledge about vegetative propagation, hardening of plants and green house. | K3 |
| CO4 | Analyze the suitable techniques in nursery and gardening | K4 |

**UNIT-I**

Nursery: definition, objectives and scope and building up of infra structure for nursery, planning and seasonal activities-Planting-direct seeding and transplants.

**UNIT-II**

Seed: Structure and types- Seed Dormancy; causes and methods of breaking dormancy –Seed storage: Seed banks, factors affecting seed viability, genetic erosion- Seed production technology-seed testing and certification.

**UNIT-III**

Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings-Hardening of plants-green house-mist chamber, shed root, shade house and glass house.

**UNIT-IV**

Gardening: definition, objectives and scope – different types of gardening- landscape and home gardening – parks and its components-plant materials and design – computer applications in land scaping-Gardening operations: soillaying, manuring, watering, management of pests and diseases and harvesting.

**UNIT-V**

Sowing/raising of seed sand seedlings – Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots-Storage and marketing procedures.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Gardeningin India | Bose,T.K.& Mukherjee, D | Oxford & IBH Publishing Co., New Delhi. | 1972 |
| 2. | Plant Propagation | Sandhu, M.K., | WileEasternLtd., Bangalore,Madras | 1989 |
| 3. | Introduction to Horticulture | Kumar, N | RajalakshmiPublications, Nagercoil. | 1997. |
| 4. | Fundamentals ofHorticulture | Edmond Musser&Andres | McGraw HillBook Co., New Delhi. | 2005 |
| 5. | Hand Book of Seed Technology | Agrawal, P.K | National Seed CorporationLtd., New Delhi. | 1993 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | S | S | M | M |
| **CO2** | S | S | M | S |
| **CO3** | M | S | M | S |
| **CO4** | S | M | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER V**

| Elective-I | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBTE04 | HERBAL TECHNOLOGY | |
| Credit: 4 | | |

**Objectives**

To impart complete knowledge about herbal medicines, phytoconstituents and their importance in drug designing and disease management.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe knowledge about history and importance of herbal medicines | K1 |
| CO2 | Understand the basic principles, chemical constituents of plant and its systemic position | K2 |
| CO3 | Apply the phytochemical extraction techniques in the pharmaceutical industry. | K3 |
| CO4 | Analyze the various herbal extraction for phytochemical screening | K4 |

**UNIT-I**

Herbal medicines: history and scope - definition of medical terms –role of medicinal plants in Siddha systems of medicine; cultivation – harvesting - processing- storage –marketing and utilization of medicinal plants.

**UNIT-II**

Pharmacognosy - systematic position –chemical constitution and medicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Gooseberry and Ashoka.

**UNIT-III**

Phytochemistry – active principles and methods of their testing - identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withania somnifera* (drugs acting on nervous system), *Clerodendron Phlomoides* (anti-rheumatic) and *Centella asiatica* (memory booster).

**UNIT-IV**

Analytical pharmacognosy: Drug adulteration -types, methods of drug evaluation-Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds, fatty acids, tannins, glycosides and volatile oils).

**UNIT-V**

Medicinal Plant Biotechnology: Genetics as applied to medicinal herbs-mutation- polyploidy. Plant tissue culture a source of bio-medicinals-Historical developments- types of cultures- phyto-pharmaceuticals in tissue cultures.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Glossary of Indian medicinal plants | R.N.Chopra,S.L.Nayarand I.C.Chopra | C.S.I.R, New Delhi | 1956 |
| 2. | Theindigenousdrugs of India | Kanny, Lall, Dey and Raj Bahadur | International Book Distributors | 1984 |
| 3. | Herbal plants and Drugs Agnes | Arber | Mangal Deep Publications | 1999 |

**REFERENCE BOOKS:-**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Ayurvedic drugs and their plant source | V.V.Sivarajan and Balachandran | Oxford IBH publishing Co | 1994 |
| 2. | Ayurvedaand Aromatherapy | Miller, Light andMiller, Bryan | Banarsidass, Delhi. | 1998 |

| | | | | |
|---|---|---|---|---|
| 3. | Principles of Ayurveda | Anne Green | Thomsons, London. | 2000 |
| 4. | Pharmacognosy | Dr.C.K.Kokate | Nirali Prakashan. | 1999 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | S | M | S | M |
| **CO2** | S | M | M | M |
| **CO3** | M | M | S | S |
| **CO4** | S | M | M | S |

**S**- Strong; **M**-Medium.

**SEMESTER V**

| Core Practical-V | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBTP05 | PRACTICAL - V - IMMUNOLOGY AND rDNA TECHNOLOGY | |
| Credit: 3 | | |

**Objectives**

To provides hands on training in the field of immunology and rDNA technology methods like blood sample analysis, WBC and RBC count, agglutination tests, precipitation tests.

To provide knowledge about the plasmid DNA isolation, restriction digestion, ligation and transformation.

1. Preparation of plasma and serum.
2. Total count of Blood cells (WBC & RBC) using Haemocytometer.
3. Agglutination tests:
    a. ABO Blood grouping.
    b. WIDAL test.
    c. ASO test.
    d. Pregnancy test.
    e. RPR test.
4. Precipitations:
    a. Radial immunodiffusion.
    b. Double immnodiffusion.
5. ELISA
6. Isolation and visualization of plasmid DNA.
7. Restriction Digestion of Lamda DNA.
8. Ligation of DNA Fragments.
9. Isolation of Antibiotic Resistant Mutants.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publisher | Year of Publication |
|---|---|---|---|---|
| 1. | Practical immunology | Frank C. Hay and olwyn M.R. Westwood | Wiley-Blackwell | 2002 |
| 2. | Veterinary Immunology & Seriology: A Practical Manual | Varsha Sharma | Satish Serial Publishing House | 2015 |
| 3. | Manual for Medical Laboratory Technology | S. Rajan | Anjanaa Book house, Chennai | 2012 |
| 4. | Molecular Biology and Recombinant DNA Technology: Practical Manual Series (Vol II) | Ashok Kumar | Narendra Publishing House | 2011 |

**SEMESTER V**

| Core Practical – VI | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBTP06 | PRACTICAL - VI - BIOPROCESS TECHNOLOGY | |
| Credit: 3 | | |

**Objectives**

To provide good laboratory practices in the aspect of microbial utilization for production and purification of metabolites.

1. Isolation of Amylase producing organisms from soil.
2. Isolation of antibiotic producing microbes from soil.
3. Culture optimization (pH and Temperature).
4. Production of industrial enzyme by submerged fermentation- Amylase
5. Assay of Industrial important enzymes – Amylase.
6. Microbial production of citric acid using *Aspergillus niger*.
7. Immobilization of yeast cells.
8. Wine production.
9. Alcohol production and estimation by chromic acid method.
10. Purification of Enzymes by Dialysis and Chromatography method - Demo.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publisher | Year of Publication |
|---|---|---|---|---|
| 1. | Experimental procedures in life sciences Manual | Rajan, Selvi Christy | Anjanaa Publisher | 2010 |

**SEMESTER V**

| SEC-III | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBTS03 | SEC - III - INDUSTRIAL BIOTECHNOLOGY AND IPR | |
| Credit: 2 | | |

**Objectives**

To understand the principles, methods and application of industrial biotechnology.

To know about the legal issues affecting the biotechnology research.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the fundamental principles, methods and application of various biotechnology food industries | K1 |
| CO2 | Understand the microbial production and its control methodology | K2 |
| CO3 | Apply the principle and methods in industrial biotechnology for production bio-products | K3 |
| CO4 | Analyze the industrial biotechnological products for betterment of mankind | K4 |

**UNIT-I**

Introduction and history of industrial biotechnology. Application of industrial biotechnology in various industries- Food, beverages, textiles, papers, and medicines. Ketogenic fermentation process.

**UNIT-II**

Microbial processes, production and commercial importance of Organic acids - Citric acid and Acetic acid. Amino Acids - L-Glutamic acid and L-Lysine. Process control fermentation of amino acids.

**UNIT-III**

Microbial production of Butanol, Acetone and Ethanol. Microbial production of Antibiotics - Production, biosynthesis of Tetracycline, Aromatic antibiotics -Chloramphenicol, novobiocin.

**UNIT-IV**

Microbial production of Beer, wine, vinegar, and its commercial importance. SCP production and its economic importance. Industrial production of Biopesticides and Biofertilizers. Mushroom cultivation.

**UNIT-V**

Intellectual Property Rights (IPR) - different types of IPRs, studies on patents granted in India and other countries. IPR in genetically modified organisms; regulating the use of biotechnology – rDNA technology – Food and Agricultural ingredients – patenting biotechnology inventions.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Intellectual Property Issues: Therapeutics, Vaccines and Molecular Diagnostics | Wolfgang Flasche , Johanna Driehaus | Springer Briefs in Biotech Patents | 2012 |
| 2. | Basic Industrial Biotechnology | S.M. Reddy, S.Ram Reddy, G.Narendra Babu | New age International Publishers | 2012 |
| 3. | Industrial Biotechnology | Dr. N. N. Bandela, Dr. Jitendra Ambulge | Kindle edition | 2016 |
| 4. | An Introduction To Intellectual Property Right | Venkataraman M | Kindle edition | 2015 |
| 5. | Biotechnology and Intellectual Property Rights | Kshitij Kumar Singh | Kindle edition | 2014 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Biotechnology- A text book of industrial microbiology | Wulfcrueger and Anneliesecrueger | Panima publishing corporation, New Delhi | 2003 |
| 2. | Bioprocess Engineering: Basic concepts, 2nd Edition. | Shuler ML and Kargi F | Prentice Hall, Engelwood Cliffs | 2002 |
| 3. | Microbial technology (Microbial processes). 2nd Edition | Peppler-Perlman. | Academic press | 2004 |
| 4. | Comprehensive Biotechnology: The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine | Young M.M., Reed. | Elsevier India Private Ltd, India. | 2004 |
| 5. | Fermentation Microbiology and Biotechnology. 2nd Edition | Mansi EMTEL, Bryle CFA | Taylor & Francis Ltd, UK | 2007 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | M | S | S |
| **CO2** | S | M | M | S |
| **CO3** | M | S | M | S |
| **CO4** | S | S | S | M |

**S**- Strong; **M**-Medium

**SEMESTER VI**

| Core – VIII | B.Sc. Biotechnology | 2019 – 2020 |
|---|---|---|
| Code: M19UBT08 | PLANT AND ANIMAL BIOTECHNOLOGY | |
| Credit: 4 | | |

**Objectives**

To provide complete knowledge about plant and animal tissue culture techniques and their application.

To educate the elementary techniques for crop improvement and establishment of cell lines and monoclonal antibodies production.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the fundamental knowledge about plant tissue culture methods | K1 |
| CO2 | Understand the protoplast technology, somaclonal variation, Cryopreservation and secondary metabolites production | K2 |
| CO3 | Choose the suitable *invitro* culture techniques of plants and animals | K3 |
| CO4 | Analyze the suitable methods for propagation of plant and animal cells | K4 |

**UNIT-I**

History and scope of plant tissue culture techniques, Laboratory organization. Micropropagation, Callus induction, organogenesis, Meristem culture, anther, pollen, embryo culture and their application.

**UNIT-II**

Protoplast technology – protoplast isolation, protoplast fusion and its application. Applications of plant tissue culture: - Elimination of pathogens, Germplasm conservation and Cryopreservation. Somoclonal variation, embryo rescue, synthetic seeds, Production of secondary metabolites.

**UNIT-III**

Antisense RNA technology – Delayed fruit ripening , Plant viral vectors-TMV, Cauliflower Mosaic Virus (CaMV). Resistance to herbicide, insecticide, virus and bacteria. Plant tissue culture techniques for crop improvement.

**UNIT-IV**

Animal Tissue culture – Culture media, Primary culture, sub-culture and establishment of cell lines, types of cell lines, maintenance of cell lines, cloning of cell lines. Application of animal tissue culture.

**UNIT-V**

Molecular techniques in cell culture – In situ Molecular Hybridization, Somatic cell fusion, Production of Monoclonal antibodies. DNA transfer – Physical, chemical and biological methods. Transgenic animals – Mice, Goat.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Plant Tissue Culture | Kalyan Kumar D | New Central Book Agency 1st edition | 2008 |
| 2. | Culture of Animal cells, A manual of basic technique | R. Ian Freshney, | John Wiley and Sons. 5th edition, | 2005 |
| 3. | Animal Biotechnology | M. Ranga | Agrobios Publications, 2nd edition | 2004 |
| 4. | An Introduction to plant tissue culture. | M.K. Razdan, | Oxford and IBH Publishing Company, New Delhi, | 2000 |
| 5. | Plant Biotechnology: The Genetic Manipulation of Plants | Slater *et al* | Oxford University Press, Oxford, 3rd edition | 2003. |
| 6. | Plant Biotechnology | Mantell S.H and Smith H | Cambridge University Press, UK, 1st edition | 1983 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | S | S | S |
| **CO2** | S | M | M | S |
| **CO3** | M | M | S | S |
| **CO4** | S | S | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER VI**

| Core – IX | B.Sc. Biotechnology | 2019 – 2020 |
|---|---|---|
| **Code: M19UBT09** | **ENVIRONMENTAL BIOTECHNOLOGY** | |
| **Credit: 4** | | |

**Objectives**

To focus on the types of pollution and their microbial remediation.

To provide a foundation for biodiversity and its conservation.

**Course Outcomes**

By the end of the course, the student should be able to:

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the scope and importance of environmental biotechnology | K1 |
| CO2 | Understand the various types of Pollution and its control methods | K2 |
| CO3 | Apply the principles and methods of Biodegradation for removal of toxic components | K3 |
| CO4 | Analyze the polluted areas for bioremediation process | K4 |

**UNIT-I**

Scope of environmental biotechnology. Pollution – types – sources – effects – Air-water – land – Noise – Thermal – Pesticide – Radioactive. Biotechnological control of air, water and soil pollution. Green house effect, ozone and its importance, global warming and Acid rain. Bio accumulation and Bio magnification of heavy metals. Principles of environment Impact Assessment and environmental monitoring.

**UNIT-II**

Biodegradation of organic pollutants: Mechanisms. Biodegradation of Xenobiotic compounds: aliphatic, aromatic, polycyclic aromatic hydrocarbons, halogenated hydrocarbons, azo dyes, lignin and pesticides. Surfactants and microbial treatment of oil pollution.

**UNIT-III**

Waste water treatment - Primary, secondary and tertiary treatment of waste water. Biological Treatment of anaerobic and aerobic; methanogenesis, methanogenic, acetogenic, and fermentative bacteria - biofilters, bioscrubbers, membrane bioreactors, biotrickling filters.

**UNIT-IV**

Bioremediation: Intrinsic bioremediation, Biostimulation and Bioaugmentation. *In situ* and *ex situ* bioremediation technologies. Bioremediation of oil spills. Phytoremediation: types and methods. Use of GMO in bioremediation. Biotransformations and Bioleaching of ores by microorganisms (gold, copper and uranium).

**UNIT-V**

Scope of Biodiversity. Conservation of Biodiversity - Current Practices in conservation of Habitat or ecosystem approaches and Species based approaches. *in situ* and *ex situ* conservation. Role agencies (CBD, IUCN, GEF, IBPGR, NBPGR, WWF, FAO, UNESCO and CITES) for conservation of biodiversity.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Textbook of Environmental Biotechnology | P. K. Mohapatra | I K International Publishing House Pvt. Ltd. | 2010 |
| 2. | Environmental Biotechnology | V.Kumaresan and N.Arumugam | Saras Publications, A.R. Camp Road, Periyavilai, Kottar Post, Nagercoil, Tamil Nadu 629002. | 2014 |
| 3. | Environmental biotechnology (Industrial pollution management) - | S.N.Jogdand, | 3rdedition, Himalaya publication, New Delhi. | 2004 |
| 4. | Environmental biotechnology. | S.K.Agarwal | 2nd Edition, TBH publication, New Delhi. | 1999 |

**REFERENCE BOOKS:-**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Environmental Biotechnology- A Biosystems Approach | Daniel Vallero | 2nd Edition, Academic Press | 2015 |
| 2. | Waste water engineering treatment and reuse | Metcalf&Eddy, Franklin L.Burton, H.DavidStensel, | 4th edition, Tata McGraw Hill publication | 2005 |
| 3. | Ecology and Biotreatment | EcEldowney, S. Hardman D.J. and Waite S. | Longman Scientific Technical. | 1993 |
| 4. | Bioremediation | Baker K.H. and Herson. D. S | McGraw Hill Inc., | 1994 |
| 5. | Environmental Microbiology | Ralph Mitchell and Ji-Dong Gu | John Wiley & Sons, Inc., Hoboken, New Jersey | 2010 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | M | S | S |
| **CO2** | S | M | M | S |
| **CO3** | M | S | M | S |
| **CO4** | S | S | S | M |

**S**- Strong; **M**-Medium.

## SEMESTER VI

| Elective-II | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBTE05 | FOOD BIOTECHNOLOGY | |
| Credit: 4 | | |

**Objectives**

To impart knowledge about food processing techniques, microbes associated with food and general procedure for food plant design, operation and quality checking.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe about scope and important of food biotechnology | K1 |
| CO2 | Understand the various types of food borne pathogens, food colorants and maintenance of food quality in food industry | K2 |
| CO3 | Apply the basic principles and methods for food productions | K3 |
| CO4 | Analyze the various forms of food quality control measures | K4 |

**UNIT-I**

Introduction, scope and important of food biotechnology. Microorganisms associated with food - bacteria, fungi & yeast. Enzymes in food preparation. Food contaminations. Food preservation & Food spoilage-types. Canning of foods.

**UNIT-II**

Food borne diseases and prevention – infection, in-toxification – Salmonellosis, poliomyelitis. Food colors (natural and artificial food colourants), Food flavoring agents.

