# M.Sc., BIOTECHNOLOGY
CHOICE BASED CREDIT SYSTEM

Curriculum and Syllabus
(2023-2024)

Enable | Enlighten | Enrich
KARPAGAM
ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956 )

## DEPARTMENT OF BIOTECHNOLOGY
FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT


## KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University) (Established under
section 3 of UGC Act, 1956)
(Accredited with A+ Grade by NAAC in the second cycle)
Pollachi Main road, Eachanari (Post), Coimbatore - 641021, Tamilnadu, India
Phone: 0422-2980011-15; Fax No: 0422-2980022-23
Email: info@karpagam.com; Web: www.kahedu.edu.in

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**(Deemed to be University) (Established under Section 3 of UGC Act, 1956)**
**(Accredited with A+ Grade by NAAC in the Second Cycle)**
**Coimbatore - 641 021, Tamil Nadu, India**

## FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT POST-GRADUATE PROGRAMMES (M.Sc., M.Com.)

## REGULAR MODE
## CHOICE BASED CREDIT SYSTEM (CBCS)

## REGULATIONS - 2023

**The following regulations are effective from the academic year 2023 -2024 and are applicable to the candidates admitted in Post Graduate (PG) Degree programmes in the Faculty of Arts, Science, Commerce and Management, Karpagam Academy of Higher Education (KAHE).**

## 1 PROGRAMMES OFFERED, MODE OF STUDY AND ADMISSION REQUIREMENTS

### 1.1 P.G. PROGRAMMES OFFERED

The various P.G. Programmes offered by the KAHE are listed in the table below.

| S. No. | Programme Offered |
|---|---|
| 1 | M.Sc. Biochemistry |
| 2 | M.Sc. Microbiology |
| 3 | M.Sc. Biotechnology |
| 4 | M.Sc. Physics |
| 5 | M.Sc. Chemistry |
| 6 | M.Sc. Mathematics |
| 7 | M.Sc. Computer Science |
| 8 | M.Com. |
| 9 | MA English |

## 1.2 MODE OF STUDY

**Full-Time**

All programmes are offered under Full-Time Regular mode. Candidates admitted under 'Full-Time' should be present in the KAHE during the complete working hours for curricular, co-curricular and extra-curricular activities assigned to them.

## 1.3 ADMSSION REQUIREMENTS (ELIGIBILITY)

A candidate for admission to the first semester Master's Degree Programme shall be required to have passed an appropriate Degree Examination of this Karpagam Academy of Higher Education or any other University accepted by the KAHE as equivalent thereto. Admission shall be offered only to the candidates who possess the qualification prescribed against each course as given in the table below.

**QUALIFICATIONS FOR ADMISSION**

| S. No. | Name of the Programme Offered | Eligibility |
|---|---|---|
| 1 | M.Sc. Biochemistry | B.Sc. Degree with Biology / Biochemistry / Chemistry / Biotechnology / B.F.Sc. / Polymer Chemistry / Microbiology/ Zoology / Botany / Plant Science / Plant Biotechnology / Animal Science / Animal Biotechnology / B.Pharm / Industrial Chemistry / Applied Microbiology / Medical Microbiology / Human Genetics / Medical Genetics / Molecular Biology / Genetics Technology / Environmental Science / Environment Biotechnology / Genetics Engineering / Bioinformatics / Plant Biology & Biotechnology / Animal Cell & Biotechnology / Agriculture / Medical Lab Technology / Nutrition & Dietetics |
| 2 | M.Sc. Microbiology | B.Sc. Microbiology / Applied Microbiology / Industrial Microbiology / Medical Microbiology / Botany / Zoology / Biology / Biotechnology / Molecular Biology / Genetic Engineering / Biochemistry / Agriculture / Forestry / Medical Lab Technology / Life Sciences |

| | | |
|---|---|---|
| 3 | M.Sc. Biotechnology | B.Sc. Degree with Biology / Biochemistry / B.Sc Biology with Chemistry Ancillary / B.F.Sc. / Microbiology / Zoology / Botany / Plant Science /Plant Biotechnology / Animal Science /Animal Biotechnology / B.Pharm / Applied Microbiology / Medical Microbiology / Human Genetics / Medical Genetics / Molecular Biology / Genetics / Environmental Science / Environment Biotechnology / Genetics Engineering / Bioinformatics / Plant Biology & Biotechnology / Animal Cell & Biotechnology / Agriculture / B.Tech ( Biotech) |
| 4 | M.Sc. Physics | B.Sc. Physics, B.Sc. Physics (CA) / B.Sc. Applied science |
| 5 | M.Sc. Chemistry | B. Sc. Chemistry, Industrial Chemistry, Polymer Chemistry |
| 6 | M.Sc. Mathematics | B.Sc. Mathematics / B.Sc. Mathematics with Computer Applications |
| 7 | M.Sc. Computer Science | B.Sc. Computer Science / Computer Technology / Information Technology / Electronics / Software Systems / BCA/ B.Sc. Applied Sciences |
| 8 | M.Com | B.Com./BCom.(CA)/B.Com(PA)/B.Com(Finance&Insurance)/ B.Com.(e-Commerce)/ B.Com.(IT) /B.B.M. /B.B.M.(CA) /B.B.A./B.B.A (CA) / B.Com (CS), B.A. Co-Operation / Bachelor's Degree in Bank Management/ B.A. Economics / B. Com Financial Analytics/ B. Com International Accounting and Finance |
| 9 | MA English | BA (English)/Any UG degree with Part II – English for four semester. |

## 2 DURATION OF THE PROGRAMMES

2.1 The minimum and maximum period for completion of the P.G. Programmes are given below:

| Programme | Min. No. of Semesters | Max. No. of Semesters |
|---|---|---|
| M.Sc., M.Com., MA | 4 | 8 |

2.2 Each semester normally consists of 90 working days or 450 Instructional hours for full-time mode of study. Examination shall be conducted at the end of every semester for the respective courses.

## 3. CHOICE BASED CREDIT SYSTEM

**3.1** All programmes are offered under Choice Based Credit System with a total credit ranges from 87 to 93 for the PG programmes.

### 3.2 Credits

Credits means the weightage given to each course of study by the experts of the Board of Studies concerned.

## 4. STRUCTURE OF THE PROGRAMME

Every Programme will have a curriculum and syllabus consisting of core courses, elective courses, open elective, Internship and project work.

### a. Core course

Core course consists of theory and practical and the examinations shall be conducted at the end of each semester.

### b. Elective course

Elective courses are to be chosen with the approval of the Head of Department concerned from the list of elective courses mentioned in the curriculum.

### c. Project Work

The candidates shall undertake the project work in the Fourth Semester either in the Department concerned or in Industries, Research Institute or any other Organizations (National / International) and the project report has to be submitted at the end of the fourth semester.

In case the candidate undertakes the project work outside the Department, the teacher concerned within the Department shall be the Main guide and the teacher/scientist under whom the work is carried out will be the Co-guide. The candidate shall bring the attendance certificate from the place where the project work carried out.

**d. Value Added Courses**

Courses of varying durations but not less than 30 hours which are optional and offered outside the curriculum that add value and help the students in getting placement. Students of all programmes are eligible to enroll for the Value Added Courses. The student shall choose one Value Added Course per semester from the list of Value Added Courses available in KAHE. The examinations shall be conducted at the end of the Value Added Course at the Department level and the student has to secure a minimum of 50% of marks to get a pass. The certificate for the Value Added Course for the passed out students shall be issued duly signed by the HOD and Dean of the Faculty concerned.