**UNIT-III**

Food engineering operations: Characteristics of food raw materials, preparative operations in food industry, cleaning of food raw materials, sorting of foods, grading of foods.

**UNIT-IV**

Food quality: Sensory evaluation of food quality, quality factors for consumer safety, food safety standards. FSSA, HACCP and FDA. Processing plant - Cleaning and sanitation methods.

**UNIT-V**

General principle, plant design – design, construction, functionality of building, design & fabrication of equipment. Plant layout Pest proofing/ fumigation methods. Water supply to food processing unit.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Food Microbiology | William C.Frazier, Dennis C. Westhoff | McGraw Hill Publications | 2017 |
| 2. | Fundamentals of Food Engineering | D.G. Rao | PHI Learning Pvt. Ltd. | 2010 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Food Biotechnology | Yiu Hui & G. Khachatourians | Wiley-Inter science | 1995 |
| 2. | Fundamentals of Food Microbiology | Bibek, Laramie & Bhunia | CRC Press | 2004 |
| 3. | Food Processing & Preservation | B. Siva | PHI Learning Pvt. Ltd. | 2011 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | M | M | S |
| **CO2** | M | M | S | S |
| **CO3** | S | S | M | M |
| **CO4** | S | S | S | M |

**S**- Strong; **M**-Medium.

## SEMESTER VI

| Elective-II | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBTE06 | MICROBIAL DISEASE AND CONTROL | |
| Credit: 4 | | |

**Objectives**

To provide a brief knowledge about microbial pathogens (viral, bacterial, fungal, protozoan and parasitic) and its control measures.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the various types of microbial pathogens and its control measures | K1 |
| CO2 | Understand the host microbial interactions and pathogenesis | K2 |
| CO3 | Solve the microbial infections and its prevention measures | K3 |
| CO4 | Analyze the clinical Specimens for disease identification and its treatment process | K4 |

**UNIT-I**

Microorganisms - microbial interactions - pathogens. General epidemiology – pathogenesis - pathology – diagnostic procedure - clinical manifestation - prevention and control measures.

**UNIT-II**

Virus: HIV, Pox virus, and *Picorna* virus -Epidemiology – pathogenesis - pathology - diagnostics procedure - clinical manifestation - prevention and control measures.

**UNIT-III**

Bacteria: *Streptococcus*, *Staphylococcus* and *Salmonella* – Epidemiology - pathogenesis - pathology - diagnostic procedure - clinical manifestation - prevention and control measures.

**UNIT-IV**

Fungi: *Aspergillus*, *Candida* and *Microspora*-Epidemiology - pathogenesis-pathology –diagnostic procedure – clinical manifestation-prevention and control measures.

**UNIT-V**

Protozoa: *Entamoeba histolytica*, *Plasmodium* species and *Trypanosoma gambiense* – Epidemiology – pathogenesis - pathology - diagnostic procedure - clinical manifestation-prevention and control measures - vectors.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publisher | Year of Publication |
|---|---|---|---|---|
| 1. | Medical Microbiology: A Guide to Microbial Infections : Pathogenesis, Immunity, Laboratory Diagnosis and Control | David Green Wood Richard slack & John Peuthrer | Churchill Livingstone | 1992 |
| 2. | Paniker'S Textbook of Medical Parasitology | Paniker and Sougata Ghosh | Jaypee Brothers Medical Publishers (P) Ltd. | 2013 |
| 3. | Textbook of Microbiology | Anantanarayan & Panekar | Universities Press | 2017 |
| 4. | Principles of Bacteriology, Virology and Immunity | Wilson & Topley | Hodder Arnold; 8th Revised edition | 1990 |
| 5. | Textbook of Medical Mycology | Jagdish Chander | Jaypee Brothers Medical Publishers; Fourth edition | 2018 |

**REFERENCE BOOK:**

| S. No. | Title of the Book | Author | Publisher | Year of Publication |
|---|---|---|---|---|
| 1. | Medical Microbiology | Jawetz Melnickand Adelbergs - Carroll | MeGraw-Hill Company | 2013 |
| 2. | Textbook of Virology | A. J. Rhodes, C. E. van Rooyen | Williams & Wilkins | 1962 |
| 3. | Medical Microbiology | Geo. F. Brooks, Karen C. Carroll, Janet S. Butel, Stephen A. Morse | McGraw Hill Education; 26 edition | 2013 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | S | S | S | S |
| **CO2** | S | M | S | S |
| **CO3** | S | S | S | M |
| **CO4** | S | S | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER VI**

| Elective- II | B.Sc., Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBTE07 | PHARMACEUTICAL BIOTECHNOLGY | |
| Credits : 4 | | |

**Objectives**

To focus on fundamental principles of Pharmacology, measurement of drug action.

To understand chemotherapeutic drugs mechanism, toxicology, drug evaluation.

To impart knowledge about therapeutic protein and tissue engineering.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the fundamental principles of Pharmacology, drug classification and drug action and pharmacokinetics of chemotherapeutic drugs | K1 |
| CO2 | Understand the knowledge of Chemo therapeutic drugs, anti-cancer and anti Inflammatory drugs. | K2 |
| CO3 | Apply the techniques for production of pharmaceutical products | K3 |
| CO4 | Analyze the skill for production various types of anti-drugs | K4 |

**UNIT-I**

History & Principle of pharmacology. Drug nomenclature & Classification systems. General Principles of Drug action Pharmaco kinetics, Pharmaco dynamics, measurement of drug action.

**UNIT-II**

Chemo therapeutic drugs - Protein synthesis inhibitors, Antibacterial, antifungal, antiprotozoal, antiviral, Antihelmithic. chemotherapy in anticancer and antiinflammatory drugs.

**UNIT-III**

Techniques of r-DNA technology for production: Insulin, HGH, GRF, Erythropoietins, IFN, TNF, Interleukins, Clotting factor VIII.

**UNIT-IV**

Production of Ergot alkaloids, Probiotics, Production of recombinant vaccines. ISO standard for industrial production.

**UNIT-V**

Protein and tissue engineering. Therapeutic proteins – Formulation, delivery and stability. Pharmaceutical bio-assay – toxin detection, antiviral and anticancer bioassay.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | A concise Text Book of Pharmacology, 6th Ed. | N.Murugesh | Sathya Publishers, Madurai | 2014 |
| 2. | A Text Book of Biotechnology | R.C. Dubey | S.Chand& Co Ltd, New Delhi. | 1993 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Pharmaceutical Biotechnology | S.S. Purohit, Kakrani, Saluja | Agrobios, India | 2003 |
| 2. | Pharmacology | Mary J. Myuk, Richard, A.Hoarey, Pamala | Lippinwitt Williams edition | 2014 |
| 3. | Pharmacology | H.P. Rang, M.M. Pale, J.M. Moore | Blackwell Publishing Ltd (Churchill Livingston) | 2003 |
| 4. | Integrated pharmacology | Page, Curtis, Sulter, Walker, Halfman. | Mosby Publishing co | 2006 |
| 5. | Principles of Pharmacology | D. Golan, A. Tashjian, E.Armstrong, J.Galanter, A.W.Armstrong, R. Arnaout and H.Rose. | Lippincott Williams and Wilkins. | 2005 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | M | S | S |
| **CO2** | S | S | S | S |
| **CO3** | S | S | S | S |
| **CO4** | M | M | S | M |

**S**- Strong; **M**-Medium

**SEMESTER VI**

| Elective – II | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| **Code: M19UBTE08** | **INDUSTRIAL SAFETY** | |
| **Credit: 4** | | |

**Objectives**

To teach student the concept of Industrial Safety and provide useful practical knowledge for workplace safety.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the industrial plant design and basic rules | K1 |
| CO2 | Understand the chemical hazards and safety | K2 |
| CO3 | Apply the knowledge about analysis various types of hazards | K3 |
| CO4 | Analyze the mechanisms of biosafety measurements in industry | K4 |

**UNIT-I**

Site selection, plant layout- design for ventilation - basic rules and requirements which govern the chemical industries – social environmental setup – tolerance limit of the society.

**UNIT-II**

Chemical hazards classification – hazards due to fire and explosion – safety analysis – chemical and job safety – safe handling and operation of materials and machineries.

**UNIT-III**

Types of hazard analysis – hazard identification – HAZOP – hazard survey – Fault tree analysis - event tree analysis.

**UNIT-IV**

Effective steps to implement safety procedure – periodic advice and constant maintenance – personal protective equipments- types – fire fighting equipments.

**UNIT - V**

Introduction – biosafety issues in Biotechnology – Historical background – primary contaminants for biohazards biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulation of Government of India – risk analysis – risk assessment – risk management.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publisher | Year of Publication |
|---|---|---|---|---|
| 1. | Industrial safety Prentice | Blake R.P. | Hall Inc. New Jersey, 2nd Edition | 1963 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publisher | Year of Publication |
|---|---|---|---|---|
| 1. | Safety and Hazard prevention in chemical operation | Fawcett H.H. and Wood W.S. | Inter sciences | 1965 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | S | S | M | S |
| **CO2** | S | S | S | M |
| **CO3** | S | S | M | M |
| **CO4** | M | M | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER VI**

| Core Practical-VII | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBTP07 | PRACTICAL - VII - PLANT AND ANIMAL BIOTECHNOLOGY | |
| Credit: 3 | | |

**Objectives**

To provide hands on training in the field of plant and animal biotechnology with familiarize the following techniques like plant and animal tissue culture media preparation, protoplast isolation, genomic DNA isolation, trypsinization, chick embryo fibroblast culture, virus cultivation.

**Plant Biotechnology**

1. Aseptic culture techniques for establishment and maintenance of cultures.
2. Tissue culture media preparation: Preparation of stock solutions of MS, Whites and Gamborg media.
3. Establishment of meristem culture using MS medium
4. Isolation of protoplasts.
5. Establishment and maintenance of callus culture.
6. Establishment and maintenance of suspension culture.
7. Synthetic seeds (Entrapment method).
8. Isolation of genomic DNA from plant.

**Animal Biotechnology**

9. Preparation & sterilization of animal cell culture media: balanced salt solution and DMEM.
10. Disaggregation of tissues – Trypsinization.
11. Culture of chick embryo fibroblast (monolayer).
12. Viability test and cell counting.
13. Inoculation of virus and observation.
14. Applications of $CO_2$ incubator & inverted microscope.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Plant Biotechnology laboratory Manual | Anjana,R and Roy,P.P | Kerala Agricultural University, Ernakulum, Kerala | 2014 |
| 2. | Biotechnology Procedures and Experiments Handbook | S. Harisha, | Infinity Science Press LLC. and Laxmi Publications Pvt. Ltd | 2007 |
| 3. | A Practical Manual On Basic Techniques In Biotechnology & Nanotechnology | S. R. Madhan Shankar & E. M. Rajesh | International E – Publication | 2013 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | M | S | M | S | S |
| **CO2** | S | S | S | M | S |
| **CO3** | M | S | S | M | S |
| **CO4** | S | S | M | M | S |
| **CO5** | S | M | S | M | M |

**S**- Strong; **M**-Medium.

## SEMESTER VI

| Core Practical-VIII | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBTP08 | PRACTICAL-VIII - ENVIRONMENTAL BIOTECHNOLOGY | |
| Credit: 3 | | |

**Objectives**

To examine water quality parameters from water samples collected from polluted environment by using biotechnological methods.

1. Isolation and enumeration of microorganism from air
2. Isolation of halophiles
3. Isolation of heavy metal resistance microorganisms
4. Determination of soil and water pH
5. Determination of dissolved sulphate in water
6. Determination of residual chlorine
7. Analysis of TDS in effluent
8. Estimation of total solids in the effluent sample
9. Isolation of coliforms from water
10. Dissolved oxygen (DO) Experiment
11. Biochemical Oxygen Demand (BOD) Experiment
12. Chemical Oxygen Demand (COD) Experiment

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Aquatic Ecology | Trivedy R.K and Ragothaman G | Published by Agrobios (India) | 2007 |
| 2. | Enviromental Science A Practical Manual | G. Swarajya Lakshmi, P. Prabhu Prasadini and Ramesh Thatikunta | Bs Publications | 2009 |
| 3. | A Lab Text Book On Environmental | A.K. Jain, Era Upadhyay and Anupam | School of Applied. Science Ansal Institute of Technology, | 2011 |

Studies Adhikary Gurgaon , Haryana

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Environmental microbiology: a laboratory manual. | Pepper, I. L., Gerba, C. P. and Brendecke, J. W. | Academic Press, San Diego, US | 1995 |
| 2. | Environmental Biotechnology Laboratory Manual, | Ismail Saadoun, | Department of Applied Biological Sciences, Jordan University of Science and Technology, P.O. Box 3030, Irbid-22110, | 2008 |
| 3. | Environmental Microbiology Methods and Protocols | John F. T. Spencer and Alicia L. Ragout de Spencer. | Humana Press Inc. Totowa, New Jersey 07512 | 2004 |
| 4. | Environmental Microbiology A Laboratory Manual, | I.L. Pepper and C.P. Gerba | 2nd edition: Elsevier Academic Press | 2004 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | M | S | S |
| **CO2** | S | M | M | S |
| **CO3** | M | S | M | S |
| **CO4** | S | S | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER VI**

**SKILL ENCHANCEMENT COURSES - V**

| SEC - IV | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBTS04 | SEC - IV - NANO-BIOTECHNOLOGY | |
| Credit: 2 | | |

**Objectives**

To understand the methods of nanoparticles preparation, characterization and its applications in various fields of science for the welfare of human as well as for environment.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe basic concepts and terminologies of Nanobiotechnology | K1 |
| CO2 | Understand the nanomaterials preparation and its uses in biological fields | K2 |
| CO3 | Apply knowledge about nanomaterials, biosensors, drug designing and imaging techniques in modern medicine | K3 |
| CO4 | Analyze the various types of nano drugs and its delivery systems. | K4 |

**UNIT-I**

Nanobiology - Concepts, definitions, prospects. Biological Nano objects –DNA, protein, lipids. Biological networks. Nanoparticles and nanocomposites.

**UNIT-II**

Methods of Nanobiotechnology - XRD, FT-IR, AFM, Scanning Probe Electron Microcopy, Lithography.

**UNIT-III**

Biosensors – definition, scope and types. Potential, Electrochemical and Biomembrane based sensors. Imaging techniques - digital & molecular imaging.

**UNIT IV**

Drug delivery systems – Polymer therapeutics - Polymer drug conjugates; polymericmicelles, Liposome. Determination of mechanical properties - Mechanical testing, Elasticity, Toughness.

**UNIT-V**

Application of Nanobiotechnology in medicine, Drug designing and Cancer treatment. Medical, Social and Ethical considerations of Nanobiotechnology.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Principles and Practices of Nanobiotechnology | Giorgio Salati | Syrawood Publishing House | 2016 |
| 2. | An Introduction to Nanobiotechnology | Yashwanth Kumar | Book Enclave | 2017 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Biomaterials Sciences: An Introduction to Materials in Medicine | Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen and Jack E. Lemons. | Academic Press, Elsevier | 2012 |
| 2. | Lehninger's Principles of Biochemistry | David L. Nelson and Michael M. Cox | | 2006 |
| 3. | Nanobiotechnology: Concepts, | Christof M. Niemayer, Chad A. | Wiley VCH publishers | 2004 |

| | | | | |
|---|---|---|---|---|
| | applications and perspectives | Mirkin | | |
| 4. | Bionanotechnology: Lessons from Nature | David. S. Goodsell | Jhonwiley | 2006 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | S | M | M |
| **CO2** | S | S | M | M |
| **CO3** | S | M | M | S |
| **CO4** | S | M | M | S |

**S**- Strong; **M**-Medium.

**SEMESTER VI**

**Self-Employment Course**

| JOC-I | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| **Code: M19UBTJ01** | **DIAGNOSTICS BIOTECHNOLOGY** | |
| **Credit: 3** | | |

**Objectives**

To Understand the common procedures used in disease diagnosis

To be familiar with various types of diseases diagnosis methods.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the techniques used for the diagnostic using enzymes | K1 |
| CO2 | Understand the concept of molecular techniques used diagnosis of diseases | K2 |
| CO3 | Apply the knowledge about diagnosis of antigen and antibody in clinical laboratory | K3 |
| CO4 | Analyze the pathogen by using advanced molecular tools | K4 |

**UNIT-I**

Enzyme Immunoassays: Enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Types of Immunoassays (Homogeneous and heterogeneous). Uses of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in diagnostic microbiology

**UNIT-II**

Molecular methods for diseases diagnostics- PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology – chemotherapy. Susceptibility tests- Micro-dilution and macro-dilution methods and diffusion.

**UNIT-III**

Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies. Concepts and methods in idiotypes. Anti-idiotypes and molecular mimicry and receptors. Epitope design and their applications. Immunodiagnostic tests - Immuno florescence and Radioimmunoassay.

**UNIT-IV**

Prenatal diagnosis - Invasive techniques and Non-invasive techniques – Diagnosis of pathogenic microbes: Classical and modern methods- Diagnosis using protein and enzyme markers, DNA/RNA based diagnosis - Molecular markers - Microarray technology - genomic and cDNA arrays. GLC, HPLC, Electron microscopy, flow cytometry and cell sorting. Transgenic animals.

**UNIT-V**

Pathogen Diagnostic techniques: Diagnosis of DNA and RNA viruses. Pox viruses, Adenoviruses, Rhabdo Viruses, Hepatitis Viruses and Retroviruses. Diagnosis of Protozoan diseases: Amoebiosis, Malaria, Trypnosomiosis, Leishmaniasis. Study ofhelminthic diseasesFasciola hepatica and Ascaris lumbricoides. Filariasis and Schistosomiasis.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics | Burtis, Carl A. and Bruns, David E | Elsevier | 2014 |
| 2. | Immunology and Molecular Diagnostics | Jayanti Tokas | Laxmi Publications | 2015 |
| 3. | Molecular Diagnostics | Lela Buckingham and Maribeth L. | F.A. Davis Company | 2007 |

| | | | | |
|---|---|---|---|---|
| | | Flaws | | |
| 4. | Single Cell Diagnostics: Methods and Protocols: 132 (Methods in Molecular Medicine) | Alan R. Thornhill | Humana Press; | 2007 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | S | M | S |
| **CO2** | S | M | S | M |
| **CO3** | M | S | M | M |
| **CO4** | S | M | S | S |

**S**- Strong; **M**-Medium.

**SEMESTER VI**

| JOC-I | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19UBTJ02 | FOOD PROCESSING TECHNOLOGY | |
| Credit: 3 | | |

**Objectives**

To develop skill in food processing (fruits and vegetables), operation and maintenance of modern equipments.

To understand the quality assurance and process of packaging, storing and marketing.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe about food processing, preservation and packing | K1 |
| CO2 | Understand the basic principles of composition and nutritive value of pulses and cereals | K2 |
| CO3 | Apply knowledge about fruit, vegetable Processing and preservation by various techniques | K3 |
| CO4 | Analyze the different types flusy, sea food processing and storage products | K4 |

**UNIT-I**

Definition and scope of Food processing, Historical evolution of food processing technology. Fundamentals of food preservation – Preservation, dehydration, Packaging and canning.

**UNIT-II**

Fruits and Vegetables - Processing- Classification, Pre- Processing, Processing and Preservation- Size reduction, Mixing, Separation, Concentration, Freezing and Refrigeration, Drying and Dehydration, Chemicals, Processing by using Pulsed Light and Irradiation.

**UNIT-III**

Pulses and cereals - Processing of pulses, composition and nutritive value, processing methods, toxic constituents. Processing of cereals- structure, composition and nutritive value, Processing methods- fermented and non-fermented products.

**UNIT-IV**

Flusy and sea food - Meat, Poultry and Egg - Pre-Processing; Processing and Preservation- Smoking, Canning, Drying, Cooling, Canning Pulsed Electric Field processing; Sea food - Types; Pre-Processing; Processing and Preservation- Dielectric, Ohmic and Infra-red heating.

**UNIT-V**

Dairy and oils - Dairy Processing- Milk Pre-Processing; Processing and Preservation - Separation, Homogenization, Pasteurization, Standardization, Sterilization (UHT), Evaporation (Spray Drying), Chilling, Freezing and Refrigeration. Oil seed Technology-Types; Pre-Processing; Processing & Preservation- Extraction of oils, meal concentrates and Value Addition.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Guide to Quality Management Systems for Food Industries. | Early R | Blackie Academic | 1995 |
| 2. | Experiments in Food Process Engineering, | H. Pandey, H.K. Sharma, R.C. Chouhan, B.C. Sarkar and M.C. Bera | CBS Publishers and Distributors | 2004 |
| 3. | Handbook of analysis and quality control for fruits and vegetables products | S. Ranganna, | Mcgraw Hill Pub. Co. New York. | 2005 |
| 4. | Food Process Engineering: Theory and Laboratory Experiments, | S. K. Sharma, S.J. Mulvaney, and S.S.H. Rizvi | Wiley and Sons | 2000 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1 | New methods of Food Preservation, | Gould, G.G. | Blackie Academic & Professional, Chennai. | 1996 |
| 2 | Food Preservation Techniques | Peter zeuthena nd Leif Bogh-Sorensen, | Wood Head Publishing Ltd., Cambridge, England | 2005 |
| 3 | Food Science and Processing Technology vol-2, Commercial processing and packaging, | Mirdula Mirajkar, Sreelatha Menon | Kanishka publishers, New Delhi | 2002 |
| 4 | The complete Technology book on processing, dehydration, canning, preservation of fruits and vegetables, , Delhi | NIIR Board, | National Institute of Industrial Research | 2005 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | S | M | S | S |
| **CO2** | M | S | M | S |
| **CO3** | S | S | M | M |
| **CO4** | S | M | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER III**

**Non-Major Elective Courses**

| NMEC – I | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| Code: M19NBT01 | NMEC - I - HEALTH AND HYGIENE | |
| Credit: 2 | | |

**Objectives**

To focus on health, maintenance of body weight, dieting.

To knowledge about personal hygiene, food contamination, role of International control of health and WHO.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the basic concept of health and ecological aspects in human health | K1 |
| CO2 | Understand the concept of body weight, BMI and diet | K2 |
| CO3 | Apply the necessity of exercise, weight control program and dieting | K3 |
| CO4 | Analyze the food contamination and methods of disease transmission | K4 |

**UNIT-I**

Health-definitions of health, dimensions of health, concept to fwellbeing, determinants of health, and ecology of health.

**UNIT-II**

Body weight and composition for Health and Sports – Ideal body weight, values and limitations of the BMI, composition of the body; Diet during training, dietary supplements for athletes.

**UNIT-III**

Exercise and Health related fitness-Health related fitness, physical activity for health benefits, types of exercise, effective weight control-dieting or exercise; weight reduction program for young athletes.

**UNIT-IV**

Hygiene-Meaning and importance; Hygienic practices of employees, personal hygiene and contamination of food products, methods of disease transmission.

**UNIT-V**

Drug Abuse and health laws – Hygiene of eating and drinking, Ventilation and lighting, Health laws for food safety and hygiene, International control of health, WHO, Health destroying habits and addictions - Pan, Ganja, Drinking, Smoking, Tea and Coffee.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Principles of food sanitation | Marriott, G. Norman | Van Nostrand Reinhold company, New York | 1985 |
| 2. | Catering management-Anintegrated approach | Sethi,M. and Matha,S., | Wiley EasternLtd., New Delhi. | |
| 3. | Test book of preventive and social medicine | K. Park | 15th edition, MIS Banarsidas Bhano Publishers, Jabalpur | 1997. |
| 4. | Nutrition for Health, fitness and Sports | Melvin H. Williams | 7th edition, MC Graw Hill international Edition | 2005 |
| 5. | Nutrition and Metabolism | Michael J.GIbney, lan A Macdonald and Helen M.Roche | Blackwell Publishing company, Bangalore | 2008 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | S | S | M | M |
| **CO2** | S | S | M | S |
| **CO3** | M | S | S | S |
| **CO4** | S | S | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER III**

| NMEC-I | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| **Code: M19NBT02** | **NMEC - I - FOOD AND NUTRITION** | |
| **Credit: 2** | | |

**Objectives**

To describe the basic aspects of nutrients and to understand the relationship between food, nutrition and health.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the basic concepts of food sources, and nutritional deficiency | K1 |
| CO2 | Understand the concepts of composition, functions, sources of food and nutrition | K2 |
| CO3 | Discover nutritional elements of various food sources | K3 |
| CO4 | Analyze macro and micro-minerals with sources, and effect of deficiency | K4 |

**UNIT-I**

Concept of Nutrition - Health, nutritional status and malnutrition. Carbohydrates - Definition, composition, functions, maintenance of blood sugar levels, requirement, sources, digestion and absorption; Dietary fiber- Definition, classification, physiological effects and sources.

**UNIT-II**

Proteins - Definition, composition, nutritional classification of proteins and amino acids, functions, sources, requirements, digestion and absorption. Lipids - Definition, composition, functions, sources, requirements, digestion and absorption. Essential fatty acids – Definition, functions, sources and effects of deficiency.

**UNIT-III**

Energy - Definition, units of measurement, direct and indirect calorimetry; Determination of energy value of food, Total Energy requirement, Factors affecting physical activity, Factors affecting Basal Metabolic Rate.

**UNIT-IV**

Nutritional elements: Functions, sources, requirements and effects of deficiency- Calcium, Phosphorous, Iron, Iodine, Copper, Fluorine, Zinc, Sodium and Potassium.

**UNIT-V**

Fat soluble Vitamins –Vitamin A, D, E and K: Functions, requirements, sources and effects of deficiency. Water soluble Vitamins – Thiamine, riboflavin, niacin, ascorbic acid, folic acid, vitamin B6 and vitamin B12: Functions, requirements, sources and effects of deficiency.

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Text Book of Bio-Nutrition, Fundamental and Management | Paul. S | RBSA Publishers | 2003 |
| 2. | Nutrition and Diet Therapy (6th Edition) | Sue Rodwell Williams | C.V. Melskey Co., | 2000 |
| 3. | Text Book of Human Nutrition | Mahtab.S.Bamji, KamalaKrishnaswamyandG.N.VBrahmam | Oxford and IBH Publishing Company | 2009 |

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Fundamentals of Foods and Nutrition (3rd edition) | Sumathi R. Mudambi, Rajagopal, M.V | New Age International (P)Ltd, Publishers, | 1997 |
| 2. | Nutrition Science (5th edition) | SrilakshmiB | New Age International (P)Ltd, Publishers | 2016 |
| 3. | Normal Nutrition, Curing diseases through diet (1st edition) | Mangala Kango | CBS Publications | 2005 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | S | S | S | M |
| **CO2** | M | M | S | S |
| **CO3** | M | S | S | S |
| **CO4** | S | S | M | M |

**S**- Strong; **M**-Medium

**SEMESTER IV**

**Non-Major Elective Courses**

| NMEC-II | B.Sc. Biotechnology | 2019 – 2020 |
|---|---|---|
| **Code: M19NBT03** | **NMEC - II - ENTREPRENEURSHIP IN BIOTECHNOLOGY** | |
| **Credit: 2** | | |

**Objectives**

To gain entrepreneurial skills in the field of mushroom cultivation, vermicomposting, hydrophonics, aquaphonics, home gardening, roof top gardening, sericulture and apiculture venture creation.

**Course Outcomes**

By the end of the course, the student should be able to:

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the scope and importance of entrepreneurship in biotechnology | K1 |
| CO2 | Understand the principles, methods and application of mushroom, vermicomposting, SCP cultivation | K2 |
| CO3 | Apply the methods of vermicomposting, mushroom, SCP and *Azolla* | K3 |
| CO4 | Analyze the various nutritional values of biological products | K4 |

**UNIT-I**

Scope and importance of entrepreneurship; Introduction to bioentrepreneurship – types of bio-industries – biopharma, bioagri, bioservices and bioindustrial; innovation – types, out of box thinking; skills for successful

entrepreneur – creativity, leadership, managerial, team building, decision making; opportunities for bioentrepreneurship.

**UNIT-II**

Introduction to mushroom fungi, nutritional value, edible and poisonous type, edible mushrooms -- Pleurotus, Volvariella and Agaricus, medicinal value of mushrooms. Preparation of culture, mother spawn production, multiplication of spawn, cultivation techniques, harvesting, packing and storage.

**UNIT-III**

Vermiculture and Vermicomposting: Introduction, Collection of wastes and their segregation and processing. Bed preparation for Anaerobic and Aerobic composting Earthworm collection and application on beds Vermicompost collection, Earthworms separation, Air drying of vermicompost, sieving and storing. Vermi-wash collection and processing.

**UNIT-IV**

Introduction to SCP production – Pond construction, Outdoor mass cultivation technology of *Spirulina*, Optimal conditions for mass cultivation, Development of *Spirulina* culture, Harvesting and Drying process of *Spirulina* biomass. *Azolla* Fodder - Introduction, Cultivation and harvesting methods. Advantages and nutritional values of *Azolla.*

**UNIT-V**

Farming – hydrophonics and aquaphonics, home gardening, roof top gardening. Sericulture – Introduction. Mulberry cultivation and silk worm rearing. Introduction to Apiculture. Honey Bee types and Life cycle. Bee keeping: Tools and Equipment. Queen rearing. Handling, Collection and preservation of honey. Honey Processing and marketing.

**Note:** Visiting the following production units and obtained enough trainings from the workshop units/fields such as, mushroom, *Spirulina* and *Azolla* cultivation, Honey bee keeping / Honey Processing / Honey Marketing, Hydrophonics, roof gardening, vermicomposting and sericulture unit.

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | The Practice of Entrepreneurship | G.G. Meredith, R.E.Nelson and P.A. Neek, | ILO, New Delhi | 1982 |
| 2. | Management of Small Scale Enterprises, | Vasant Desai, | Himalaya Publishing House | 2004 |
| 3. | Entrepreneurship: Successfully | Bruce R Barringer and R Duane Ireland, | Launching New Ventures, 3rd ed., Pearson Edu., | 2013 |
| 4. | Mushrooms Cultivation, Marketing and Consumption | Manjit Singh Bhuvnesh Vijay Shwet Kamal G.C. Wakchaure | Directorate of Mushroom Research (Indian Council of Agricultural Research) Chambaghat, Solan – 173213 (HP) | 2011 |
| 5. | Yuvagreen Azolla Bed for Azolla Cultivation | Yuvagreen | Daya Publishing House, New Delhi | 2008 |
| 6. | Hydroponics: Hydroponics Gardening Guide - from Beginner | Thomas Thatcher | Breakthough Publishing, USA | 2016 |
| 7. | Roof Terrace Gardening | Michele Osborne | Aquamarine; New edition, India | 2012 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Enterprise for life scientists: Developing innovation and entrepreneurship in the biosciences. | Adams, D. J., and Sparrow, J. | Bloxham: Scion | 2008 |
| 2. | Biotechnology entrepreneurship: Starting, managing, and Leading biotech companies. | Shimasaki, C. D. | Amsterdam: Elsevier. Academic Press is an imprint of Elsevier. | 2014 |

| | | | | |
|---|---|---|---|---|
| 3. | Honey Bee Biology and Beekeeping, | Dewey M. Caron | Revised Edition. Wicwas Press, Kalamazoo | 2013 |
| 4. | The Complete Step-by-step Book of Beekeeping: A Practical Guide to Beekeeping, from Setting up a Colony to Hive Management and Harvesting the Honey. | David Cramp | Lorenz Books. London. | 2012 |
| 5. | Mushroom Cultivation in India | B .C. Suman and V.P Sharma | Daya Publishing House, New Delhi | 2007 |
| 6. | Azolla a super organism | Rich Mark Constantino | Kindle Edition, Amazon Asia-Pacific Holdings Private Limited | 2009 |
| 7. | An Introduction to Sericulture | M. Madan Mohan Rao | BS Publications, New Delhi | 2019 |
| 8. | Nutraceutical Spirulina : Commercial Cultivation Using Rural Technology in India | Pushpa Srivastava | Aavishkar Publishers, Distributors, Jaipur; First edition | 2017 |
| 9. | Hydroponics for the Home Grower | Howard M. Resh | CRC Press; 1st edition USA | 2015 |


**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | M | M | S | S |
| **CO2** | S | M | M | S |
| **CO3** | M | S | M | S |
| **CO4** | S | S | S | M |

**S**- Strong; **M**-Medium.

**SEMESTER IV**

| NMEC-II | B.Sc. Biotechnology | 2019 - 2020 |
|---|---|---|
| **Code: M19NBT04** | **NMEC-II - AGRICULTURAL BIOTECHNOLOGY** | |
| **Credit: 2** | | |

**Objectives**

To introduce the principles, practices and application of agricultural biotechnology.

**Course Outcomes**

On the successful completion of the course, students will be able to

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Describe the basic principles of crop improvement, plant breeding, micro-propagation in agricultural field | K1 |
| CO2 | Understand the mechanism of biological nitrogen fixation, production of bio-fertilizers and applications | K2 |
| CO3 | Apply the microbes in bio-fertilizers and bio-pesticides | K3 |
| CO4 | Analyze a nutritional value of biofertilizer and plant growth quality modifications | K4 |

**UNIT-I**

Introduction to Agricultural biotechnology. Crop improvement hybridization and plant breeding techniques. Micropropagation and plant tissue culture technique and its application in agriculture. Somatic hybridization, haploid production and cryopreservation.

**UNIT-II**

Mechanism of biological nitrogen fixation process. Production of biofertilizers and applications of rhizobium, azotobacter, azolla and mycorrhiza. Use of plant growth regulators in agriculture and horticulture.

**UNIT-III**

Microbes based Biofertilizers: Azolla and Anabena, Rhizobium, Azotobacter, Azospirillum, Mycorrhiza. Biopesticide – Trichoderma, BT and NPV.

**UNIT-IV**

Biodiversity Legislation in India; Indian Biodiversity Act and provisions on crop genetic resources. Convention on Biological Diversity (CBD) and Cartagena protocol on Biosafety. Conservation strategies for seed gene bank; Impact of GE crops on Biodiversity.

**UNIT-V**

Transgenic plants in quality modifications–Starch, Oil, Protein, and Golden Rice. Current status of transgenics, Biosafety norms and controlled field trails and release of transgenic (GMO).

**TEXT BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Environmental microbiology | GrantW.D.and Long P.E | Springer | 1981 |
| 2. | Handbook on Agriculture, Biotechnology and development | Stuart J. Smyth, Peter W.B. Phillips, David Castle | Edward Elgar Publishing Inc. | 2014 |

**REFERENCE BOOKS:**

| S. No. | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Agricultural Biotechnology | Kumar HD | Daya Publishing house | 2005 |
| 2. | Agricultural Biotechnology | Rajmohanjoshi | Isha Books, Delhi | 2006 |
| 3. | Text book of Agricultural Biotechnology | AhindraNag | PHI Learning Private Limited, New Delhi | 2008 |

**Mapping with Programme Outcomes**

| Cos | PO1 | PO2 | PO3 | PO4 |
|---|---|---|---|---|
| **CO1** | S | S | S | M |
| **CO2** | S | M | S | M |
| **CO3** | S | S | S | S |
| **CO4** | S | M | M | M |

**S**- Strong; **M**-Medium

# MAHENDRA ARTS & SCIENCE COLLEGE
## (Autonomous)
Affiliated to Periyar University, Salem.
Accredited by NAAC with 'A' Grade & Recognized u/s 2(f) and 12(B) of the UGC Act 1956
Kalippatti – 637 501, Namakkal (Dt), Tamil Nadu.