**e. Internship**

The student shall undergo 15 days internship in the end of second semester. Internship report will be evaluated and marks will be awarded in the third semester. Students have to earn 2 credits for the Internship.100 marks is awarded for Internship through Continuous Internal Assessment.

**f. Open Elective**

He / She may select one of the open elective courses from the list given below offered by other departments in the third semester. Students have to earn 02 credits for this course. (The student cannot select a course offered by the parent department).

| S.No. | Name of the offering Department | Course Code | Name of the Course |
|---|---|---|---|
| 1 | English | 23EGPOE301 | English for Competitive Examinations |
| 2 | Commerce | 23CMPOE301 | Personal Finance and Planning |
| 3 | Management | 23MBAPOE301 | Organizational Behavior |
| 4 | Computer Applications | 23CAPOE301 | Robotics Process Automation |
| 5 | Computer Science | 23CSPOE301 | Cyber Forensics |
| 6 | Mathematics | 23MMPOE301 | Coding theory |
| 7 | Physics | 23PHPOE301 | Material Characterization |
| | | 23PHPOE302 | Numerical Methods and Programming |
| 8 | Chemistry | 23CHPOE301 | Chemistry in Everyday Life |
| 9 | Microbiology | 23MBPOE301 | Fermentation Technology |
| 10 | Biochemistry | 23BCPOE301 | Nutrition and Dietetics |
| 11 | Biotechnology | 23BTPOE301 | Sericulture |

**Online Course**

Student shall study at least one online course from SWAYAM / NPTEL / MOOC in any one of the first three semesters for which examination shall be conducted at the end of the course by the respective external agencies if any. The student can register to the courses which are approved by the Department. The student shall produce a Pass Certificate from the respective agencies before the end of the third semester. The credit(s) earned by the students will be considered as additional credit(s) over and above the credits minimum required to earn a particular Degree.

## 5. MEDIUM OF INSTRUCTION

The medium of instruction for all courses, examinations, seminar presentations and project/thesis/dissertation reports should be in English.

## 6. MAXIMUM MARKS

The maximum marks assigned to different courses shall be as follows:

**(i)** Each of the theory and practical courses shall carry maximum of 100 marks. Out of which 40 marks are for Continuous Internal Assessment (CIA) and 60 marks for End Semester Examinations (ESE).

**(ii) Maximum Marks for Project work**

| S. No | Programme | Maximum Marks | CIA | ESE |
|---|---|---|---|---|
| 1 | M.Sc., M.Com., MA | 200 | 80 | 120 |

## 7. a. FACULTY MENTOR

To help students in planning their courses of study and for general advice on the academic programme, the HoD shall allot a certain number of students to a faculty who will function as mentor throughout their period of study. Faculty mentors shall advise the students and monitor their behavior and academic performance. Problems if any shall be counseled by them periodically. The Faculty mentor is also responsible to inform the parents of their wards progress. Faculty mentor shall display the cumulative attendance particulars of his / her ward students' periodically (once in 2 weeks) on the Notice Board to enable the students to know their attendance status and satisfy the **clause 7** of this regulation.

b. **ONLINE COURSE COORDINATOR**

To help students in planning their online courses and for general advice on online courses, the HOD shall nominate a coordinator for the online

courses. The Online course coordinator shall identify the courses which the students can select for their programme from the available online courses offered by different agencies periodically and inform the same to the students. Further, the coordinators shall advice the students regarding the online courses and monitor their course.

## 8. CLASS COMMITTEE

Every class shall have a Class Committee consisting of teachers of the class concerned, student representatives (Minimum two boys and 2 girls of various capabilities and Maximum of 6 students) and the concerned HoD / senior faculty as a Chairperson. The objective of the class committee Meeting is all about the teaching – learning process. Class Committee shall be convened at least once in a month. The functions of the Class Committee shall include

1. The class committee shall be constituted during the first week of each semester.
2. The Class Committee of a particular class of any department is normally constituted by the HoD/Chairperson of the Class Committee. However, if the students of different departments are mixed in a class, the Class Committee shall be constituted by the respective Dean of the Faculty.
3. The HoD/Chairperson of the Class committee is authorized to convene the meeting of the class committee.
4. The respective Dean of the Faculty has the right to participate in any Class committee meeting.
5. The Chairperson is required to prepare the minutes of every meeting, and submit the same to the Dean concerned within two days after having convened the meeting. Serious issues if any shall be brought to the notice of the Registrar by the HoD/Chairperson immediately.
6. Analyzing and solving problems experienced by students in the class room and in the laboratories.
7. Analyzing the performance of the students of the class after each test and finding the ways and means to improve the performance.

## 9. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or group shall have a “Course Committee” comprising all the teachers handling the common course with one of them nominated as course coordinator. The nomination of the course coordinator shall be made by the Dean depending upon whether all the teachers handling the common course belong to a single department or to various other departments. The ‘Course Committee’ shall meet in order to arrive at a common scheme of

evaluation for the tests to ensure a uniform evaluation of the tests. If feasible, the course committee shall prepare a common question paper for the Internal Assessment test(s).

## 10. REQUIREMENTS TO APPEAR FOR THE END SEMESTER EXAMINATION

**a.** Ideally every student is expected to attend all classes and secure 100% attendance. However, in order to allow for certain unavoidable circumstances, the student is expected to attend at least 75% of the classes and the conduct of the candidate should be satisfactory during the course.

**b.** A candidate who has secured attendance between 65% and 74% (both included), due to medical reasons (Hospitalization / Accident / Specific Illness) or due to participation in University / District / State / National / International level sports or due to participation in Seminar / Conference / Workshop / Training Programme / Voluntary Service / Startup Activity / Extension activities or similar programmes with prior permission from the Registrar shall be given exemption from prescribed minimum attendance requirements and shall be permitted to appear for the examination on the recommendation of the Head of Department concerned and Dean to condone the shortage of attendance. The Head of Department has to verify and certify the genuineness of the case before recommending to the Dean concerned. However, the candidate has to pay the prescribed condonation fee to KAHE.

**c.** However, a candidate who has secured attendance less than 65% in the current semester due to any reason shall not be permitted to appear for the current semester examinations. But he/she will be permitted to appear for his/her supplementary examinations, if any and he/she has to re-do the same semester with the approval of the Dean, Students Affairs and Registrar.

## 11. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

11.1 Every Faculty is required to maintain an **Attendance and Assessment Record (Log book)** which consists of attendance of students marked for each lecture/practical/ project work class, the test marks and the record of class work (topic covered), separately for each course. This should be submitted to the HoD once in a week for checking the syllabus coverage, records of test marks and attendance. The HoD shall sign with date after due verification. The same shall be submitted to respective Dean once in a fortnight. After the completion of the semester the HoD should keep this

record in safe custody for five years as records of attendance and assessment shall be submitted for inspection as and when required by the KAHE/any other approved body.

11.2 **Continuous Internal Assessment (CIA)**: The performance of students in each course will be continuously assessed by the respective faculty. The Retest will be conducted and considered based on the requirements and recommendations by the Head of the Department. The guidelines for the Continuous Internal Assessment (CIA) are given below:

**Theory Courses**

| S. No. | Category | Maximum Marks |
|---|---|---|
| 1 | Attendance | 5 |
| 2 | Test – I (first 2 ½ units) | 10 |
| 3 | Test – II (last 2 ½ units) | 10 |
| 4 | Journal Paper Analysis & Presentation* | 15 |
| | **Continuous Internal Assessment : Total** | 40 |

*****Evaluated by two faculty members of the department concerned. Distribution up of marks for one Journal paper analysis: Subject matter 5 marks, Communication/PPT Presentation 4 marks, Visual aid 2 marks and Question and Discussion 4 marks

**Practical Courses**

| S. No. | Category | Maximum Marks |
|---|---|---|
| 1 | Attendance | 5 |
| 2 | Observation work | 5 |
| 3 | Record work | 5 |
| 4 | Model practical examination | 15 |
| 5 | *Viva – voce* [Comprehensive]* | 10 |
| **Continuous Internal Assessment: Total** | | **40** |

* *Viva - voce* conducted during model practical examination.

Every practical Exercise / Experiment shall be evaluated based on the conduct of Exercise/ Experiment and records maintained.

11.3 **Pattern of Test Question Paper**

| **Instruction** | **Remarks** |
|---|---|
| Maximum Marks | 50 marks |
| Duration | 2 Hours |
| Part – A | Objective type (20x1=20) |
| Part - B | Short Answer Type (3 x 2 = 6) |
| Part - C | 3 Eight marks questions 'either – or' choice (3 x 8 = 24 Marks) |

**11.4 Attendance**

**Marks Distribution for Attendance**

| **S. No.** | **Attendance (%)** | **Maximum Marks** |
|---|---|---|
| 1 | 91 and above | 5.0 |
| 2 | 81 - 90 | 4.0 |
| 3 | 76 - 80 | 3.0 |
| 4 | Less than or equal to 75 | 0 |

## 12. ESE EXAMINATIONS

**12.1End Semester Examination (ESE)**: ESE will be held at the end of each semester for each course. The question paper is for a maximum of 60 marks.

Pattern of ESE Question Paper

| **Instruction** | **Remarks** |
|---|---|
| Maximum Marks | 60 marks for ESE |
| Duration | 3 hours (½ Hr for Part – A Online & 2 ½ Hours for Part – B and C) |
| Part – A | 20 Questions of 1 mark each (20 x 1 = 20 Marks )<br>Question No. 1 to 20 Online Multiple Choice Questions |
| Part- B | 5 Questions of six marks each (5 x 6 = 30 Marks.)<br>Question No. 21 to 25 will be 'either-or' type, covering all five units of the syllabus; i.e., |

| Instruction | Remarks |
|---|---|
| | Question No. 21: Unit - I, either 21 (a) or 21 (b), Question No. 22: Unit - II, either 22 (a) or 22 (b), Question No. 23: Unit - III, either 23 (a) or 23 (b), Question No. 24: Unit - IV, either 24 (a) or 24 (b), Question No. 25: Unit - V, either 25 (a) or 25 (b) |
| Part - C | Question No.26. One Ten marks Question (1 x 10 = 10 Marks) |

12.2 **Practical:** There shall be combined valuation. The pattern of distribution of marks shall be as given below.

| | |
|---|---|
| Experiments | : 40 Marks |
| Record | : 10 Marks |
| *Viva-voce* | : 10 Marks |
| **Total** | **: 60 Marks** |

**Record Notebooks for Practical Examination**

Candidate taking the Practical Examination should submit Bonafide Record Notebook prescribed for the practical examination, failing which the candidate will not be permitted to take the practical examination.

In case of failures in Practical Examination, the marks awarded for the Record at the time of first appearance of the Practical Examination shall remain the same at the subsequent appearance also by the candidate.

12.3. **Evaluation of Project Work**

12.3.1 The project shall carry a maximum marks as per clause 6 (ii). ESE will be a combined evaluation of Internal and External Examiners.

12.3.2 The project report prepared according to the approved guidelines and duly signed by the supervisor(s) shall be submitted to HoD.

Guidelines to prepare the project report

a. Cover page
b. Bonafide certificate
c. Declaration
d. Acknowledgement
e. Table of contents
f. Chapters
   Introduction
   Aim and Objectives
   Materials and Methods (Methodology)
   Results (Analysis of Data) and Discussion (Interpretation)
   Summary
   References

12.3.3 The evaluation of the project will be based on the project report submitted and *Viva-Voce* Examination by a team consisting of the supervisor, who will be the Internal Examiner and an External Examiner who shall be appointed by the COE. In case the supervisor is not available, the HoD shall act as an Internal Examiner.

12.3.4 If a candidate fails to submit the project report on or before the specified date given by Examination Section, the candidate is deemed to be failed in the project work and shall re-enroll for the same in a subsequent semester.

If a candidate fails in the *viva-voce* examinations he/she has to resubmit the project report within 30 days from the date of declaration of the results. For this purpose the same Internal and External examiner shall evaluate the resubmitted report.

12.3.5 Copy of the approved project report after the successful completion of *viva voce* examinations shall be kept in the KAHE library.

**13. PASSING REQUIREMENTS**

13.1 Passing minimum: There is a passing minimum 20 marks out of 40 marks for CIA and the passing minimum is 30 marks out of 60 marks in ESE. The overall passing in each course is 50 out of 100 marks (Sum of the marks in CIA and ESE examination).

13.2 If a candidate fails to secure a pass in a particular course (either CIA or ESE or Both) as per clause 13.1, it is mandatory that the candidate has to register and reappear for the examination in that course during the subsequent semester when examination is conducted for the same till he/she secures a pass both in CIA and ESE (vide Clause 2.1).

13.3 Candidate failed in CIA will be permitted to improve CIA marks in the subsequent semesters by writing tests and by re-submitting assignments.

13.4 CIA marks (if it is pass) obtained by the candidate in the first appearance shall be retained by the Office of the Controller of Examinations and considered valid for all subsequent attempts till the candidate secures a pass in ESE.

13.5 A candidate who is absent in ESE in a Course / Practical / Project work after having enrolled for the same shall be considered to have Absent (AAA) in that examination.

## 14. IMPROVEMENT OF MARKS IN THE COURSE ALREADY PASSED

Candidates desirous to improve the marks secured in a passed course in their first attempt shall reappear once (**only in ESE**) in the subsequent semester. **The improved marks shall be considered for classification but not for ranking.** If there is no improvement there shall be no change in the marks awarded earlier.

## 15. AWARD OF LETTER GRADES

All assessments of a course will be done on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each course as detailed below:

| Letter grade | Marks Range | Grade Point | Description |
|---|---|---|---|
| O | 91 - 100 | 10 | OUTSTANDING |
| A+ | 81- 90 | 9 | EXCELLENT |
| A | 71-80 | 8 | VERY GOOD |
| B+ | 66- 70 | 7 | GOOD |
| B | 61 – 65 | 6 | ABOVE AVERAGE |
| C | 55 - 60 | 5 | AVERAGE |
| D | 50 - 54 | 4 | PASS |
| RA | <50 | - | REAPPEARANCE |
| AAA | - | - | ABSENT |

## 16. GRADE SHEET

After the declaration of the results, Grade Sheets will be issued to each student which will contain the following details:

i. The list of courses enrolled during the semester and the corresponding grade scored.

ii. The Grade Point Average (**GPA**) for the semester and

iii. The Cumulative Grade Point Average (**CGPA**) of all courses enrolled from first semester onwards.