## DEPARTMENT OF BIOTECHNOLOGY

**List of Courses Focusing on Employability/ Entrepreneurship/ Skill Development (Regulations – 2016)**

**Programme: B.Sc. Biotechnology**

| S.No. | Course Name | Course Code | Employability | Entrepreneurship | Skill Development |
|---|---|---|---|---|---|
| 1. | Computer applications in Biology | M16UBTS01 | | | ✓ |
| 2. | Biophysics & Bioinstrumentation | M16UBTS02 | | | ✓ |
| 3. | Applied Statistics | M16USTN01 | | | ✓ |
| 4. | Applied Microbiology II | M16UMBA02 | | | ✓ |
| 5. | Bioinformatics | M16UBTS03 | | | ✓ |
| 6. | Health and Hygine | M16UBTN01 | | | ✓ |
| 7. | Food and Nutrition | M16UBTN02 | | | ✓ |
| 8. | Applied Biotechnology | 16UBTN03 | | | ✓ |
| 9. | Agricultural Biotechnology | M16UBTN04 | | ✓ | |
| 10. | Nursery and gardening | M16UBTE03 | | ✓ | |
| 11. | Immunology | M16UBT05 | | | ✓ |
| 12. | Industrial Biotechnology and IPR | M16UBTS04 | ✓ | | |
| 13. | rDNA Technology | M16UBT06 | | | ✓ |
| 14. | Bioprocess Technology | M16UBT07 | | | ✓ |
| 15. | Environmental Biotechnology | M16UBT09 | | | ✓ |
| 16. | Herbal Technology | M16UBTE04 | | | ✓ |
| 17. | Food Biotechnology | M16UBTE05 | ✓ | | |

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| S.No. | Course Name | Course Code | Employability | Entrepreneurship | Skill Development |
|---|---|---|---|---|---|
| 18. | Pharmaceutical Biotechnology | M16UBTE07 | | | ✓ |
| 19. | Biofertilizer Technology | M16UBTE08 | ✓ | | |
| 20. | Nano Biotechnology | M16UBTS05 | | | ✓ |

**Head of the Department**

HEAD OF THE DEPARTMENT
Department of Biotechnology,
Mahendra Arts & Science College (Autonomous),
Kalippatti (Po) - 637 501. Tiruchengode (Tk),
Namakkal (Dt). Tamil Nadu. India.

**Principal**

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## DEPARTMENT OF BIOTECHNOLOGY

### List of Courses Focusing on Employability/ Entrepreneurship/ Skill Development (Regulations – 2016)

**Programme: B.Sc. Biotechnology**

| S.No. | Name of the Course | Course Code | Employability/ Entrepreneurship/ Skill development | Year of introduction (during the last five years) |
|---|---|---|---|---|
| 1. | Computer applications in Biology | M16UBTS01 | Skill development | 2016 - 2017 |
| 2. | Biophysics & Bioinstrumentation | M16PBTE01 | Skill development | 2017 - 2018 |
| 3. | Applied Statistics | M16USTN01 | Skill development | 2017 - 2018 |
| 4. | Applied Microbiology II | M16UMBA02 | Skill development | 2017 - 2018 |
| 5. | Bioinformatics | M16UBTS03 | Skill development | 2017 - 2018 |
| 6. | Health and Hygiene | M16UBTN01 | Skill development | 2017 - 2018 |
| 7. | Food and Nutrition | M16UBTN02 | Skill development | 2017 - 2018 |
| 8. | Applied Biotechnology | 16UBTN03 | Skill development | 2017 - 2018 |
| 9. | Agricultural Biotechnology | M16UBTN04 | Entrepreneurship | 2017 - 2018 |
| 10. | Nursery and gardening | M16UBTE03 | Entrepreneurship | 2018 - 2019 |
| 11. | Immunology | M16UBT05 | Skill development | 2018 - 2019 |
| 12. | Industrial Biotechnology and IPR | M16UBTS04 | Employability | 2018 - 2019 |
| 13. | rDNA Technology | M16UBT06 | Skill development | 2018 - 2019 |
| 14. | Bioprocess Technology | M16UBT07 | Skill development | 2018 - 2019 |
| 15. | Environmental Biotechnology | M16UBT09 | Skill development | 2018 - 2019 |
| 16. | Herbal Technology | M16UBTE04 | Skill development | 2018 - 2019 |

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| S.No. | Name of the Course | Course Code | Employability/ Entrepreneurship/ Skill development | Year of introduction (during the last five years) |
|---|---|---|---|---|
| 17. | Food Biotechnology | M16UBTE05 | Employability | 2018 – 2019 |
| 18. | Pharmaceutical Biotechnology | M16UBTE07 | Skill development | 2018 - 2019 |
| 19. | Bio fertilizer Technology | M16UBTE08 | Employability | 2018 - 2019 |
| 20. | Nano Biotechnology | M16UBTS05 | Skill development | 2018 - 2019 |

**Head of the Department**

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**Principal**

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## BACHELOR OF SCIENCE

## CHOICE BASED CREDIT SYSTEM

## SYLLABUS FOR B.Sc. BIOTECHNOLOGY

**For the students admitted from the Academic Year 2016-2017 onwards**

PRINCIPAL
MAHENDRA ARTS & SCIENCE COLLEGE
(Autonomous)
Kalippatti (PO) - 637 501, Namakkal (DT)

## REGULATIONS

### 1. Objectives of the course:

- To learn the applications of biological agents to provide goods and services for human community by materials processing.
- To equip the practical skills of molecular and genome based techniques.
- To gain knowledge on frontier areas of Biotechnology.
- To understand the impact of Biotechnology on basic human needs such as Agriculture, Industry, Medicine, Environment etc.
- To enrich the knowledge of students on current scenario in Biotechnology

### 2. Eligibility for Admission:

Candidates seeking admission to the first year Degree course shall be required to have passed PUC/12th Std. / 10+2/ its equivalent with at least Biology and Chemistry as two optional subjects.

### 3. Duration of the course:

The duration of the course is THREE academic years divided into six semesters under Chiose Based Credit System.

### 4. Features of CBCS:

Under Choice Based Credit System (CBCS), a set of papers consisting of Core papers, Elective papers, Skill based elective papers and Non-major elective papers are offered. Beside the Core Papers, which are totally related to the major subject, the students have the advantage of studying supportive papers and non-major papers. This provides enough opportunity to the students to learn not only the major subject but also inter disciplinary and application oriented subjects.

### 5. Credits:

In CBCS, each paper is assigned with a certain number of Credits depending upon the workload of the students. The total Credits to be earned by a student to qualify for the degree is above 140. The credit of the paper is fixed by giving due weightage to the syllabus content and contact hours per week.

### 6. Evaluation Procedure:

Evaluation is based on Continuous Internal Assessment **(CIA)** test and University Examination. Distribution of marks as follows

**THEORY**

| University examination (UE) | Internal Assessment (IA) |
|---|---|
| 75 marks | 25 marks |

**PRACTICAL**

| University examination (UE) | Internal Assessment (IA) |
|---|---|
| 60 marks | 40 marks |

**7. Question Paper Pattern**

**THEORY**

**Time: 3 Hours** **Max. Marks: 75**

**SECTION – A**

(Answer ALL Questions) (10 x 2= 20marks)

All Question Carry equal marks-2 questions from each unit

**SECTION – B**

Answer ALL Questions: (5x 5 = 25marks)

(Internal Choice)

All Questions carry equal marks-2 questions from each unit.

**SECTION – C**

Answer any THREE out of five (3X10=30 marks)

1 question from each unit

All units in the syllabus should be given equal weightage

**PRACTICAL**

| | |
|---|---|
| Time: 6 Hours | Maximum Marks: 60 |
| Major Practical | 20 Marks |
| Minor Practical | 10 Marks |
| Spotters | 5 x 4 = 20 Marks |
| Record | 5 Marks |
| Viva-voce | 5 Marks |

**MAHENDRA ARTS AND SCIENCE COLLEGE**
**(Autonomous)**
**DEPARTMENT OF BIOTECHNOLOGY**
**B.Sc., Biotechnology – Course Structure (CBCS Pattern- 2016-2017 Onwards)**

| Part | Sem. | Paper Code | Title of the Paper | Credits | Lecture Hrs/Wk | Int. Marks | Ext. Marks |
|---|---|---|---|---|---|---|---|
| Part -I | I | M16UFTA01 | Tamil –I | 3 | 5 | 25 | 75 |
| Part –II | | M16UFEN01 | English -I | 3 | 5 | 25 | 75 |
| Part –III Core -I | | M16UBT01 | Major -Cell Biology | 5 | 6 | 25 | 75 |
| Part –III Allied –I | | M16UBCA01 | Allied Biochemistry – I | 4 | 6 | 25 | 75 |
| Part –III Core Practical-I | | M16UBTP01 | Lab in Cell biology and Plant biology | - | 3 | - | - |
| Part –III Allied Practical–I | | M16UBCAP01 | Lab in Biochemistry | - | 3 | - | - |
| Part –IV Value Education | | M16UVE01 | Manavalakalai – Yoga | 2 | 2 | 25 | 75 |
| | | | | **17** | | | |
| Part -I | II | M16UFTA02 | Tamil –II | 3 | 5 | 25 | 75 |
| Part –II | | M16UFEN02 | English –II | 3 | 5 | 25 | 75 |
| Part –III Core -II | | M16UBT02 | Major –Plant Biology | 5 | 5 | 25 | 75 |
| Part –III Allied –II | | M16UBCA02 | Allied -Biochemistry –II | 4 | 5 | 25 | 75 |
| Part –IV SBEC –I | | M16UBTS01 | Computer applications in Biology | 2 | 2 | 25 | 75 |
| Value Education | | M16UES01 | Environmental Studies | 2 | 2 | 25 | 75 |
| Part –III Core Practical-I | | M16UBTP01 | Lab in Cell biology and Plant biology | 3 | 3 | 40 | 60 |
| Part –III Allied Practical–I | | M16UBCAP01 | Lab in Biochemistry | 3 | 3 | 40 | 60 |
| | | | | **25** | | | |
| Part –I | III | M16UFTA03 | Tamil –III | 3 | 5 | 25 | 75 |
| Part –II | | M16UFEN03 | English –III | 3 | 5 | 25 | 75 |
| Part –III Core –III | | M16UBT03 | Major -Animal Biology | 5 | 5 | 25 | 75 |
| Part –III Allied –III | | M16UMBA01 | Allied – Basic Microbiology | 4 | 5 | 25 | 75 |
| Part –IV SBEC-II | | M16UBTS02 | Biophysics and Bioinstrumentation | 2 | 2 | 25 | 75 |
| Part –IV NMEC | | | NMEC | 2 | 2 | 25 | 75 |
| Part –III Core Practical-II | | M16UBTP02 | Lab in Animal biology, Genetics and Molecular biology | - | 3 | - | - |

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|---|---|---|---|---|---|---|---|
| Part –III Allied Practical–II | | M16UMBAP01 | Lab in Microbiology | - | 3 | - | |
| | | | | **19** | | | |
| Part –I | **IV** | M16UFTA04 | Tamil –IV | 3 | 5 | 25 | 75 |
| Part –II | | M16UFEN04 | English –IV | 3 | 5 | 25 | 75 |
| Part –III Core -IV | | M16UBT04 | Major –Genetics and Molecular Biology | 5 | 5 | 25 | 75 |
| Part –III Allied –IV | | M16UMBA02 | Allied – Applied Microbiology | 4 | 5 | 25 | 75 |
| Part –IV SBEC -III | | M16UBTS03 | Bioinformatics | 2 | 2 | 25 | 75 |
| Part –IV NMEC | | | NMEC | 2 | 2 | 25 | 75 |
| Part –III Core Practical-II | | M16UBTP02 | Lab in Animal biology, Genetics and Molecular biology | 3 | 3 | 40 | 60 |
| Part –III Allied Practical–II | | M16UMBAP01 | Lab in Microbiology | 3 | 3 | 40 | 60 |
| | | | | **25** | | | |
| Part –III Core –V | **V** | M16UBT05 | Immunology | 5 | 5 | 25 | 75 |
| Part –III Core -VI | | M16UBT06 | rDNA Technology | 5 | 5 | 25 | 75 |
| Part –III Core -VII | | M16UBT07 | Industrial Biotechnology and IPR Technology | 5 | 5 | 25 | 75 |
| Elective I | | | Elective | 4 | 5 | 25 | 75 |
| Part –IV SBEC -V | | M16UBTS04 | Industrial Biotechnology and IPR | 2 | 4 | 25 | 75 |
| Part –III Core Practical-III | | M16UBTP03 | Lab in Immunology & rDNA Technology | 3 | 3 | 40 | 60 |
| Part –III Core Practical-IV | | M16UBTP04 | Lab in Bioprocess Technology | 3 | 3 | 40 | 60 |
| | | | | **27** | | | |
| Part –III Core –VIII | **VI** | M16UBT08 | Plant & Animal Biotechnology | 5 | 5 | 25 | 75 |
| Part –III Core -IX | | M16UBT09 | Environmental Biotechnology | 5 | 5 | 25 | 75 |
| Elective II | | | Elective | 4 | 5 | 25 | 75 |
| Part –IV SBEC -VI | | M16UBTS05 | Nano-biotechnology | 2 | 2 | 25 | 75 |
| Part –III Core Practical-V | | M16UBTP05 | Lab in Plant & Animal Biotechnology | 3 | 4 | 40 | 60 |
| Part –III Core Practical-VI | | M16UBTP06 | Lab in Environmental Biotechnology | 3 | 4 | 40 | 60 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Project | | M16UBTPR1 | Project | 5 | 5 | 40 | 60 |
| Extension activities | | M16UEX01 | Extension activities | 1 | 0 | 0 | 100 |
| | | | | **28** | | | |
| | | | **Total Credits** | **141** | | | |

**List of Non Major Elective Courses offered by the Department**

| SEM | Paper Code | Title of the Paper | Credits | Marks | | |
|---|---|---|---|---|---|---|
| | | | | Lecture Hrs/Wk | Int. Marks | Ext. Marks |
| III | M16UBTN01 | Health and Hygiene | 2 | 4 | 25 | 75 |
| | M16UBTN02 | Food and Nutrition | 2 | 4 | 25 | 75 |
| IV | M16UBTN03 | Applied Biotechnology | 2 | 4 | 25 | 75 |
| | M16UBTN04 | Agricultural Biotechnology | 2 | 4 | 25 | 75 |

**List of Elective Papers offered by the Department**

| SEM | Paper Code | Title of the Paper | Credits | Marks | | |
|---|---|---|---|---|---|---|
| | | | | Lecture Hrs/Wk | Int. Marks | Ext. Marks |
| V | M16UBTE01 | Bioethics & Bio-safety | 4 | 4 | 25 | 75 |
| | M16UBTE02 | Developmental Biology | 4 | 4 | 25 | 75 |
| | M16UBTE03 | Nursery and gardening | 4 | 4 | 25 | 75 |
| | M16UBTE04 | Herbal Technology | 4 | 4 | 25 | 75 |
| VI | M16UBTE05 | Food Biotechnology | 4 | 4 | 25 | 75 |
| | M16UBTE06 | Microbial Disease and Control | 4 | 4 | 25 | 75 |
| | M16UBTE07 | Pharmaceutical Biotechnology | 4 | 4 | 25 | 75 |
| | M16UBTE08 | Biofertilizer Technology | 4 | 4 | 25 | 75 |

## SEMESTER - I

| Part | Paper Code | Title of the Paper | Credits | Lecture Hrs/Wk | Int. Marks | Ext. Marks |
|---|---|---|---|---|---|---|
| Part -I | M16UFTA01 | Tamil –I | 3 | 5 | 25 | 75 |
| Part –II | M16UFEN01 | English -I | 3 | 5 | 25 | 75 |
| Part –III Core -I | M16UBT01 | Major -Cell Biology | 5 | 6 | 25 | 75 |
| Part –III Allied –I | M16UBCA01 | Allied Biochemistry – I | 4 | 6 | 25 | 75 |
| Part –III Core Practical-I | M16UBTP01 | Lab in Cell biology and Plant biology | - | 3 | - | - |
| Part –III Allied Practical–I | M16UBCAP01 | Lab in Biochemistry | - | 3 | - | - |
| Part –IV Value Education | M16UVE01 | Manavalakalai – Yoga | 2 | 2 | 25 | 75 |
| | | | **17** | | | |

## CELL BIOLOGY - M16UBT01

**UNIT I**

Cell as a Basic unit; Classification of cell types; Cell theory; Organization of plant and animals cells; Structural comparison of Microbial, Plant and Animal cells.

**UNIT II**

Ultra-structure of cells; Sub cellular Organization; structure and function of Cell wall, cell membrane, Cytosol Endoplasmic reticulum and Chloroplast, vacuoles, Peroxisomes, lyzosome.

**UNIT III**

Chromosomes and cell division: Morphology, Structural organization, ultra Structure of chromosome, specialized chromosomes. Cell cycle, Mitosis, Meiosis, Cellular senescence and applications.

**UNIT IV**

Specialized cells: Motile cells (amoeboid, ciliary, flagellar movements), nerve Cells and nerve impulse conduction, muscle cells and muscle contraction.

**UNIT V**

Cell-Cell adhesion, Cell signaling- types- G Protein receptors, Cell membrane traffic, Histological techniques- Sectioning, Embedding and Mounting

**REFERENCES**


1. A Text Book of Cell Biology- Aminul Islam. Books and Allied (P) Ltd, Kolkatta. First edition.2011.
2. Cell Biology- Powar.C.B, Himalaya publishing house, New Delhi.1983.
3. Cell Biology - - DeRoberties, Blaze publishers & Distributors Pvt.Ltd., NewDelhi.
4. Fundamentals of Cytology – Sharp, Mc Graw Hill Company.
5. Cytology – Wilson & Marrison, reinform Publications.
6. Cell and Molecular biology concepts and experiments- Gerald Karp; 4 the Edition.

## ALLIED - I - BIOCHEMISTRY - I - M16UBCA01

**UNIT-I**

Carbohydrates - Introduction, classification, monosaccharide-structure, stereoisomers and structural isomers, mutarotation, and chemical reactions. Oligosaccharides-Dissaccharides-structure and importance of sucrose, Lactose, maltose, .Polysaccharides-structure and importance of homopolysaccharides and heteropolysaccharides.

**UNIT-II**

Amino acids - Classification, Essential & Non- essential amino acids, structure andproperties. Protein: Definition, classification and functions – structural levels of organization **UNIT-III**

Enzymes – Definition, classification with example, active site, lock and key model, induced fit hypothesis. Enzyme units – kinetics- factors affecting enzyme activity,

**UNIT -IV**

Lipids - **C**lassification, physical & Chemical properties, saturated and unsaturated fatty acids , Structure of cell membrane & transport.

**UNIT-V**

Vitamins - Classification, occurrence, deficiency symptoms, biochemical functions of fat soluble and water soluble Vitamins.

**REFERENCES**


1. Lehninger's Principles of Biochemistry (2000) by Nelson, David l. and Cox, M.M. Macmillan/ worth,.NY
2. Fundamentals Of Biochemistry (1999) by Donald Voet, Judith G.Voet and Charlotte W Pratt, John Wiley & Sons, NY
3. Biochemistry 3rd (1994) by Lubert stryer, W H freeman and co, Sanfrancisco.
4. Biochemistry 4th edition (1988) by Zubay G L , W M C Brown Publishers.
5. Principles of Biochemistry (1994) Garrette & Grisham, Saunders college publishing.
6. Outlines of Biochemistry (1987) by Eric E.Conn, P.K. Stumpf, G.Brueins and Ray H.Doi, John Wiley & Sons, NY
7. Text book of biochemistry (1997) 4th edition Thomas M devlin, A John Wiley, Inc publication, New york.

## SEMESTER - II

| Part | Paper Code | Title of the Paper | Credits | Lecture Hrs/Wk | Int. Marks | Ext. Marks |
|---|---|---|---|---|---|---|
| Part -I | M16UFTA02 | Tamil –II | 3 | 5 | 25 | 75 |
| Part –II | M16UFEN02 | English –II | 3 | 5 | 25 | 75 |
| Part –III Core -II | M16UBT02 | Major –Plant Biology | 5 | 5 | 25 | 75 |
| Part –III Allied –II | M16UBCA02 | Allied -Biochemistry –II | 4 | 5 | 25 | 75 |
| Part –IV SBEC –I | M16UBTS01 | Computer applications in Biology | 2 | 2 | 25 | 75 |
| Value Education | M16UES01 | Environmental Studies | 2 | 2 | 25 | 75 |
| Part –III Core Practical-I | M16UBTP01 | Lab in Cell biology and Plant biology | 3 | 3 | 40 | 60 |
| Part –III Allied Practical–I | M16UBCAP01 | Lab in Biochemistry | 3 | 3 | 40 | 60 |
| | | | **25** | | | |

## PLANT BIOLOGY - M16UBT02

**UNIT I**

Classifications : Artificial - Natural – Phylogenetic. Biosystematics : Two Kingdom and Five Kingdom System of classification. General outlines of Bentham and Hooker's classification- Study of the range, character and economic importance of following families: Anonaceae, Fabaceae, Apocynaceae, Euphorbiaceae and Musaceae.

**UNIT II**

Structure and modifications of Root, Stem and Leaf, Phyllotaxy - Structure and types of Inflorescences - Structure and types of flowers, fruits and seeds

**UNIT III**

Tissue and tissue systems – Meristem: types of meristem- Shoot and root apical meristem - anatomy of monocot and dicot roots – anatomy of monocot and dicot stems - anatomy of monocot and dicot leaves.

**UNIT IV**

Absorption of Water and movement - Diffusion, Osmosis, Plasmolysis, Mechanism of Stomatal opening and closing. Photosynthesis – significance–electron transport system – cyclic and non-cyclic photophosphorylation – C3 and C4 pathways. Respiration – mechanism of glycolysis – Krebs cycle – pentose phosphate pathway.

**UNIT V**

Modes of Reproduction in Angiosperms - Vegetative propagation - Micropropagation - Sexual Reproduction: Structure of mature anther, Structure of mature Ovule and its types Pollination : types – Double fertilization - Development of male and female gametophytes - Development of Dicot Embryo.

**REFERENCES**


1. Pandey, S.N. 1991 – Plant Physiology, Tata McGraw Hill Publishers (P) Ltd., New Delhi.
2. Verma, V., 1991-A Text Book of Plant Physiology, Emkay Publications, NewDelhi.
3. Sivarajan, V.V (1993) – Introduction to Principles of Plant Taxonomy, Oxford & IBH Publishing Co., New Delhi.
4. Sen, S. (1992) – Economic Botany, New Central Book Agency,Calcutta.
5. Earnes, A.J. 1936. Morphology of Lower Vascular Plants. Tata McGraw Hill Publishing Co., New Delhi
6. Esau, K. 1960. Plant Anatomy, Wiley Eastern Private Limited. New Delhi.

## ALLIED - II-BIOCHEMISTRY - II - M16UBCA02

**UNIT I**

Concept of acids and bases. Buffers -Definition and determination of pH, Henderson Hasselbach Equation. Bioenergetics- Laws of Thermodynamics, Redox potential, Respiratory chain, Oxidative phosphorylation (Theories and Mechanism).

**UNIT II**

Carbohydrate metabolism -Glycolysis, Pyruvate Oxidation and Citric acid cycle HMP shunt, Gluconeogenesis, Glycogenesis, Glycogenolysis.

**UNIT III**

Protein metabolism -Transamination, oxidative and non-oxidative deamination, decarboxylation - urea cycle.

**UNIT IV**

Lipid metabolism- Biosynthesis of fatty acids and Oxidation of fatty acids (alpha,beta and omega oxidation). Cholesterol Biosynthesis.

**UNIT V**

Hormones – Definition, Classification of Hormones, Pituitary Hormones (TSH, ACTH, FSH, LH, GH) and Hypothalamic Hormones (TRF, CRF, GnRH, GHRH).Biological function and disorders of Hormones - Insulin, thyroxine, adrenaline and nor-adrenaline.

**REFERENCES**


1. Fundamentals of Biochemistry, J.L. Jain, S.Chand publications, 2004.
2. Harper's Biochemistry Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, 24th edition, Prentice Hall International. Inc.
3. Fundamentals of Biochemistry (1999) by Donald Voet, Judith G.Voet and Charlotte W Pratt, John Wiley & Sons, NY.
4. Biochemistry 3rd (1994) by lubert stryer, W H freeman and co, Sanfrancisco.
5. Text book of biochemistry (1997) 4th edition Thomas M devlin, A John Wiley, In.
6. Principles of Biochemistry (1994) Garrette & Grisham, Saunders college.
7. Essentials of Biochemistry Sathyanarayanan.U. Books and allied (p) Ltd, 2002 publishing

## SBEC - I- COMPUTER APPLICATIONS IN BIOLOGY - M16UBTS01

**UNIT I**

Introduction to computer: introduction, types of computer; characteristic to computer, generations of computer, classification of computer, programming languages, machine languages, assembly languages, high level languages, input device s, keyboard, mouse, types containing output devices, documentary printer, inject printer, lasser printer, LCD and LED storage devices, ROM, RAM, hard disk. CD, DVD, Primary memory.

**UNIT II**

Overview Of C- History of C-importance of C, basic structure of C program, contents, variables and data types, character set, Keyboard and identifiers, constants, variables, declaration of storage class, operators and expressions: evaluation of expressions- types of conversion in expressions, operators, -associative mathematical functions- managing input and output operations: reading and writing a character- formatted input and output.

**UNIT-III**

Decision making and branching: simple IF-IFELSE, Nesting statements, GO TO statement, Decision making and looping; WHILE statements, DO statements, FOR statement –junks in loops. Array: definition and declarations0 types: one, two, multi and dynamic array.

**UNIT VI**

Character array and string; introduction, declaring strings, OOPS, user defined function- definition of function, written values and their types, function class, Function declaration, all caterogry of functions, nesting of function. Structure and union, introduction accessing structure members, structure initialization, array of structure, array within structure unions.

**UNIT-V**

Scope and applications of Bioinformatics, Internet basic, biological data base and analysis, Applications of sequence analysis.

**REFERENCES**


1. Fundamentals of computer science and communications engineering by Alex Lean and Mathew Lean
2. Programming in ANSCI C by E.Balagurusamy.
3. Introduction to Bioinformatics by S.Ignacimuthu.

## ENVIRONMENTAL STUDIES -M16UES01

**UNIT I**

Environment – definition – scope – structure and function of ecosystems- producers, consumers and decomposers- energy flow in the ecosystem - ecological succession – food chain, food webs and ecological pyramids – concept of sustainable development.

**UNIT II**

Natural resources: renewable - air, water, soil, land and wildlife resources. Non – renewable – mineral coal ,oil and gas. Environmental problems related to the extraction and use of natural resources.

**UNIT III**

Biodiversity – definition – values – consumption use, productive social, ethical, aesthetic and option values threats to bio diversity – hotspots of bio diver sity – conservation of bio - diversity: in – situ ex – situ. Bio – wealth - national and global level .

**UNIT IV**

Environmental Pollution: definition – causes, effects and mitigation measures – air pollution, water pollution, soil pollution noise pollution, thermal pollution – nuclear hazards – solid wastes, acid rain – climate change and global warming environmental laws and regulations in india.

**UNIT V**

Social Issues and the Environment - urban problems related to energy. water conservation, rain water harvesting, watershed management, wasteland reclamation, Environment Protection Act- Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act, wildlife Protection Act, forest Conservation Act.

**REFERENCES**


1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad - 380013, India, Email: mapin@icenet. net (R).
3. Environmental Studies For Undergraduate Courses Erach Bharucha
4. Down to Earth, Centre for Science and Environment (R).
5. Environmental studies by Anilkumar .D.E. Newvage Internationational.
6. Environmental Biology by Phatia.A.L. Ramesh Publisher.
7. Environmental Problems and solution by Arthana.D.K. Vanathy Publisher. Environment its important and the imperative by Sivam varatharajan. Pratheeba publication.

## PRACTICAL - I - LAB IN CELL BIOLOGY AND PLANT BIOLOGY – M16UBTP01

### CELL BIOLOGY

1. Microscopes and its parts
2. Micrometry - Stage and Ocular Micrometer.
3. Cell Counting - Haemocytometer
4. Mounting buccal epithelium and observing living cells using vital staining.
5. Mitosis in Onion root tip squash
6. Meiosis in grasshopper testis squash
7. Chironomous - Salivary gland Chromosome squash preparation
8. Staining of macro molecules- Carbohydrates and Lipids..
9. Observation o slides (Cardiac muscle, Sperm cell, Muscle cell).
10. Staining of Mitochondria in Yeast using Janus green.
11. Microtomy (Demo)

### PLANT BIOLOGY

1. Description of plant family - Anonaceae, Fabaceae, Apocynaceae, Euphorbiaceae & Musaceae
2. Observation of plant Morphology
3. Primary T.S of Monocot and Dicot stem, root, leaf
4. Osmosis, Plasmolysis and Photosynthesis by $O_2$ evolution
5. Dissection of embryo.

## ALLIED PRACTICAL – I - LAB IN BIOCHEMISTRY - M16UBCAP01

1. Qualitative analysis of carbohydrates
2. Qualitative analysis of amino acids
3. Preparation and estimation of starch from potato
4. Preparation of casein from milk
5. Separation of sugar by paper chromatography
6. Separation of amino acid by paper chromatography
7. Separation of lipid by thin layer chromatography
8. Estimation of amino acid by formal titration method
9. Estimation of ascorbic acid by 2,6 Dichloro phenol Indophenol method
10. Estimation of reducing sugar by DNS method
11. Estimation of protein by Biuret method
12. Estimation of cholesterol by Zak's method

## SEMESTER - III

| Part | Paper Code | Title of the Paper | Credits | Lecture Hrs/Wk | Int. Marks | Ext. Marks |
|---|---|---|---|---|---|---|
| Part –I | M16UFTA03 | Tamil –III | 3 | 5 | 25 | 75 |
| Part –II | M16UFEN03 | English –III | 3 | 5 | 25 | 75 |
| Part –III Core –III | M16UBT03 | Major -Animal Biology | 5 | 5 | 25 | 75 |
| Part –III Allied –III | M16UMBA01 | Allied – Basic Microbiology | 4 | 5 | 25 | 75 |
| Part –IV SBEC-II | M16UBTS02 | Applied Microbiology II and Bioinstrumentation | 2 | 2 | 25 | 75 |
| Part –IV NMEC | | NMEC | 2 | 2 | 25 | 75 |
| Part –III Core Practical-II | M16UBTP02 | Lab in Animal biology, Genetics and Molecular biology | - | 3 | - | - |
| Part –III Allied Practical–II | M16UMBAP01 | Lab in Microbiology | - | 3 | - | |
| | | | **19** | | | |

## ANIMAL BIOLOGY - M16UBT03

**UNIT I**

Classification: concept of species; binomial nomenclature; Salient features, classification and detailed study of non-chordates and chordates up to class level.

**UNIT II**

Animal tissue - epithelium (covering), connective (support), muscle (movement), nervous (control).

**UNIT III**

Anatomy and physiology of different systems - digestive, circulatory, respiratory, endocrine and excretory system of human beings.

**UNIT IV**

Modes of reproduction-Asexual and sexual reproduction; Modes-Binary fission, sporulation, budding, gemmule, fragmentation. Gametogenesis-spermatogenesis & oogenesis; Menstrual cycle; Fertilization, Post–fertilization changes.

**UNIT V**

Concept of biodiversity; patterns of biodiversity; importance of biodiversity; loss of biodiversity; biodiversity conservation; hotspots, endangered organisms, extinction, biosphere reserves, national parks and sanctuaries.

**REFERENCES**


1. Kotpal R.L (2003) Modern text book of Zoology- Rostogi Publications, Meerut.
2. Agarwal V.K (2000) Invertebrate Zoology- S.Chand Company.
3. Ekambaranatha Iyer (1993) Manual of Zoology Vol.II, Viswanathan (printers& publishers) Chennai.
4. Jordon, E.L & Verma, P.S. (2000) Chordate Zoology, S.Chand & Co, New Delhi
5. Hoar, W.S (1987) General and Comparative physiology, prentice – Hall.
6. R.C.Dubey (1998).A Text book of Biotechnology ,S.Chand& co Ltd New Delhi .

## ALLIED- BASIC MICROBIOLOGY - M16UMBA01

**UNIT - I**

Development of microbiology as a discipline. Spontaneous generation *vs*. biogenesis. Development of various microbiological techniques. Concept of fermentation. Establishment of fields of medical microbiology, immunology and environmental microbiology with special reference to the work of following scientists: Anton von Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch, Beijerinck, Sergei N. Winogradsky, Alexander Fleming, Selman A. Waksman, Elie Metchnikoff.

**UNIT – II**

Classification of Microbes - Systems of classification, Numerical taxonomy, Systematic classification of bacteria - Bergey's Manual of Systematic Bacteriology (up to section level), Classification of bacteria on the basis of Nutritional types, Oxygen requirement. General characteristics of Archaebacteria, Rickettsias, Mycoplasmas, Cyanobacteria and Actinomycetes.

**UNIT - III**

History of phycology with emphasis on contributions of Indian scientists. General characteristics of algae including occurrence, thallus organization, algae cell ultra-structure, pigments, flagella, eyespot, food reserves and vegetative, asexual and sexual reproduction. Different types of life cycles in algae: Haplobiontic, Haplontic, Diplontic, Diplobiontic and Diplohaplontic life cycles. Detailed life cycle of *Chlamydomonas* and *Spirogyra*.

**UNIT - IV**

Historical developments in the field of Mycology including significant contributions of eminent mycologists. General characteristics of fungi including habitat, distribution, nutritional requirements. Fungal cell ultra-structure, thallus organization and aggregation. Fungal wall structure and synthesis. Sexual and asexual reproduction. Heterokaryosis, heterothallism and parasexual mechanism. Detailed life cycle of *Aspergillus* and *Rhizopus*.

**UNIT - V**

Protozoa: General characteristics with special reference to *Amoeba, Paramecium* and *Giardia* Viruses, viroids and prions: A general introduction with special reference to the structure of the following: TMV, poliovirus, T4 and λphage, lytic and lysogenic cycles, one step multiplication curve.

**REFERENCES**


1. Tortora, G.J., Funke, B.R. and Case, C.L. **2012.** Microbiology - An Introduction. 11th *Edition.* Pearson Education.
2. Stainer, Ingharam, Wheelis and Painter. 1987. General Microbiology. 5th Edition. Macmillan Education, London.
3. A.J. Salle. 1974. Fundamental Principles of Bacteriology. Tata McGraw – Hill Edition.
4. AH Rose. 1977. Chemical Microbiology – An introduction to microbial physiology. Butterworth, London.
5. S. Meenakumari. 2006. Microbial Physiology. MJP Publishers.
6. MT Madigan, JM Martinko and Jack Parker. Brock Biology of Microorganisms. 10th Edition. Pearson and Education Inc., New Jersey.
7. David Freifelder, David M. Freifelder and John E. Cronan. 1994. Microbial genetics. 2nd Edition. Jones & Bartlett Publishers.
8. R.W. Old and S.B. Primrose. 1985. Principles of gene manipulation. Blackwell Scientific Publications.
9. Benjamin Lewin. 2006. Genes IX. 9th Edition. Jones and Bartlett publishers.
10. R.A. Atlas. 1998. Microbiology, Fundamental and Applications. 2nd Edition. McMillan Publishers.
11. Powar and Daginawala. 2010. General Microbiology. Volume – I. Himalaya Publishing House.
12. Prescott, Harley, Klein. 2003. Microbiology. 5th Edition. McGraw Hill Publ.
13. Bernard R. Glick & Jack J. Pasternak. 2002. Molecular Biotechnology. Indian edition. Panima Publishing Corporation.
14. Pelzer, Chan and Kreig. 1986. Microbiology. 5th Edition. McGraw-Hill.