GPA of a Semester and CGPA of a programme will be calculated as follows.

$$\textbf{GPA} \text{ of a Semester} = \frac{\text{Sum of the product of the GP by the corresponding credits of the courses offered in that Semester}}{\text{Sum of the credits of the courses of that Semester}}$$

i.e. **GPA** of a Semester = $\dfrac{\sum_i CiGPi}{\sum_i Ci}$

**CGPA** of the entire programme = $\dfrac{\text{Sum of the product of the GPs by the corresponding credits of the courses offered for the entire programme}}{\text{Sum of the credits of the courses of the entire programme}}$

i.e. **CGPA** of the entire programme = $\dfrac{\sum_n \sum_i CniGPni}{\sum_n \sum_i Cni}$

where,

Ci is the credit fixed for the course 'i' in any semester
GPi is the grade point obtained for the course 'i' in any semester
'n' refers to the Semester in which such courses are credited

**Note: RA** grade will be excluded for calculating **GPA** and **CGPA**.

## 17. REVALUATION

Candidate can apply for revaluation or retotalling of his / her semester examination answer script (**theory courses only**), within 2 weeks from the date of declaration of results, on payment of a prescribed fee. For the same, the prescribed application has to be sent to the Controller of Examinations through the HoD. **A candidate can apply for revaluation of answer scripts not exceeding 5 courses at a time.** The Controller of Examinations will arrange for the revaluation and results will be intimated to the candidate through the HODs concerned**.** Revaluation is not permitted for supplementary theory courses.

## 18. TRANSPARENCY AND GRIEVANCE COMMITTEE

Revaluation and Re-totaling is allowed on representation (clause 17). Student may get the Xerox copy of the answer script on payment of prescribed fee, if he / she wish. The student may represent the grievance, if any, to the Grievance Committee, which consists of Dean of the Faculty, (if Dean is HoD, the Dean of another Faculty nominated by the KAHE), the HoD of Department concerned, the faculty of the course and Dean from other

discipline nominated by the KAHE and the CoE. If the Committee feels that the grievance is genuine, the script may be sent for external valuation; the marks awarded by the External examiner will be final. The student has to pay the prescribed fee for the same.

## 19. ELIGIBILITY FOR THE AWARD OF THE DEGREE

**A student shall be declared to be eligible for the conferment of the Degree if he / she has**

- Successfully completed all the components in clause 3 and gained the required number of total credits as specified in the curriculum corresponding to his / her Programme within the stipulated period.
- Not any disciplinary action pending against him / her.
- The award of the degree must be approved by the Board of Management.

## 20. CLASSIFICATION OF THE DEGREE AWARDED

20.1 Candidate who qualifies for the award of the Degree (vide clause 13) having passed the examination in all the courses in his / her first appearance, within the specified minimum number of semesters and securing a **CGPA not less than 8.0** shall be declared to have passed the examination in **First Class with Distinction.**

20.2 Candidate who qualifies for the award of the Degree (vide clause 13) having passed the examination in all the courses within the specified maximum number of semesters (vide clause 2.1), securing a **CGPA not less than 6.5** shall be declared to have passed the examination in **First Class**.

20.3 All other candidates (not covered in clauses 20.1 and 20.2) who qualify for the award of the degree (vide Clause 19) shall be declared to have passed the examination in **Second Class**.

## 21. PROVISION FOR WITHDRAWAL FROM END-SEMESTER EXAMINATION

21.1 A candidate due to valid reason on prior application may be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination.

21.2 Such withdrawal shall be permitted only once during the entire period of study of the degree programme.

21.3 Withdrawal of application is valid only if it is made within 10 days prior to the commencement of the examination in that course or courses and

recommended by the HoD / Dean concerned and approved by the Registrar.

21.3.1 Notwithstanding the requirement of mandatory TEN days notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.

21.4 Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction. This provision is not applicable to those who seek withdrawal during IV semester.

21.5 Withdrawal from the End semester examination is **NOT** applicable to arrears courses of previous semesters.

21.6 The candidate shall reappear for the withdrawn courses during the examination conducted in the subsequent semester.

## 22. PROVISION FOR AUTHORISED BREAK OF STUDY

22.1 **Break of Study shall be granted only once for valid reasons for a maximum of one year during the entire period of study of the degree programme.** However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If a candidate intends to temporarily discontinue the programme in the middle of the semester for valid reasons, and to rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he / she applies to the Registrar, but not later than the last date for registering for the end semester examination of the semester in question, through the HoD stating the reasons therefore and the probable date of rejoining the programme.

22.2 The candidate thus permitted to rejoin the Programme after the break shall be governed by the Curriculum and Regulations in force at the time of rejoining. Such candidates may have to do additional courses as per the Regulations in force at that period of time.

22.3 The authorized break of study (for a maximum of one year) will not be counted for the duration specified for passing all the courses for the purpose of classification. (Vide Clause 20). However, additional break of study granted will be counted for the purpose of classification.

22.4 The total period for completion of the Programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 2.1 irrespective of the period of break of study (vide clause 22.3) in order that he/she may be eligible for the award of the degree.

22.5 If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be considered as permitted 'Break of Study' or 'Withdrawal' (Clause 21 and 22) is not applicable for this case.

## 23. RANKING

A candidate who qualifies for the PG Degree programme passing all the Examinations in the first attempt, within the minimum period prescribed for the programme of study from Semester I through Semester IV to the programme shall be eligible for ranking. Such ranking will be confined to 10% of the total number of candidates qualified in that particular programme of Study subject to a maximum of 10 ranks.

**The improved marks will not be taken into consideration for ranking.**

## 24. SUPPLEMENTARY EXAMINATION

Supplementary Examination will be conducted only for the final semester students within ten days from the date of publication of results for students who have failed in one theory course only. Such students shall apply with prescribed fee to the Controller of Examinations within the stipulated time.

## 25. DISCIPLINE

25.1. If a student indulges in malpractice in any of the Internal / External Examinations he / she shall be liable for punitive action as prescribed by the KAHE from time to time.

25.2. Every student is required to observe discipline and decorous behavior both inside and outside the campus and not to indulge in any activity which will tend to bring down the prestige of the KAHE. The erring students will be referred to the disciplinary committee constituted by the KAHE, to enquire into acts of indiscipline and recommend the disciplinary action to be taken.

## 26. REVISION OF REGULATION AND CURRICULUM

Karpagam Academy of Higher Education may from time to time revise, amend or change the Regulations, Scheme of Examinations and syllabi if found necessary.

# Karpagam Innovation and Incubation Council (KIIC)

**(A Section 8 Company)**

Based on the 2019 National Innovation and Startup Policy and the 2019–2023 Tamil Nadu Startup Policy, KIIC has recommended to the KAHE students who are affiliated with the KIIC that it be incorporated in the university Program Regulations 2023-24 and implement from this academic year.