## BIOPHYSICS AND BIO-INSTRUMENTATION - M16UBTS02

**UNIT –I**

Nature of chemical bond, Bonds in biological system. Laws of thermodynamics and concept of free energy, Biophysics of Water, Mole concept, Molarity & Normality

**UNIT – II**

Microscopes- Principles, applications and types. Spectroscopy – Beer-Lamberts law, Colorimetry, UV-Visible spectrophotometer (Single beam and double beam), IR spectrophotometer, Atomic Absorption spectrophotometer. Flame photometer.

**UNIT –III**

Centrifugation – Principle, preparation and analytical centrifugation, differential centrifugation, density gradient centrifugation – Rate zonal and Isopycnic. Chromatography – Principle, gas liquid chromatography, HPLC, Ion exchange chromatography, affinity chromatography and gel permeation chromatography.

**UNIT – IV**

Electrophoresis – Agarose gel electrophoresis, SDS-PAGE, 2D gel electrophoresis, X-ray crystallography, Auto radiography.

**UNIT – V**

Methods of Imaging – X-ray, CT Scan, ECG, EEG, Concept of Radioactivity, methods for measuring radioactivity – GM counter, Scintillation counter (Liquid and solid)

**REFERENCES**


1. General Biophysics, vol. I & II – H.V. Volkones.
2. David Freifelder, David M. Freifelder and John E. Cronan. 1994. Microbial genetics. 2nd Edition. Jones & Bartlett Publishers.
3. Bioseparations. B.Sivasankar. First edition. 2010. PHI Learning Pvt Ltd, New Delhi
4. Biophysical chemistry – Upadhyay, Himalaya Publication,edition 3, 2005.
5. Biophysics - S. Mahesh (2003), New Age International (P), Ltd.
6. Techniques and methods in Biology. K.L Ghatak. 2001. First edition. PHI Learning Private Limited, New Delhi.

## NMEC- APPLIED STATISTICS - M16USTN01

**UNIT I**

Bio-statistics - definition - types of data – Diagrammatic and Graphical Representation- Sources of data in life science - Uses of statistics.

**UNIT II**

Measures of Central Tendency - Mean, Median, Mode, - Merits and Demerits.

**UNIT III**

Measures of dispersion - Range, Standard deviation, Quartile deviation, Merits and demerits, coefficient of variations

**UNIT IV**

Correlation - Types and methods of correlation, Rank - Correlation,

**UNIT V**

Regression, Simple regression equation, fitting, Prediction.

**REFERENCES**


1. P.S.S. Sundar Rao, J. Richard (2012). An introduction to Biostatistics and
2. Reaserch methodology. Fifth Edition,Prentice Hall of India Learning Private Ltd, New Delhi. Price RS.275/-.
3. 2.Gurumani N (2005). An introduction to Biostatistics. 2nd Revised Edition,
4. MJP Publishers, Chennai. PriceRs.160/-.
5. Daniel WW, (1987). Biostatistics, John Wiley and Sons, New York.

## NMEC - I - HEALTH AND HYGIENE

**UNIT-I**

Health-definitions of health, dimensions of health, concept to fwellbeing, determinants of health, and ecology of health.

**UNIT-II**

Body weight and composition for Health and Sports – Ideal body weight, values and limitations of the BMI, composition of the body; Diet during training, dietary supplements for athletes.

**UNIT-III**

Exercise and Health related fitness-Health related fitness, physical activity for health benefits, types of exercise, effective weight control- dieting or exercise; weight reduction program for young athletes.

**UNIT-IV**

Hygiene-Meaning and importance; Hygienic practices of employees, personal hygiene and contamination of food products, methods of disease transmission.

**UNIT-V**

Drug Abuse and health laws – Hygiene of eating and drinking, Ventilation and lighting, Health laws for food safety and hygiene, International control of health, WHO, Health destroying habits and addictions - Pan, Ganja, Drinking, Smoking, Tea and Coffee.

**REFERENCES**


1. Marriott, G. Norman (1985). Principles of food sanitation. Van Nostrand Reinhold Company, New York.
2. K. Park (1997).Test book of preventive and social medicine. 15th edition, MIS Banarsidas Bhano Publishers, Jabalpur.
3. Melvin H. Williams (2005). Nutrition for Health, fitness and Sports. 7th edition, MC Graw Hill international Edition.
4. Michael J.GIbney, lan A Macdonald and Helen M.Roche (2008). Nutrition and MetabolismBlackwell Publishing company, Bangalore

## NMEC - I - FOOD AND NUTRITION

**UNIT-I**

Concept of Nutrition - Health, nutritional status and malnutrition. Carbohydrates - Definition, composition, functions, maintenance of blood sugar levels, requirement, sources, digestion and absorption; Dietary fiber-Definition, classification, physiological effects and sources.

**UNIT-II**

Proteins - Definition, composition, nutritional classification of proteins and amino acids, functions, sources, requirements, digestion and absorption. Lipids - Definition, composition, functions, sources, requirements, digestion and absorption. Essential fatty acids – Definition, functions, sources and effects of deficiency.

**UNIT-III**

Energy - Definition, units of measurement, direct and indirect calorimetry; Determination of energy value of food, Total Energy requirement, Factors affecting physical activity, Factors affecting Basal Metabolic Rate.

**UNIT-IV**

Nutritional elements: Functions, sources, requirements and effects of deficiency- Calcium, Phosphorous, Iron, Iodine, Copper, Fluorine, Zinc, Sodium and Potassium.

**UNIT-V**

Fat soluble Vitamins –Vitamin A, D, E and K: Functions, requirements, sources and effects of deficiency. Water soluble Vitamins – Thiamine, riboflavin, niacin, ascorbic acid, folic acid, vitamin B6 and vitamin B12: Functions, requirements, sources and effects of deficiency.

**REFERENCES**


1. Sumathi R. Mudambi, Rajagopal, M.V (1997). Fundamentals of Foods and Nutrition (3rd edition), New Age International (P) Ltd, Publishers.

2. Srilakshmi,B. (2016). Nutrition Science (5thedition), New Age International (P)Ltd, Publishers.

3. Mangala Kango (2005). Normal Nutrition, Curing diseases through diet (1stedition), CBS Publications.

4. Mahtab.S.Bamji, Kamala Krishnaswamy and G.N.V. Brahmam. (2009). Text Book of Human Nutrition Oxford and IBH Publishing Company.

## SEMESTER - IV

| Part | Paper Code | Title of the Paper | Credits | Lecture Hrs/Wk | Int. Marks | Ext. Marks |
|---|---|---|---|---|---|---|
| Part –I | M16UFTA04 | Tamil –IV | 3 | 5 | 25 | 75 |
| Part –II | M16UFEN04 | English –IV | 3 | 5 | 25 | 75 |
| Part –III Core -IV | M16UBT04 | Major –Genetics and Molecular Biology | 5 | 5 | 25 | 75 |
| Part –III Allied –IV | M16UMBA02 | Allied – Applied Microbiology | 4 | 5 | 25 | 75 |
| Part –IV SBEC -III | M16UBTS03 | Bioinformatics | 2 | 2 | 25 | 75 |
| Part –IV NMEC | | NMEC | 2 | 2 | 25 | 75 |
| Part –III Core Practical-II | M16UBTP02 | Lab in Animal biology, Genetics and Molecular biology | 3 | 3 | 40 | 60 |
| Part –III Allied Practical–II | M16UMBAP01 | Lab in Microbiology | 3 | 3 | 40 | 60 |
| | | | **25** | | | |

## GENETICS AND MOLECULAR BIOLOGY - M16UBT04

**UNIT I**

Mendelian laws of inheritance, Back cross and Test cross. Non-Mendelian inheritance; Chromosomal theory of inheritance. Cytoplasmic inheritance- Snail coiling, keppa particl in paramecium; Haemophilia, Color blindness.

**UNIT II**

Chromosome aberrations – Numeral and Structural aberrations. Albinism, Sickle Cell Anemia, Phenyl Ketonuria. Genome organization in Bacteria, Plant and Animal.

**UNIT III**

Structure, types and forms & functions of DNA and RNA. Central dogma of molecular Biology- DNA replication in prokaryotic and eukaryotic, DNA Repair, DNA recombination. Regulation of gene expression-lac and trp operons.

**UNIT IV**

Microbial genetics and Mutations: Conjugation, Transduction, Transformation. Mutations – Spontaneous and induced- chemical and Physical mutagens. Analysis of mutations in biochemical pathways, one gene – one enzyme hypothesis. One gene one polypeptide hypothesis.

**UNIT V**

Molecular biology of N2 fixation, nif gene rearrangement and N2 fixation in cyanophytes, nif gene transfer in Chloroplast. Agrobacterium and crown gall tumor formation. Molecular marker techniques - RFLP, RAPD, AFLP.

**REFERENCES**


1. Plant biochemistry and Molecular biology,Lea,P.J & Leegood;1993 John Wiley & sons.
2. Molecular genetics of Photosynthesis, Anderson,B Salter,H,1996., IRL press, Oxford.
3. Cell and Molecular Biology – Robertis *et al*.Waverly publication, edition 8, 1995.
4. Genetics – Strickberger, M.W.Printice hall,edition 4,1997.
5. Molecular Biology of the Cell – Alberts. Garland publication, edition 4, 2002.
6. Text Book of Cell and Molecular Biology - Ajay Paul. Books and Allied (P) Ltd, 2 edi. 2007.
7. Principles of Genetics – E.J.Gardener, M.J.Simmons and D.P.Snustad, John Wiley & Sons Publications.

## ALLIED- APPLIED MICROBIOLOGY II - M16UMBA02

**UNIT- I**

Sterilization- Physical and chemical. Growth of bacteria – multiplication – growth curve – Determination of growth. Culture techniques – Pure culture, anaerobic culture – preservation of cultures. Collection and transport of clinical specimens for microbiological examinations. Antimicrobial chemotherapy – Antibiotics – mode of actions

**UNIT -II**

Morphology, culture, biochemical, pathogenicity, laboratory diagnosis and prevention of bacterial diseases - *Staphylococcus aureus, Streptococcus pyogens, Mycobacterium tuberculosis, Corynebacterium diphtheriae, Clostridium tetani, Bacillus anthracis, Salmonella typhi, Vibrio cholerae, Escherichia coli, Pseudomonas aeruginosa*.

**UNIT –III**

Virology: Pox viruses – Variola, Vaccinia. Herpes viruses — Hepatitis Viruses. Picorna Viruses - Polio. Orthomyxo Virus – Influenza. Retro Virus – HIV. Parasitology:, Malaria parasite - Plasmodium species. Mycology: Morphological features of fungi - isolation, identification and diagnosis of fungi from clinical specimens. Superficial mycosis- Taenia nigra - Cutaneous mycosis Dermatophytosis. Subcutaneous mycosis- Sporotrichosi,. Systemic mycosis –Histoplasmosis. Opportunistic mycosis - Candidiasis, - Aspergillosis. Antifungal agents – Sensitivity tests - Mycotoxins.

**UNIT –IV**

Microorganisms of environment (soil, water and air). Microbial interactions – mutualism, commensalism, antagonism, competition, parasitism, predation. Microbiology of air. Microbes in air. Methods of purification of air. Air borne diseases.

**UNIT –V**

Microbiology of water – Potability of water quality – Indicator organisms – water purification – waterborne diseases and their control measures. Microbiology of sewage – chemical and biochemical characteristics of sewage – BOD & COD – Sewage treatment – Physical, chemical and biological (trickling filter, activated sludge and oxidation pond) treatment.

**REFERENCES**


1. AH Rose. 1976. Chemical Microbiology – An introduction to microbial physiology – Butterworth, London.
2. MT Madigan, JM Martinko & Jack Parker. 2002. Brock Biology of Microorganisms – 10th Edition – Pearson and Education Inc., New Jersey.
3. Prescott, Harley, Klein. 2003. Microbiology. 5th Edition. McGraw Hill Publ.
4. Bernard R. Glick & Jack J. Pasternak. 2002. Molecular Biotechnology. Indian edition. Panima Publishing Corporation.
5. Pelzer, Chan and Kreig. 1986. Microbiology. 5th Edition. McGraw-Hill.
6. S. Meenakumari. 2009. Microbial Physiology. MJP Publishers.

## BIOINFORMATICS - M16UBTS03

**UNIT -I**

Important contributions - sequencing development - aims and tasks of Bioinformatics - applications of Bioinformatics - challenges and opportunities - Computers and programs – internet - world wide web – browsers - EMB net – NCBI.

**UNIT- II**

Importance of databases - nucleic acid sequence databases - protein sequence data bases - structure databases - bibliographic databases and virtual library - specialized analysis packages

**UNIT -III**

Sequence analysis of biological data- models for sequence analysis and their biological motivation- methods of alignment - methods for optimal alignments; using gap penalties and scoring matrices- multiple sequence alignment – introduction - tools for MSA - application of multiple sequence alignment.

**UNIT- IV**

Gene predictions strategies - protein prediction strategies - molecular visualization- Homology - phylogeny and evolutionary trees - Homology and similarity - phylogeny and relationships.

**UNIT -V**

Discovering a drug - target identification and validation - identifying the lead compound - optimization of lead compound - chemical libraries.

**REFERENCES**


1. T K Attwood, D J parry-Smith, Introduction to Bioinformatics, Pearson Education, 1st Edition, 11th Reprint 2005.
2. C S V Murthy, Bioinformatics, Himalaya Publishing House, 1st Edition 2003.
3. Stephen A. Krawetz, David D. Womble, Introduction To Bioinformatics A Theoretical and Practical Approach, Humana Press, 2003.
4. Hooman H. Rashidi, Lukas K. Buehler, Bioinformatics Basics-Applications in Biological Science and Medicine, CRC press, 2005.
5. S.C. Rastogi & others, Bioinformatics- Concepts, Skills, and Applications, CBS Publishing, 2003.
6. S. Ignacimuthu, S.J., Basic Bioinformatics, Narosa Publishing House, 1995.

## LAB IN ANIMAL BIOLOGY, GENETICS AND MOLECULAR BIOLOGY - M16UBTP02

### Animal Biology

1. Cockroach –Digestive system and Reproductive systems.
2. Mounting of chick embryo blastoderm
3. Mounting of Mouth parts of Cockroach.
4. Mounting of Mouth parts of Cockroach.
5. Analysis of excretory product during chick development.
6. Collection and handling of Blood specimen
7. Collection and handling of Urine specimen
8. Qualitative analysis of Urine sample
9. Detemine haemoglobin concentration
10. Estimation of sugar in Urine
11. Estimation of sugar in Blood
12. Observation of Amoeba, paramecium, Plasmodium, Tapeworm – Scoelex, Earth worm, Starfish,
13. Observation of Chick embryos (24, 33 &48Hours).
14. Observation of Frog post-fertilization stages- 2, 4 &8 cell stages.
15. Observation of Transverse section of Ovum, overy, testis, kidney Pancreas, pituitary thymus and thyroid gland.

### Genetics and Molecular Biology

1. Karyotype analysis: Man – Normal and Abnormal – Down and Turner's Syndromes.
2. Mendel's laws of genetics - Mono and Dihybrid crosses.
3. Rearing morphology of drosophila (mutant eye identification)
4. Observation of Genetic model organisms (*Arabidopsis thaliana* and *Coenorrabditis elegans*)
5. Isolation and purification of plasmid DNA.
6. Observation of DNA - Agarose gel electrophoresis.
7. Quantification of nucleic acids – DNA & RNA – Chemical and UV method.
8. Separation of protein by SDS PAGE and Staining
9. Bacterial mutagenesis – physical & chemical.
10. Preparation of *E. coli* competent cells.
11. Transformation of bacteria – $CaCl_2$ method.
12. Bacterial conjugation.
13. Transduction.

## LAB IN MICROBIOLOGY - M16UMBAP01

1. Cleaning and Preparation of glassware
2. Preparation of Microbiological media
3. Sterilization – glassware and media – wet, dry and filtration
4. Isolation of microorganisms from various samples
5. Counting of microbes – Use of haemocytometer, colony counting
6. Identification of microbes – Microscopy & Macroscopy
7. Motility of Bacteria by Hanging drop method
8. Staining of bacteria – Simple & differentia staining - Gram, spore, capsule, flagella
9. Culture Techniques - Pure culture - slant, stab, streak etc.
10. Maintenance and storage of bacterial strains.
11. Staining of fungi
12. Identification of algae, fungi, lichens and yeast
13. Identification of protozoa and nematodes
14. Biochemical characterization of Bacteria – Catalse test, oxidase test, Sugar fermentation, IMVIC, urease test, TSI test, Starch hydrolysis.
15. Cultural characteristics of microorganisms on Basal medium, Selective medium,
16. Differential medium, Enriched medium, Enrichment medium.
17. Growth - Growth curve
18. Antibiotic sensitivity test by Kirby- Bauer disc diffusion method.
19. Determination of potability of water by MPN method.

## NMEC-II -APPLIED BIOTECHNOLOGY - 16UBTN03

**UNIT I**

Genetic engineering of Herbicide resistant plants, Insect resistance, Viral resistance – Stress tolerant plants, flower pigmentation,- modification of nutritional content, Delayed fruit ripening, Artificial seeds, Terminator seed technology, Nif gene transfer. Intellectual Property Rights.

**UNIT II**

Transgenic animals (Cattle, Mice) , super ovulation, Embryo transfer, IVF, Preservation Methods. Production of recombinant products – Growth hormones, Human interferons. Dairy Biotechnology, Seri technology. Stem cell therapy. Ethical issues of animal Biotechnology.