## Norms to Student Start-Ups

a) Any (UG/PG /(Ph.D.) Research scholars, student, right from the first year of their program is allowed to set a startup (or) work part time/ full time in a startup or work as intern in a startup

b) Any (UG/PG / (Ph.D.) Research scholars) student right from the first year of their program is allowed to earn credit for working on Innovative prototypes/business Models/ Pre incubation (case to case basis).

c) Start Up activities will be evaluated based on the guidelines being given by the expert committee of the KIIC

d) Student Entrepreneurs may use the address of incubation center (KIIC) to register their venture while studying in KAHE.

e) Students engaged in startups affiliated with the KIIC or those who work for them may be exempted from KAHE's attendance requirements for academic courses under current regulations, up to a maximum of 30% attendance per semester, including claims for ODs and medical emergencies Potential Students who have been incubated at KIIC may be permitted to take their University semester exams even if their attendance is below the minimum acceptable percentage, with the proper authorization from the head of the institution.
(On case-to-case basis depends upon the applicability strength, societal benefits and quality of the Innovation and Subsequent engagement of the students with the/ her business)

f) Any Students Innovators/entrepreneurs are allowed to opt their startup in place mini project /major project, /seminar and summer training etc. (In plant training, Internship, value added Course.). The area in which the student wishes to launch a Startup may be interdisciplinary or multidisciplinary.

g) Student’s startups are to be evaluated by Expert committee, formed by KIIC and KAHE

## Guide lines to award Credits/ Marks to a Student startup

Student’s startup stages are divided into five phases and these startup phases can be considered equally in place of the course title as mentioned below with the same credits allotted to the course title in a University curriculum.

| Sl. No. | Description/Startup phases | In place of the Subject / Course title | Grades/Credits /Marks |
|---|---|---|---|
| 1 | **Idea stage/Problem Identification** | **Seminar** | **Same Marks/Credits can be awarded that are listed in the course title's curriculum for the respective startup phases.** |
| 2 | **Proof of Concept (POC) /Solution development** | **In-plant training /Internship** | |
| 3 | **Product Development (Lab scale) /Prototype Model/ Company Registered** | **Mini Project/ Value added Course** | |
| 4 | **Validation/Testing** | **Main Project phase I** | |
| 5 | **Business Model/Ready for Commercialization/Implementation** | **Main Project phase II,** | |

**DEPARTMENT OF BIOTECHNOLOGY**
**FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT**
**PG PROGRAMME (CBCS) – M.Sc., Biotechnology (2023–2024 Batch and Onwards)**

| Course code | Name of the course | Objectives and Outcomes | | Instruction hours/Week | | | Credit (s) | Marks | | | Category | Page.No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PEOs | POs | L | T | P | | CIA | ESE | Total | | |
| **SEMESTER – I** | | | | | | | | | | | | |
| 23BTP101 | Biochemistry | I | a | 4 | 0 | 0 | 4 | 40 | 60 | 100 | CC | 6 |
| 23BTP102 | Microbiology | I | a | 4 | 0 | 0 | 4 | 40 | 60 | 100 | CC | 8 |
| 23BTP103 | Cell Biology and Molecular genetics | I | a | 4 | 0 | 0 | 4 | 40 | 60 | 100 | CC | 10 |
| 23BTP104 | Bioinstrumentation and Biostatistics | I,II | a,b | 3 | 1 | 0 | 4 | 40 | 60 | 100 | CC | 12 |
| 23BTP105A<br>23BTP105B<br>23BTP105C | Ecology, Biodiversity and Evolutionary Biology<br>Microbial Genetics<br>System Biology | I | a | 4 | 0 | 0 | 4 | 40 | 60 | 100 | EC | 14-19 |
| 23BTP111 | Analytical Biochemistry Practical–I | II | b,c | 0 | 0 | 4 | 2 | 40 | 60 | 100 | CC | 20 |
| 23BTP112 | Microbiology and Molecular Genetics Practical–II | II | b,c | 0 | 0 | 4 | 2 | 40 | 60 | 100 | CC | 22 |
| Journal Paper Analysis & Presentation | | IIIIV | d | 2 | 0 | 0 | - | - | - | - | CC | 24 |
| **Semester total** | | | | **21** | **1** | **8** | **24** | **280** | **420** | **700** | | |
| **SEMESTER – II** | | | | | | | | | | | | |
| 23BTP201 | Recombinant DNA technology | I,III | a, e,f | 4 | 0 | 0 | 4 | 40 | 60 | 100 | CC | 25 |
| 23BTP202 | Immunology and Immunotechnology | I,III | a, e,f | 4 | 0 | 0 | 4 | 40 | 60 | 100 | CC | 27 |
| 23BTP203 | Molecular and Developmental Biology | I,III | a, e,f | 3 | 1 | 0 | 4 | 40 | 60 | 100 | CC | 30 |
| 23BTP204 | Fermentation and BioprocessTechnology | I,III | a, e,f | 4 | 0 | 0 | 4 | 40 | 60 | 100 | CC | 32 |
| 23BTP205A<br>23BTP205B<br>23BTP205C | Microbial Biotechnology<br>Marine Biotechnology<br>Biosafety and IPR | I,III | a, e,f | 4 | 0 | 0 | 4 | 40 | 60 | 100 | EC | 34-40 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23BTP211 | Recombinant DNA, Bioprocess and FermentationTechnology Practical–III | II,III | b,c | 0 | 0 | 4 | 2 | 40 | 60 | 100 | CC | 41 |
| 23BTP212 | Immunology and Immuno technology Practical – IV | II,III | b,c | 0 | 0 | 4 | 2 | 40 | 60 | 100 | CC | 43 |
| Journal Paper Analysis & Presentation | | III,IV | d | 2 | 0 | 0 | - | - | - | - | CC | 45 |
| **Semester total** | | | | **21** | **1** | **8** | **24** | **280** | **420** | **700** | | |
| **SEMESTER- III** | | | | | | | | | | | | |
| 23BTP301 | Plant Biotechnology | I,III | a, e,f | 4 | 0 | 0 | 4 | 40 | 60 | 100 | CC | 46 |
| 23BTP302 | Animal Biotechnology | I,III | a, e,f | 4 | 0 | 0 | 4 | 40 | 60 | 100 | CC | 48 |
| 23BTP303 | Environmental Biotechnology | I,III | a, e,f | 4 | 0 | 0 | 4 | 40 | 60 | 100 | CC | 50 |
| 23BTP304 | Genomics, Proteomics and Bioinformatics | I,III | a, e,f | 3 | 1 | 0 | 4 | 40 | 60 | 100 | CC | 52 |
| 23BTP305A<br>23BTP305B<br>23BTP305C | Food Biotechnology<br>Agricultural Biotechnology<br>Pharmaceutical Biotechnology | I,III | a, e,f | 3 | 0 | 0 | 3 | 40 | 60 | 100 | EC | 54-59 |
| 23BTP311 | Plant and Animal Biotechnology Practical–V | II, III | b,c | 0 | 0 | 4 | 2 | 40 | 60 | 100 | CC | 60 |
| 23BTP312 | Genomics, Proteomics and Bioinformatics Practical–VI | II, III | b,c | 0 | 0 | 3 | 2 | 40 | 60 | 100 | CC | 62 |
| Journal Paper Analysis & Presentation | | III, IV | d | 1 | 0 | 0 | - | - | - | - | CC | 64 |
| Open elective | | I | a | 3 | 0 | 0 | 2 | 40 | 60 | 100 | OE | 65-86 |
| 23BTP391 | Internship Programme | III, IV | d,e,f,g | - | - | - | 2 | 100 | 0 | 100 | | 87 |
| **Semester total** | | | | **22** | **1** | **7** | **27** | **420** | **480** | **900** | | |
| **SEMESTER – IV** | | | | | | | | | | | | |
| 23BTP491 | Project and Viva Voce | III, IV | d,e,f,g | - | - | - | 15 | 80 | 120 | 200 | CC | 88 |
| **Semester total** | | | | **-** | **-** | **-** | **15** | **80** | **120** | **200** | | |
| | | | | **64** | **3** | **23** | **90** | **1060** | **1440** | **250** | | |