**UNIT III**

Fermentation – Types, Fermentor- Types, Strain improvement, Media formulation, Upstream & Down stream processing. Production of industrially important enzymes, antibiotics, organic acids, Vitamins & aminoacids.SCP. Role of GMOs in Biodegradation. Bioleaching

**UNIT IV**

Immunoglobulin genes – functions & phylogenetic analysis. Isolation, characterization, purification and production of lymphocytes. Role of Immuno Supperssors and Modulators. Molecular Immunodiagnostic methods. Specificity of T- cell receptors. Role of Biotechnology in Vaccine production. Monoclonal antibodies.

**UNIT V**

Nanoparticles- Metals. Biological networks. Bionano Particles- nanostarch, nanoparticulate, nanocomposites,nanobiosensors. Dentrimers as nanoparticulates. Nanotechnology in Molecular diagnosis. Nanotechnology in drug Discovery & Delivery. Applications of nanomaterials in medicine. Ethical considerations of Nanobiotechnology.

**REFERENCES**


1. J.Hammond, P.McGarvey and V.Yusibov 2000. Plant Biotechnology. Springer verlag.
2. Paul Christou and Harry Klee. (2004). Hand Book of Plant Biotechnology. Vol I& II. John Wiley & Sons. Ltd.

3. H.S.Chawla. 1998. Biotechnology in crop improvement. International Book Distributing Company.
4. Nigel Jenkins. Animal Cell Biotechnology: Methods and protocols. Humana Press.
5. John,R.W.Masters. (2000). Animal Cell Culture- Practical approach. Third edn. Oxford University Press.
6. U.Satyanarayana. 2005. Biotechnology. Books and Allied (p) Ltd.
7. Peter F. Stanbury. Principles of Fermentation Technology. Butterworth-Heinemann, Elsevier Science Ltd.
8. Alexender. N. Glazer & Hiroshi Nikaido.W.H. (1995) Microbial Biotechnology. Freeman and Company.
9. Rajasekara Pandian M and Senthilkumar B (2007) Immunology and Immunotechnology. Panima Publishing Corporation , New Delhi.
10. Kuby J (1997) Immunology 3rd Edn .WH Freeman &Co. New York.

## NMEC-II-AGRICULTURALBIOTECHNOLOGY- M16UBTN04

**UNIT-I**

Introduction to Agricultural biotechnology. Crop improvement hybridization and plant breeding techniques. Micropropagation and plant tissue culture technique and its application in agriculture. Somatic hybridization, haploid production and cryopreservation.

**UNIT-II**

Mechanism of biological nitrogen fixation process. Production of biofertilizers and applications of rhizobium, azotobacter, azolla and mycorrhiza. Use of plant growth regulators in agriculture and horticulture.

**UNIT-III**

Microbes based Biofertilizers: Azolla and Anabena, Rhizobium, Azotobacter, Azospirillum, Mycorrhiza. Biopesticide – Trichoderma, BT and NPV.

**UNIT-IV**

Biodiversity Legislation in India; Indian Biodiversity Act and provisions on crop genetic resources. Convention on Biological Diversity (CBD) and Cartagena protocol on Biosafety. Conservation strategies for seed gene bank; Impact of GE crops on Biodiversity.

**UNIT-V**

Transgenic plants in quality modifications–Starch, Oil, Protein, and Golden Rice. Current status of transgenics, Biosafety norms and controlled field trails and release of transgenic (GMO).

**REFERENCES**


1. Grant,W.D and Long P.E (1981). Environmental microbiology Springer
2. Stuart J. Smyth, Peter W.B. Phillips. (2014). Handbook on Agriculture, Biotechnology and development , David Castle Edward Elgar Publishing Inc.
3. Kumar, H.D. (2005). Agricultural Biotechnology, Daya Publishing house
4. Rajmohanjoshi (2006).Agricultural Biotechnology. Isha Books, Delhi.
5. AhindraNag . (2008). Text book of Agricultural Biotechnology PHI Learning Private Limited, New Delhi

## SEMESTER - V

| Part | Paper Code | Title of the Paper | Credits | Lecture Hrs/Wk | Int. Marks | Ext. Marks |
|---|---|---|---|---|---|---|
| Part –III Core –V | M16UBT05 | Immunology | 5 | 5 | 25 | 75 |
| Part –III Core -VI | M16UBT06 | rDNA Technology | 5 | 5 | 25 | 75 |
| Part –III Core -VII | M16UBT07 | Bioprocess Technology | 5 | 5 | 25 | 75 |
| Elective I | | Elective | 4 | 5 | 25 | 75 |
| Part –IV SBEC -V | M16UBTS04 | Industrial Biotechnology and IPR | 2 | 4 | 25 | 75 |
| Part –III Core Practical-III | M16UBTP03 | Lab in Immunology & rDNA Technology | 3 | 3 | 40 | 60 |
| Part –III Core Practical-IV | M16UBTP04 | Lab in Bioprocess Technology | 3 | 3 | 40 | 60 |
| | | | **27** | | | |

## IMMUNOLOGY- M16UBT05

**UNIT I**

Historical perspectives and Scope of Immunology, Innate and Acquired immunity, Cells of the Immune system, Haematopoiesis, Organs of the Immune System: Primary and Secondary Lymphoid Organs.

**UNIT II**

Antigen – Characteristics of antigens, Classes , Factors that influence immunogenicity. Haptens, Mitogens, Adjuvants. Humoral Immune response – B cell activation and proliferation. Cell mediated Immune response – T cell receptors and its activation.

**UNIT III**

Immunoglobulins – Structure and functions. Antigen – Antibody reactions – Agglutination, precipitation, RIA, ELISA, FACS. Organization and expression of immunoglobulin genes.

**UNIT IV**

Cytokines: Types and function, Complement-, Classical, Alternative pathway. Major Histocompatability Complex, Hybridoma technology. Hypersensitivity and its types.

**UNIT V**

Transplantation immunology.. Autoimmunity, Cancer immunology, Vaccines. Immunotherapeutics.Immuno tolerance, Immunity to infectious diseases-AIDS.

**REFERENCES**


1. Kubey, J. 1993. Immunology Freeman and company.
2. Janeway, C.A., Immuno-biology Paul Travers1994.
3. Seemi Farhat Basir., Text Book of Immunology by. First edition.
4. Madhavee Latha, P., A Text Book of Immunology, First Edition. S.Chand & Company Ltd, New Delhi.
5. Ajoy Paul.. Textbook of Immunology
6. Rajasekara pandian M and Senthil kumar B., 2007. Immunology and Immunotechnology. (2007), Panima publishing corporation , New Delhi.

## rDNA TECHNOLOGY - M16UBT06

**UNIT I**

Introduction to genetic engineering and recombinant DNA technology. Various steps involved in rDNA technology. Enzymes of rDNA technology - Restriction endonucleases, exonuclease, DNA modifying enzymes - Polymerase, Transferase, alkaline phosphatase, polynucleotide kinase,and Ligase. cohesive and blunt end ligation, linkers, adaptors and homopolymeric tailing.

**UNIT II**

Vectors - Plasmids - pBR322, PUC19, Phage vectors, Cosmids, Phagemids, lambda phage virus vectors, Shuttle vectors and expression vectors and M13 mp vectors. Insertion and replacement vectors, Artificial chromosome vectors (YAC, BAC), animal virus derived vectors - SV40p, vaccinia/bacculo and retroviral vectors. Plant based vectors - Ti and Ri as vectors.

**UNIT III**

Construction of genomic libraries and cDNA Libraries. Recombinant selection and screening, DNA amplification - Principles, application and types of Polymerase chain reaction (PCR), RFLP and RAPD.

**UNIT IV**

Principles of DNA hybridization. Southern, Northern and Western blotting techniques. DNA Sequencing methods, Site directed mutagenesis, Chromosome jumping, DNA Microarray, Method of gene transfer - agrobacterium mediated / chemical mediated and Biolistics.

**UNIT V**

Transgenic plants with reference to virus and pest resistances, herbicide tolerance and stress tolerance (cold, heat and salt); Transgenic animals – Pharmaceutical products - insulin. Farm animal production. Recombinant DNA technology in the production of vaccines. Ethical issues and safety regulations in rDNA technology.

**REFERENCES**


1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. 2002. Molecular Biology of the Cell, 4th Edition. Garland Sciences.
2. Stanley Maloy 1994. Microbial genetics. 2nd Edition. Jones and Bartlett publisher.
3. Uldis N. Streips and Ronalad E. Yasbin. 2002. Modern Microbial Genetics. 2nd Edition. Wiley-Blackwell.

4. Sandy B. Primrose, Richard M. Twyman, Robert W. Old. 2008. Principles of Gene Manipulation. 6th Edition. Blackwell Science.
5. Brown TA. 2008. Genomes. 3rd Edition. New York: Garland Publishing Co. New York: Garland Science.
6. Old, R.W and S.B. Primrose. 1996. Principles of Gene Manipulation: An Introduction to Genetic Engineering. 2nd Edition. Blackwell Scientific Publications, Oxford.
7. Glover, DM. and BD. Hames. 1995. DNA Cloning: A Practical Approach. 2nd Edition. IRL Press, Oxford.
8. Watson J.D., Gilman M., Witkowski, J. and Zoller M. 1992. Recombinant DNA. 2nd Edition. Scientific American Books, New York.
9. Daniel L. Hartl. 2011. Analysis of Genes and Genomes. 8th edition. Maryellen Ruvolo. Laxmi Publications.
10. Keya Chaudhuri. 2012. Recombinant DNA Technology. The Energy and Resources Institute, TERI.

## BIOPROCESS TECHNOLOGY - M16UBT07

**UNIT I**

Introduction to bioprocess, isolation and screening of industrially important microbes. Primary & Secondary detection & assay of fermentation products. Improvement of the strains for increased yield and other desirable characteristics.

**UNIT II**

Advantages of bioprocess over chemical process. Fermentations – submerged and solid state. Types of fermentor- CSTR, Tower, jet loop, Air left, bubble column, packed bed. Immobilization- Immobilized cells. Enzyme co-immobilization. Bioreactor design, parts and their functions.

**UNIT III**

Media formulation, sterilization- Batch and continues sterilization systems, Sterilization of air- Fibrous filters. Measurement and control of bioprocess parameters- pH, Temperature, Dissolved oxygen. Antifoam agents. Aeration and agitation.

**UNIT IV**

Rate of oxygen transfer. Determination of oxygen transfer coefficients. Biological properties of medium. Biological heat transfer. Heat transfer coefficients. Scale up and scale down process.

**UNIT V**

Downstream processing: Precipitation, filtration, flocculation and centrifugation. Cell disruption methods - physical and chemical. Chromatography and separation, drying and crystallization.

**REFERENCES**


1. Shuler ML and Kargi F., Bioprocess Engineering: Basic concepts, Prentice Hall, Engelwood Cliffs, 2002.
2. Kalaichelvan and Arulpandi, Bioprocess Technology. MJP. Publishers 2008.
3. Doran. Bioprocess Engineering Principle. Elsevier. 2007.
4. Stanbury, RF and Whitaker A., Principles of Fermentation Technology, Pergamon press, Oxford, 1997.
5. Comprehensive Biotechnology. The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine, Vol 1, 2, 3 and 4 (2004). Edited by M. M. Young, Reed Elsevier India Private Ltd, India

## ELECTIVE- BIOETHICS & BIO-SAFETY - M16UBTE01

**UNIT-I**

Introduction to ethics/bioethics – Framework for ethical decision making; biotechnology and ethics – biotechnology in agriculture and environment: benefits and risks –benefits and risks of genetic engineering.

**UNIT-II**

Ethical issues against the molecular technologie. Basics of bioethics principles, international codes and guidelines in India - Ethics in post-genomic era Ethical aspects of genetic testing – ethical aspects relating to use of genetic information – genetic engineering and biowarfare.

**UNIT III**

Introduction to Biosafety, Biosafety issues in biotechnology-historical background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals.

**UNIT IV**

Biosafety guidelines and regulations (National and International) – Operation of biosafety Guidelines and regulations of Government of India; Definition of GMOs & LMOs; Benefits of Biotechnology, ELSI of Biotechnology, Recombinant products for human healthcare.

**UNIT V**

Recombinant foods & religious beliefs, GM foods, Release of genetically engineered organisms. Roles of Institutional Biosafety Committee, RCGM, GEAC etc. Biosafety issues in Biotechnology. Overview of National Regulations and International Agreements.

**REFERENCES**


1. Sateesh, M.K., 2008. Bioethics and Biosafety, I.K.International Pvt. Ltd, New Delhi, India.
2. Senthil Kumar Sadhasivam and Mohammed, Jaabir. 2008. IPR, Biosafety and Biotechnology Management. Jasen Publications, Tiruchirapalli, India.
3. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers.

## DEVELOPMENTAL BIOLOGY M19UBTE02

**UNIT-I**

Reproductive cycle in mammals, Spermatogenesis and Oogenesis in mammals, Types of eggs and Fertilization.

**UNIT-II**

Reproductive hormones, Sperm Banking, Artificial Insemination, In vitro Fertilization, Embryo Transfer and surrogacy.

**UNIT-III**

Types and patters of cleavage, Blastulation, Gastrulation, outline of fate maps and morphogenetic movements, Metamorphosis (Insects and amphibians) and its hormone control.

**UNIT-IV**

Plant embryogenesis- Development of Microsporangium and Megasporangium, Pollination, Embryo development and double fertilization in plants and seed formation.

**UNIT-V**

Genetic control of development- pattern determination, Bithorax complex, genes controlling the flower development and Drosophila development.

**REFERENCES**


1. Jain, P.C. (2013). Elements of Developmental Biology.Vishal Publication, New Delhi.
2. Sastry, K. V. and Vinita Shukal (2012).Developmental Biology. Rastogi publications.
3. Verma , P.S., Agarwal, V.K., and Tyagi., (1995). Chordate embryology. S. Chand & Co., New Delhi.
4. A.K. (2016).Berry An Introduction to Embryology– M K publications New Delhi-51.
5. Gilbert, S. F.(2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA .

## NURSERY AND GARDENING M16UBTE03

**UNIT-I**

Nursery: definition, objectives and scope and building up of infra structure for nursery, planning and seasonal activities-Planting-direct seeding and transplants.

**UNIT-II**

Seed: Structure and types- Seed Dormancy; causes and methods of breaking dormancy –Seed storage: Seed banks, factors affecting seed viability, genetic erosion- Seed production technology-seed testing and certification.

**UNIT-III**

Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings-Hardening of plants-green house-mist chamber, shed root, shade house and glass house.

**UNIT-IV**

Gardening: definition, objectives and scope – different types of gardening- landscape and home gardening – parks and its components- plant materials and design – computer applications in land scaping- Gardening operations: soillaying, manuring, watering, management of pests and diseases and harvesting.

**UNIT-V**

Sowing/raising of seed sand seedlings – Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots-Storage and marketing procedures.

**REFERENCES**


1. Bose,T.K.& Mukherjee, D.(1972). Gardening in India Oxford & IBH Publishing Co.,New Delhi.
2. Sandhu, M.K., (1989). Plant Propagation. While Eastern Ltd., Bangalore, Madras.
3. Kumar, N. (1997). Introduction to Horticulture. Raja Lakshmi Publications, Nagercoil.
4. Edmond Musser & Andres. (2005). Fundamentals of Horticulture McGraw Hill Book Co., New Delhi.
5. Agrawal, P.K (1993). Hand Book of Seed Technology National Seed CorporationLtd., New Delhi. .

## HERBAL TECHNOLOGY-M16UBTE04

**UNIT-I**

Herbal medicines: history and scope - definition of medical terms –role of medicinal plants in Siddha systems of medicine; cultivation – harvesting -processing- storage –marketing and utilization of medicinal plants.

**UNIT-II**

Pharmacognosy - systematic position –chemical constitution and medicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Gooseberry and Ashoka.

**UNIT-III**

Phytochemistry – active principles and methods of their testing - identification and utilization of the medicinal herbs; Catharanthus roseus (cardiotonic), Withania somnifera (drugs acting on nervous system),Clerodendron Phlomoides (anti-rheumatic) and Centella asiatica (memory booster).

**UNIT-IV**

Analytical pharmacognosy: Drug adulteration -types, methods of drug evaluation-Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds, fatty acids, tannins, glycosides and volatile oils).

**UNIT-V**

Medicinal Plant Biotechnology: Genetics as applied to medicinal herbs- mutation- polyploidy. Plant tissue culture a source of bio-medicinals-Historical developments- types of cultures- phyto-pharmaceuticals in tissue cultures.

**REFERENCES**


1. Chopra, R.N., S.L.Nayar and I.C.Chopra (1956). Glossary of Indian medicinal plants. C.S.I.R, New Delhi
2. Kanny, Lall, Dey and Raj Bahadur (1984). The indigenous drugs of India. International Book Distributors.
3. Arber (1999). Herbal plants and Drugs. Agnes Mangal Deep Publications. New Delhi.

## INDUSTRIAL BIOTECHNOLOGY AND IPR - M16UBTS04

**UNIT I**

Microbial production of Beer, wine, vinegar, and its commercial importance. Ketogenic fermentation process and mushroom fermentation. SCP production and its economic importance.

**UNIT II**

Microbial production of Butanol- Acetone , glycerol fermentation- History, versatility of the process, fermentation procedure and equipments, sterility and contaminations, future prospects for the butanol acetone fermentation.

**UNIT III**

Microbial processes, production and commercial important of Organic acids- Citric acid, Acetic acid. Microbial production of amino acids- Process control in amino acid fermentation, production of L-Glutamic acids, L-Lysine. commercial uses of amino acids.

**UNIT IV**

Microbial production of Antibiotics- Production, biosynthesis of Tetracycline, Aromatic amino acids -Chloramphenicol, novobiocin. Industrial production of Biopesticides and Biofertilizers.