**Elective courses***

| Elective –1 (20BTP105) | | Elective –2 (20BTP205) | | Elective –3 (20BTP305) | |
|---|---|---|---|---|---|
| **Course code** | **Name of the course (Theory)** | **Course Code** | **Name of the course (Theory)** | **Course Code** | **Name of the course** |
| 23BTP105A | Ecology, Biodiversity and Evolutionary Biology | 23BTP205A | Microbial Biotechnology | 23BTP305A | Food Biotechnology |
| 23BTP105B | Microbial Genetics | 23BTP205B | Marine Biotechnology | 23BTP305B | Agricultural Biotechnology |
| 23BTP105C | System Biology | 23BTP205C | Biosafety and IPR | 23BTP305C | Pharmaceutical Biotechnology |

| Open Elective Course | | | |
|---|---|---|---|
| **Semester** | **Subject code** | **Subject** | **Page.No** |
| III | 23MBAPOE301 | Organisational Behaviour | 65 |
| III | 23PHPOE301 | Material Characterization | 67 |
| III | 23CAPOE301 | Robotics Process Automation | 69 |
| III | 23BCPOE301 | Nutrition and Dietetics | 71 |
| III | 23CSPOE301 | Cyber Forensics | 73 |
| III | 23CMPOE301 | Personal Finance and Planning | 75 |
| III | 23CHEOE301 | Chemistry in Everyday Life | 77 |
| III | 23MBPOE301 | Fermentation Technology | 79 |
| III | 23EGPOE301 | English for Competitive | 81 |
| III | 23BTPOE301 | Sericulture | 83 |
| III | 23MMPOE301 | Coding Theory | 85 |

*Electives areTransborder/cross disciplinary / Discipline centric elective nature.

**Blue – Employability, Green– Entrepreneurship, Red- Skill Development**

**PROGRAMME OUTCOMES (POs)**

1. Graduates will able to have knowledge on the basic and applied theories.
2. Ability to design and conduct experiments as well as to interpret the results.
3. Graduates will be able to visualize and work on multidisciplinary laboratory problems.
4. Making the graduates to demonstrate their communication effectively and scientifically as independent researcher.
5. Providing a broad educational, and analytical knowledge necessary to make the students for appearing in competitive examinations.
6. Generating the graduates with anability to identify and formulate process/product with professional, societal and ethical responsibilities.
7. Graduates will be able to recognize the needs for life long learning.

## PROGRAMME SPECIFIC OUTCOMEs (PSOs)

**To enable the student to emerge as:**

a) An expert to work on biotechnological concepts with modern tools and techniques towards product and process development for academic, industrial and research applications.

b) Proficiency to demonstrate entrepreneurial and leadership skills with life-long learning.

## PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

**PEO I:**The post-graduates of Biotechnology will be able to acquire thein-depth knowledge of the basic and applied subjects of Biotechnology.

**PEO II:**The post-graduates of Biotechnology are equipped to design,analyze,conduct and interpret the experiments and data for the development of process/product within the realistic constraints.

**PEO III:**The post-graduates of Biotechnology will be able to acquire the knowledge and ability to use the concept of theories, practical skills and recent technological tools insolving any technological and professional issues independently in a global and societal context.

**PEO IV:**The graduates of Biotechnology will continue to learn to update and to be come an entrepreneur in a competitive world and also contribute to all forms of life.

## MAPPING OF PEOs AND POs

| PEOs | Programme Outcome(s) | | | | | | |
|---|---|---|---|---|---|---|---|
| | (a) | (b) | (c) | (d) | (e) | (f) | (g) |
| PEO I | × | × | | × | × | | |
| PEO II | | × | × | × | | × | |
| PEO III | | | | × | × | × | |
| PEO IV | | | | × | × | × | × |

SEMESTER–I

**23BTP101** **BIOCHEMISTRY** **4H –4C**

**InstructionHours/week:L:4 T:0 P:0** **Marks:**Internal:**40** External:**60** Total:**100**
**End Semester Exam:**3Hours

**Course Objectives**

The main objectives of the course are

- To understand the key concepts of cellular structure and organization of various biomolecules
- To attain strong theoretical knowledge on three-dimensional construction of biological macromolecules and the principles of molecular recognition
- To understand the functions and importance of various biomolecules
- To describe the various metabolic pathways involved in cells for its normal functioning
- To obtain strong background on how the DNA is selectively expressed as functional proteins
- To obtain necessary knowledge on disorders associated with metabolism of biomolecules

**Course Outcomes**

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

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Understand Biochemistry as discipline and mile stone discoveries in life sciences that led to establishment of Biochemistry as separate discipline | Understand |
| CO2 | Understand fundamental properties of elements, their role information of biomolecules and in chemical reactions withinliving organisms | Understand |
| CO3 | Extend the structure of aminoacids, proteins, enzymes, chemical messengers, carbohydrates, lipids,and nucleic acid | Understand |
| CO4 | Develop the metabolism of carbohydrates,lipids,proteins and amino acids,and write chemical reactions for the individual steps in each pathway | Create |
| CO5 | To define the chemical reactions involved in biochemical pathways that produce ATP, such ascitric acidcycleandelectron transport | Remember |
| CO6 | Formulate the enzymes (biocatalysts),and their salient attributes including unique conformation and amazing catalytic properties | Create |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | S | S |
| **CO2** | S | S | S | S | L | S | S |
| **CO3** | M | S | S | S | L | S | S |
| **CO4** | M | M | M | M | L | M | M |
| **CO5** | M | M | M | M | L | M | M |
| **CO6** | M | M | M | M | L | M | M |

**S-Strong; M-Medium; L-Low**

**UNIT –I** **10 hours**

**Introduction: History of Biochemistry;** Chemical basis of life;Composition of living matter; **Structure and Properties of water** Structure-function relationships.

**UNIT-II** **10 hours**

**Biomolecules: Classification,** Structure and properties of carbohydrates,fattyacids aminoacids,proteins. Structure and properties of purines, pyrimidines,nucleosides,nucleotides,polynucleotides,ribonucleic acids and deoxy ribonucleic acids,nucleoprotein complexes.

**UNIT–III** **10 hours**

**Enzymology**:Enzymes classification and nomenclature;mechanism of action,regulation of enzymatic activity, enzyme kinetics – Michaelis Menton equation,Lineweaver burk plot and enzyme inhibition.

**UNIT- IV** **10 hours**

**Metabolism**:Biosynthesis and degradation of fattyacids and cholesterol,biosynthesis and degradation of aminoacids,peptides and proteins,biosynthesis and degradation of purines,pyrimidines and nucleic acids.

**UNIT –V** **8 hours**

**Bioenergetics**:TCA Cycle, glycolysis, gluconeogenesis,pentose phosphates hunt, Embden-Meyerh of pathway, ureacycle,interconnection of pathways,metabolic regulation,bioenergetics:Respiratory chain, ATP cycle,energy-rich compounds.

**SUGGESTED READINGS**


1. Jain,J.L.(2002).*Fundamentals of Biochemistry*(5ed.). New Delhi: S.Chand& Co.
2. Zubay,G.L.,Parson,W.W.,& VanceD.E.(1995).*Principles of Biochemistry*.(1st ed.) Oxford: MC thBrown Publishers.
3. Murray,R.K.,Bender, D.A.,Botham, K.M.,&Kennelly, P.J.,(2012).*Harper's illustrated Biochemistry* (29thed.).London:McGraw-HillMedical.
4. Voet,G.,&Voet,A.(2004).*Fundamentals of Biochemistry*(3 rd ed.). NewYork:JohnWileyand Sons,Inc.
5. Nelson,D.L.,&Cox,M.M.(2013).Lehninger: Principles ofBiochemistry (6thed.). New York: W.H. FreemanandCompany.