**UNIT V**

Intellectual Property Rights (IPR)- different types of IPRs, studies on patents granted in India and other countries. IPR in genetically modified organisms; Regulating the use of biotechnology – rDNA technology – Food and Agricultural ingredients – patenting Biotechnology invention.

**REFERENCES**


1. Wulf crueger and Anneliese crueger. 2003. Biotechnology- A text book of industrial microbiology. Panima publishing corporation. New Delhi.
2. Jackson AT. 1991. Bioprocess Engineering in Biotechnology. Prentice Hall, Engelwood Cliffs.
3. Shuler ML and Kargi F. 2002. Bioprocess Engineering: Basic concepts, 2nd Edition. Prentice Hall, Engelwood Cliffs.
4. Peppler-Perlman. 2004. microbial technology(Microbial processes). Academic press, 2nd Edition.

5. Young M.M., Reed. 2004. Comprehensive Biotechnology: The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine. Vol 1, 2, 3 and 4. Elsevier India Private Ltd, India.
6. Mansi EMTEL, Bryle CFA. 2007. Fermentation Microbiology and Biotechnology. 2nd Edition. Taylor & Francis Ltd, UK.

## LAB IN IMMUNOLOGY & rDNA TECHNOLOGY - M16UBTP03

1. Preparation of plasma and serum.
2. Blood cell analysis – Using Haemocytometer
    a. Total count of WBC,
    b. Differential count of WBC.
3. Agglutination tests:
    a. ABO Blood grouping.
    b. WIDAL test.
    c. ASO test.
    d. Pregnancy test.
    e. RPR test.
4. Precipitations:
    a. Radial immunodiffusion.
    b. Double immnodiffusion.
    c. Counter Current immuno electrophoresis.
5. ELISA
6. Isolation and visualization of plasmid DNA.
7. Restriction Digestion of Lamda DNA.
8. Ligation of DNA Fragments.
9. Isolation of Antibiotic Resistant Mutants.
10. Bacterial Transformation.

## LAB IN BIOPROCESS TECHNOLOGY - M16UBTP04

1. Isolation of  Amylase producing organisms from soil.
2. Isolation of antibiotic producing microbes from soil.
3. Culture optimization (pH and Temperature).
4. Production of industrial enzyme by submerged fermentation- Amylase and Protease
5. Assay of Industrial important enzymes – Amylase & Protease.
6. Microbial production of citric acid using *Aspergillus niger*.
7. Immobilization of cells & enzyme.
8. Wine production.
9. Alcohol production and estimation by chromic acid method.
10. Purification of Enzymes by Dialysis and Chromatography method-Demo.

## SEMESTER - VI

| Part | Paper Code | Title of the Paper | Credits | Lecture Hrs/Wk | Int. Marks | Ext. Marks |
|---|---|---|---|---|---|---|
| Part –III Core –VIII | M16UBT08 | Plant & Animal Biotechnology | 5 | 5 | 25 | 75 |
| Part –III Core -IX | M16UBT09 | Environmental Biotechnology | 5 | 5 | 25 | 75 |
| Elective II | | Elective | 4 | 5 | 25 | 75 |
| Part –IV SBEC -VI | M16UBTS05 | Nano-biotechnology | 2 | 2 | 25 | 75 |
| Part –III Core Practical-V | M16UBTP05 | Lab in Plant & Animal Biotechnology | 3 | 4 | 40 | 60 |
| Part –III Core Practical-VI | M16UBTP06 | Lab in Environmental Biotechnology | 3 | 4 | 40 | 60 |
| Project | M16UBTPR1 | Project | 5 | 5 | 40 | 60 |
| Extension activities | M16UEX01 | Extension activities | 1 | 0 | 0 | 100 |
| | | | **28** | | | |

## PLANT AND ANIMAL BIOTECHNOLOGY - M16UBT08

**UNIT I**

Historical events in plant tissue culture, Plant tissue culture, Callus induction, organogenesis, Meristem culture, anther, pollen, embryo culture and their application.

**UNIT II**

Protoplast technology - protoplast isolation, protoplast fusion and its application. Applications of plant tissue culture: - Elimination of pathogens, Germplasm conservation, somoclonal variation, embryo rescue, artificial seeds, Production of secondary metabolites, production of somatic hybrids.

**UNIT III**

Agrobacterium mediated gene transfer, Plant viral vectors. Resistance to herbicide, insecticide, virus and bacteria. Plant tissue culture techniques for crop improvement in dicots and monocots

**UNIT – IV**

Animal cell and Tissue culture: Culture media Primary culture, sub-culture and establishment of cell lines, types of cell lines, maintenance of cell lines, cloning of cell lines. Collection and Preservation of embryos.

**UNIT – V**

Molecular techniques in cell culture – In situ Molecular Hybridization, Somatic cell fusion, Production of Monoclonal antibodies. DNA transfer – Co precipitation with $CaCl_2$, Lipofection, Electroporation, Other methods. Transgenics: Transgenic animals – Production and application, Expression of the bovine growth hormone; transgenic in industry – vaccine production.

**REFERENCES**


1. Culture of Animal cells, A manual of basic technique, R. Ian Freshney, John Wiley and Sons, 5th edition, 2005.
2. Animal Biotechnology – M.M. Ranga, Agrobios Publications, 2nd edition, 2004.
3. An Introduction to plant tissue culture. M.K. Razdan, Oxford and IBH Publishing Company, New Delhi, 2000.
4. Plant Biotechnology: The Genetic Manipulation of Plants, Slater et al, Oxford University Press, Oxford, 3rd edition, 2003.
5. Plant Biotechnology – Mantell S.H and Smith H, Cambridge University Press, UK, 1st edition, 1983.

## ENVIRONMENTAL BIOTECHNOLOGY - M16UBT09

**UNIT I**

Renewable and Non-Renewable resources of energy. Conventional fuels and their environmental impact – Firewood, plant, Animal, Water, Coal and Gas. Modern fuels and their and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen production, Convert ion of sugar to alcohol Gasohol.

**UNIT II**

Bioremediation : Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes.

**UNIT III**

Phytoremediation. Degradation of pesticides and other toxic chemicals by microorganisms. Degradation aromatic and chlorinates hydrocarbons and petroleum products.

**UNIT IV**

Treatment of municipal waste and Industrial waste and Industrial effluents. Biofertilizers Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and Fungal biofertilizers (VAM).

**UNIT V**

Bioleaching Enrichment of ores by microorganisms (gold, copper and uranium). Environmental significance of genetically modified microbes, plants and animals.

**REFERENCES**


1. Environmental biotechnology (Industrial pollution management) - S.N.Jogdand, 3rd edition, Himalaya publication, 2004.
2. Environmental biotechnology-S.K.Agarwal, TBH, 2nd Edition, 1999.
3. Waste water engineering treatment and reuse-Metcalf&Eddy, Franklin L.Burton, H.David Stensel, 4th edition, Tata McGraw Hill publication, 2005.
4. Ecology and Biotreatment by Ec Eldowney, S. Hardman D.J. and Waite S. 1993. - Longman Scientific Technical.
5. Bioremediation by Baker K.H. and Herson. D. S, 1994, Mc Graw Hill Inc.,
6. Environmental Microbiology edited by Ralph Mitchell. A John Wiley and Sons. Inc.

## ELECTIVE- FOOD BIOTECHNOLOGY - M16UBTE05

**UNIT I**

Microorganisms associated with food - bacteria, fungi & yeast. Enzymes in food preparation. Food contaminations. Food preservation & Food spoilage- types. Canned foods.

**UNIT II**

Food borne diseases. Food colors (natural & artificial food colourants) – carotenoids, anthocyanins and melanin. Food flavoring agents.

**UNIT III**

Food engineering operations: Characteristics of food raw materials, preparative operations in food industry, cleaning of food raw materials, sorting of foods, grading of foods.

**UNIT IV**

Food quality: Sensory evaluation of food quality, quality factors for consumer safety, food safety standards. FSSA, HACCP and FDA. Processing plants- Cleaning and sanitation methods.

**UNIT V**

General principle, plant design – design, construction, functionality of building, design & fabrication of equipment. Plant layout Pest proofing/ fumigation methods. Water supply to food processing unit.

**REFERENCES**


1. Food Processing & Preservation – B.Siva PHI Learning Pvt Ltd 2011.
2. Fundamentals of Food Engineering – D.G. Rao, PHI Learning Pvt Ltd 2010.
3. Food Microbiology – Fundamentals & Frontiers – Michael P. Doyle.
4. Food Microbiology – Frazier. McGraw Hill Publications. Fourth edition.
5. Food Biotechnology – Yiu Hui & G. Khachatourians.
6. Fundamentals of Food Microbiology - Bibek, Laramie & Bhunia, CRC Press.

## NANO BIOTECHNOLOGY - M16UBTS05

**UNIT I**

Nanobiology-concepts, definitions, prospects. Biological Nano objects –DNA, protein, lipids. Biological networks. Bionanoparticles– nanocomposites, nanoparticles.

**UNIT II**

Methods of Nanobiotechnology - TEM, SEM, AFM, Scanning Probe Electron Microcopy. Nanofabrication- Lithography. Characterization techniques – NMR, Mass (MALDI-TOF) spectroscopy, x-ray diffraction.

**UNIT III**

Biosensors – definition and classification – Types: Potential, Electrochemical and Biomembrane based sensors. Imaging techniques-digital & molecular.

**UNIT IV**

Drug delivery systems –polymer therapeutics - polymer drug conjugates; polymeric micelles, Liposome. Determination of mechanical properties - Mechanical testing, Elasticity, Toughness.

**UNIT V**

Application of Nanobiotechnology in medicine, Drug designing and Cancer treatment. Medical, Social and Ethical considerations of Nanobiotechnology.

**REFERENCES**


1. Biomaterials Sciences: An Introduction to Materials in Medicine 2nd Edition, Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen and Jack E. Lemons.
2. Lehninger's Principles of Biochemistry, 4th Edition, David L. Nelson and Michael M. Cox, 2006
3. Nanobiotechnology: Concepts, applications and perspectives, Christof M. Niemayer, Chad A. Mirkin, Wiley VCH publishers 2004.
4. Bionanotechnology: Lessons from Nature, David. S. Goodsell. Jhonwiley 2006.
5. Naobiotechnology: Molecular Diagnosis, K.K. Jain, Tailor L. Francis Group.

## ELECTIVE-MICROBIAL DISEASE AND CONTROL-M16UBTE06

### UNIT-I

Microorganisms - microbial interactions - pathogens. General epidemiology – pathogenesis - pathology – diagnostic procedure - clinical manifestation - prevention and control measures.

### UNIT-II

Virus: HIV, Pox virus, and Picorna virus -Epidemiology – pathogenesis - pathology - diagnostics procedure - clinical manifestation -prevention and control measures.

### UNIT-III

Bacteria: Streptococcus, Staphylococcus and Salmonella – Epidemiology - pathogenesis - pathology - diagnostic procedure - clinical manifestation - prevention and control measures.

### UNIT-IV

Fungi: Aspergillus, Candida and Microspora-Epidemiology - pathogenesis-pathology – diagnostic procedure – clinical manifestation-prevention and control measures.

### UNIT-V

Protozoa: Entamoeba histolytica, Plasmodium species and Trypanosoma gambiense – Epidemiology – pathogenesis - pathology -diagnostic procedure - clinical manifestation-preventijon and control measures - vectors.

### REFERENCES


1. David Green Wood Richard slack & John Peuthrer. (1992). Medical Microbiology: A Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control. Churchill Livingstone
2. Paniker and Sougata Ghosh. (2013). Paniker'S Textbook of Medical Parasitology. Jaypee Brothers Medical Publishers (P) Ltd.
3. Anantanarayan & Panekar. (2017). Textbook of Microbiology. Universities Press
4. Wilson & Topley Hodder Arnold (1990). Principles of Bacteriology, Virology and Immunity; 8th revised edition.
5. Jagdish Chander. (2017). Textbook of Medical Mycology. Jaypee Brothers Medical Publishers; Fourth edition.
6. Karen C. Carroll, Janet S. Butel, Stephen A. Morse. (2013). Medical MicrobiologyGeo. F. Brooks, McGraw Hill Education; 26 edition

## ELECTIVE-PHARMACEUTICAL BIOTECHNOLOGY-M16UBTE07

**UNIT-I**

History & Principle of pharmacology. Drug nomenclature & Classification systems. General Principles of Drug action Pharmaco kinetics, Pharmaco dynamics, measurement of drug action.

**UNIT-II**

Chemo therapeutic drugs - Protein synthesis inhibitors, Antibacterial, antifungal, antiprotozoal, antiviral, Antihelmithic. chemotherapy in anticancer and antiinflammatory drugs.

**UNIT-III**

Techniques of r-DNA technology for production: Insulin, HGH, GRF, Erythropoietins, IFN, TNF, Interleukins, Clotting factor VIII.

**UNIT-IV**

Production of Ergot alkaloids, Probiotics, Production of recombinant vaccines. ISO standard for industrial production.

**UNIT-V**

Protein and tissue engineering. Therapeutic proteins – Formulation, delivery and stability. Pharmaceutical bio-assay – toxin detection, antiviral and anticancer bioassay.

**REFERENCES**


1. Murugesh, N. (2014). A concise Text Book of Pharmacology, 6th Ed. Sathya Publishers, Madurai.
2. Dubey, R.C. (1993). A Text Book of Biotechnology S. Chand & Co Ltd, New Delhi.
3. Purohit, S.S. and Kakrani, Saluja. (2003). Pharmaceutical Biotechnology. Agrobios, India
4. Mary J. Myuk, Richard, A.Hoarey, Pamala. (2014). Pharmacology Lippinwitt Williams edition.
5. Rang, H.P. Pale, M.M. Moore, J.M. (2003). Pharmacology. Blackwell Publishing Ltd (Churchill Livingston).

## ELECTIVE-INDUSTRIAL SAFETY- M19UBTE08

### UNIT-I

Site selection, plant layout- design for ventilation - basic rules and requirements which govern the chemical industries – social environmental setup – tolerance limit of the society.

### UNIT-II

Chemical hazards classification – hazards due to fire and explosion – safety analysis – chemical and job safety – safe handling and operation of materials and machineries.

### UNIT-III

Types of hazard analysis – hazard identification – HAZOP – hazard survey – Fault tree analysis - event tree analysis.

### UNIT-IV

Effective steps to implement safety procedure – periodic advice and constant maintenance – personal protective equipments- types – fire fighting equipments.

### UNIT - V

Introduction – biosafety issues in Biotechnology – Historical background – primary contaminants for biohazards biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulation of Government of India – risk analysis – risk assessment – risk management.

### REFERENCES


1. Blake R.P. (1963). Industrial safety Prentice. Hall Inc. New Jersey, 2nd Edition.
2. Fawcett H.H. and Wood W.S. (1965). Safety and Hazard prevention in chemical operationInter sciences

## ELECTIVE-BIOFERTILIZER TECHNOLOGY-M16UBTE08

**UNIT-I**

An introduction to fertilizers, synthetic fertilizers, natural fertilizers, inorganic fertilizers, organic fertilizers, bio-fertilizers - importance, advantages and constraints.

**UNIT-II**

Isolation, culturing methods, enumeration and identification of microbial species - Rhizobium, Azospirillum, Azotobacters, blue green algae and phosphate solubilisers.

**UNIT-III**

Morphology of Rhizobium, Azospirilium, Azotobacters, blue green algae and phosphate solubilisers and maintenance.

**UNIT-IV**

Preparation of microbial inoculants – large-scale production of microbes - their application as biofertilizers – crop responses to biofertilizers.

**UNIT-V**

Azolla - distribution, morphological and biochemical characteristics – cyanobacterial symbionts - azolla biofertilizer technology- organic matter and composting - method of processes, applications and limitations.

**REFERENCES**


1. Jeswani, L.M. and Balddev, B (1990). Advances in Pulse Production Technology. ICAR, New Delhi
2. Malsen,L.J.G.V. and S.Somaatmadja. (1993). PROSEA-Plant Resources of South East Asia. Oil and Pulses. International Book Distributors, Dehradun.
3. SubbaRao, N.S. (2000). Biofertilizers in Agriculture. Oxford & IBH publishing Co., New Delhi
4. Daniel Sundararaj, D. and G.Thulasidas. (1993). Paniker'S Textbook of Medical Parasitology, Macmilan India Ltd.

## LAB IN PLANT AND ANIMAL BIOTECHNOLOGY - M16UBTP05

### Plant Biotechnology

1. Aseptic culture techniques for establishment and maintenance of cultures.
2. Tissue culture media preparation: Preparation of stock solutions of MS, Whites and Gamborg media.
3. Establishment of meristem culture using MS medium
4. Isolation of protoplasts.
5. Establishment and maintenance of callus culture.
6. Establishment and maintenance of suspension culture.
7. Synthetic seeds (Entrapment method).
8. Isolation of genomic DNA from plant.

### Animal Biotechnology

1. Preparation & sterilization of animal cell culture media: balanced salt solution and DMEM.
2. Disaggregation of tissues – Trypsinization.
3. Culture of chick embryo fibroblast (monolayer).
4. Viability test and cell counting.
5. Inoculation of virus and observation.
6. Applications of $CO_2$ incubator & inverted microscope.

## LAB IN ENVIRONMENTAL BIOTECHNOLOGY - M16UBTP06

1. Isolation and enumeration of microorganism from air
2. Isolation of halophiles
3. Isolation of heavy metal resistance microorganisms
4. Determination of soil and water pH
5. Determination of dissolved sulphate in water
6. Determination of residual chlorine
7. Analysis of TDS in effluent
8. Estimation of total solids in the effluent sample
9. Isolation of coli forms from water
10. Dissolved oxygen (DO) Experiment
11. Biochemical Oxygen Demand (BOD) Experiment
12. Chemical Oxygen Demand (COD) Experiment