SEMESTER–I

23BTP102 MICROBIOLOGY 4H – 4C

**Instruction Hours/week: L:4 T:0 P:0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3Hours

**Course Objectives**

The main objectives of the course are

- To understand landmark discoveries in Microbiology and different domains classification of living organisms
- To be familiar with general characters of prokaryotes for conventional and molecular characterization using modern methods
- To understand the conceptual knowledge on metabolism of microorganisms
- To attain essential knowledge of cellular organization and life cycle of microorganisms
- To understand the economic importance of microorganisms
- To obtain information regarding diseases caused by microorganisms

**Course Outcomes**

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

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Demonstrate the principles and applications of microscopic techniques | Understand |
| CO2 | Demonstrate microbial structure and similarities and differences among various groups of microorganisms such as bacteria and fungi | Understand |
| CO3 | To organize microbial diversity using different methods and systematics of bacteria | Apply |
| CO4 | Discuss thevarious methods for identification of isolated and unculturable microorganisms | Understand |
| CO5 | Comprehend the various methods for identification of unknown microorganisms | Apply |
| CO6 | Discuss the industrial applications of microorganisms | Create |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | M | M |
| **CO2** | S | S | S | S | L | M | M |
| **CO3** | S | S | S | S | L | S | S |
| **CO4** | M | M | M | M | L | M | M |
| **CO5** | S | S | S | S | L | S | S |
| **CO6** | S | S | S | S | L | S | S |

**S-Strong; M-Medium; L-Low**

**UNIT-I** **10 hours**

**History and development of microbiology**:The history and development of Microbiology, Ultrastructure , Characterization and classification of bacteria, Viruses, fungi and algae, Bergy's system of classification. Molecular systematic classification. Abnormal forms of bacteria, archae bacteria, mycoplasma and PPLO.

**UNIT –II** **10 hours**

**Cultivation and Maintenance of microorganisms**: Types of media preparation, methods of sterilization, cultivation of bacteria – Principles of -microbial nutrition, physical requirements, Construction of culture media; Enrichment culture techniques for isolation of nutritional categories. Koch's postulates, Axenic culture, Isolation of pure cultures, maintenance and preservation of the pure cultures. Culture characteristics, bacterial growth kinetics and growth curve, Synchronous growth; Continuous culture; Influence of environmental factors on Growth; enumeration of cells by direct and indirect methods, Culture collection and maintenance of cultures.

**UNIT –III** **10 hours**

**Eukaryotic Microorganisms**- General characters, Structure and Reproduction of Slime molds. Michoriza: VAM, cyanobacteria, protozoa. **Virology:** Virus and bacteriophages, general properties of viruses, viral structure, **viral replication** : Lytic and lysogenic cycle of bacteriophages, cultivation and identification of viruses; sub-viral particles – viroids and prions. **Viral Genetics:** M13 and lambda.

**UNIT –IV** **10 hours**

**Microbial diseases and control measures:** Control and treatment of Bacterial - TB, Cholera and Typhoid. Protozoan - Amoebiasis and Malaria. **Viral diseases**: Hepatitis B, COVID-19 and HIV- symptoms, character, causes, diagnosis, precaution, **Plant viruses:** TMV- introduction and structure. Fungal Diseases: Aspergillosis-- symptoms, character, causes, diagnosis, precaution Control of microorganisms - drugs, chemotherapy, antimicrobial agents, Antifungal antibiotics; Chemotherapeutics, susceptibility test (broth procedures and diffusion methods), narrow and broad spectrum (Penicillin, ampicillin, sulfonamide, vancomycin, tetracycline, chloramphenicol), antifungals (clotrimazole, fluconazole), antiretroviral (tenofovir, AZT). mode of action of antibiotics; Resistance to antibiotics.

**UNIT- V** **8 hours**

**Application of microbiology**: Production of carbohydrates - Solvents: ethanol; Beverages: wine, Edible mushroom (Oyster, paddy straw, button) and medicinal mushroom, its types, production and their applications. Bioplastics, bacterial quorum sensing; microbial fuel cells; prebiotics and probiotics.

**SUGGESTED READINGS**


1. Black,J.G.(2002).*Microbiology Principlesand Explorations*.(9thed.) NewYork: JohnWiley and SonsPublishing.
2. Prescott,L.M.,Harley,J.P.&Klien,D.A.(2005).*Microbiology*.(6thed.) Boston:NY,McGraw- Hill PublishingCompany.
3. Talaro, K.P.,(2009).*Foundations inMicrobiology*.(8thed.) McGraw- HillPublishingCompany, NewYork.
4. Prescott,&Dunn's.(1984).*Industrial Microbiology* (4thed.).Conneticut:GeraldReed&AVI PublishingCompanyInc.
5. Pascale,C.(2005).*Cellular Microbiology*.(2nded.) New York: AmericanSocietyfor Microbiology.
6. Hui, Y.H.,Goddik, L.M.,Hansen,A.S.,Josephsen,J.,Nip,W.K.,Stanfield,P.S.,&Toldra,F. (2004). *Hand book of Food and Beverage Fermentation Technology*.London:Taylor and Francis publishers.
7. Pelczar, M.J.,Chan, E.C.S.,& Krieg,N.R.(1993).*Microbiology*(5thed.). McGraw Hill Book Company.
8. Roland,V.G.(2005).*AppliedFoodMicrobiology*.London: Star PublishingCo.
9. Atlas,R.M.(2015).*Principles ofMicrobiologyIllinois*:(2nded.) USA,WCBMcGraw Hillpublishers.

SEMESTER–I

23BTP103 **CELL BIOLOGY AND MOLECULAR GENETICS** 4H – 4C

**Instruction Hours/week:L:4 T:0 P:0** **Marks:**Internal:**40** External:**60** Total:**100**

**End Semester Exam:**3Hours

**Course Objectives**

Themainobjectivesofthecourseare

- To understand the structures and functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles
- To understand how the cellular components are used to generate and utilize energy in cells
- To understand the cellular components underlying cell division
- To impart knowledge in genetics and genome organizations inorganisms
- To understandtheprinciples of extensions to Mendelian inheritance, including multiple allelism, lethal alleles and gene interactions
- To obtain knowledge on normal chromosome number, structure and behaviors in human cells, and understand the cause and effect of alterations in chromosome number and structure

**Course Outcomes**

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Describe the structures and basic components of prokaryotic and eukaryotic cells | Understand |
| CO2 | Elaborate how the cellular components are used for various cellular activities | Create |
| CO3 | Demonstrate the pathways involved in various cellular events including cell cycle | Understand |
| CO4 | Understand the inheritance of genes among plants and animals and the genetic makeover as well as the physical appearance of organisms | Understand |
| CO5 | To apply the Mendelian inheritance and the inheritance of gene in human beings | Apply |
| CO6 | Illustrate the effect of chromosomal abnormalities in human diseases | Understand |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | M | M | M | M | L | M | M |
| **CO2** | S | S | S | M | L | M | M |
| **CO3** | M | M | M | M | L | M | M |
| **CO4** | M | M | M | M | L | M | M |
| **CO5** | S | S | S | M | L | M | M |
| **CO6** | M | M | M | M | L | M | M |

**S-Strong; M-Medium; L-Low**

**UNIT- I** **10 hours**

**Cellorganization:**

Structure of prokaryotic and eukaryotic cells, Structural organization and function of intracellular organelles (Nucleus, Endoplasmic Reticulum,Golgi complex,Mitochondria,Chloroplast, Lysosomes, Peroxisomes and vacuoles),Cytoskeletons.Chromatin organization and packaging. Lipid bilayer and membrane protein diffusion,osmosis,ion channels, active transport, and ion pumps.Intracellular protein sorting-Mechanism and regulation of intra cellular transport in mitochondria,chloroplast, endoplasmic reticulum and nucleus. Electrical properties of membranes.

**UNIT- II** **10 hours**

**Cell regulation:**

Nucleicacid-Replication,Types, Transcription, Post transcriptional modification,Translation and Post translational modification, Regulation of gene expression. Cell cycle and its regulation, Cell cycle Check points, Cyclins and protein kinases.

**UNIT- III** **10 hours**

**Genetics:**

Mendelian and Non-Mendelian principles. Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests. Genetic recombination,Linkage and Crossingover. Mutations-Typesof Mutation,Genetic analysis of Mutations,DNA repair Mechanisms.

**UNIT- IV** **10 hours**

**Genetic transformation,Genome mapping and Transposable elements:**

Gene transfer in Bacteria- Transformation,Conjugation,Transduction.Mapping genes by interrupted mating, Linkage maps,Tetrad analysis,Mapping with molecular markers,Mapping by using somatic cell hybrids.Introduction to Transposable elements–Discovery and types, Mechanism of Insertion sequences–Transposons of *E.coli*, Bacteriophage and Yeast.

**UNIT- V** **8 hours**

**Microbial and Human genetics:**

Bacteriophages - properties, Structure, Role of phages as vectors.Human genetics -Pedigree analysis,linkage testing,karyotypes,genetic disorders, Eugenics.Epigenetics & Genome Imprinting. Structural and numerical alterations of chromosomes, Ploidy and its genetic implications,Quantitative genetics-Polygenetic inheritance,Heritability and its measurements, Quantitative Trait Locus(QTL) mapping.

**SUGGESTED READINGS:**


1. Alberts,B.(2017*). Molecular BiologyoftheCell*(Sixth ed.). Garland SciencePublication.
2. Cooper,G.M.(2018).*TheCell:A Molecular Approach*(Eighthed.). SinauerAssociates (Oxford University Press).
3. Krishnaiya,G.R. (2019).*ATextbook ofMicrobial Genetics &MolecularBiology* (First ed.). BlueRosePublishers.
4. Strachan,T.,Read,A.(2018).*HumanMolecular Genetics*(Fifth ed.).Garland Science Publication.
5. MOOC:https://nptel.ac.in/courses/102103012/
6. MOOC:https://nptel.ac.in/courses/102104052/
7. Ranzoni,A.M.,Cvejic,A.(2018*).Single-cellbiology:resolving biological complexity, onecell atatime*.Development.TheCompany ofBiologistsPublication.
8. E-content:http://172.16.25.76/course/view.php?id=1602

SEMESTER–I

23BTP104 **BIOINSTRUMENTATION AND BIOSTATISTICS** 4H-4C

**InstructionHours/week:L:3 T:1 P:0** **Marks:** Internal:**40** External:**60** Total:**100**

**End Semester Exam:**3Hours

**Course Objectives**

The main objectives of the course are

- To understand the fundamental principles of bioinstrumentation commonly used in biomedical research labs and hospitals
- To comprehend the colorimetric and spectroscopic principles
- To recognize the concepts on centrifugation and chromatography
- To obtain key knowledge on electrophoresis
- To understand key concepts on biostatistics and its various tools
- To attain strong knowledge on the applications of biostatistics and its relevant softwares

**Course Outcomes**

Onsuccessful completion of the course, the learners will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Demonstrate the bioinstrumentation principles with respect to device desig and applications | Understand |
| CO2 | To apply colorimetric and spectroscopic methods to analyze biological samples | Apply |
| CO3 | Apply the principles centrifugation and chromatography for compound separation | Apply |
| CO4 | Propose the separation of nucleic acids and proteins using electrophoresis | Create |
| CO5 | Recognize the definition of biostatistics and its relation with other sciences | Apply |
| CO6 | Apply the biostatistical knowledge analyzing biological problems using relevant softwares | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | S | S |
| **CO2** | S | S | S | S | L | S | S |
| **CO3** | S | S | S | S | L | S | S |
| **CO4** | M | M | M | M | L | M | M |
| **CO5** | M | M | M | M | L | M | M |
| **CO6** | M | M | M | M | L | M | M |

**S-Strong; M-Medium; L-Low**

**UNIT–I Microscopy, Colorimetryand Spectroscopy: 10 hours**

**Microscopy :** Introduction: Principle and applications of Simple, Compound, Fluorescent, Phase Contrast, Bright & Dark Field, Atomic Force, Laser Confocal and Electron Microscope (SEM & TEM). UV-NIR, AAS, ICPMS Colorimetry and Spectroscopy**:**Calorimetry,basic principles**,**Color and absorption spectra,Beer's and Lambert's law.,Instrumentation and applications of UV Visible light spectroscopy, Spectrofluorimeter, FTIR, NMR spectroscopy–2D and 3D structure prediction.

**UNIT–II Centrifugation and Chromatography:** **10 hours**

Principle,types of centrifuges,Principles, g and RPM value, Applications of analytical and preparative centrifuge,density gradient and ultra-centrifuge.Chromatography:Principles,Type- Paper, thin layer, normal and reverse phase,ion-exchange,affinity,gel-filtration,size exclusion, HPTLC,HPLC and FPLC.MALDI-TOF-MS, extraction methods (Supercritical fluid CO2, microwave assisted, ultrasound assisted etc), GC-MS& LC-MS (QTOF and QQQ).

**UNIT–III Electrophoresis:** **10 hours**

Principle,instrumentation and applications of Electrophoresis:Agarose gel electrophoresis,Sodium dodecyl sulphate-polyacrylamide gel (SDS-PAGE),native PAGE, immuno, pulse field, gel, capillary electrophoresis,2D-Electrophoresis,isoelectric focusing, gel documentation and image analysis, Immuoblotting.

**UNIT- IV Biostatistics**: **10 hours**

Data collection,classification and presentation of tabulation.Measures of central tendency–mean, median and mode. Measures of dispersion–mean deviation, standard deviation, standard errorand analysis of variance.Probability and probability distribution–theorems, binomial, poisson and normal distribution.Correlation and regression–simple correlation, correlation co-efficient, simple and linear regression analysis.

**UNIT- V Applications of biostatistics**: **8 hours**

Randomized block design,ANOVA,Test of significance-F, t, DMRT and chi-square test. Statistical and graphical software–SPSS and other softwares. Case studies.Statistical software's (Microsoft excel, graph pad prism, epi graph, origin etc)

**SUGGESTED READINGS:**


1. Sawhney, S.K.& Singh, R. (2005). Introductory *Practical Biochemistry* (2nded.). Alpha Science International Ltd. Publishers, Oxford, United Kingdom.
2. Chatwal, G.R.&Anand, S.K. (2014). *Instrumental Methods of Chemical Analysis* (5thed.). Himalaya PublishingHouse,Mumbai,India.
3. Glover,T.&Mitchell,H.(2015).*An Introduction to Biostatistics* (3rded.). WavelandPress,I llinois, United States.
4. Hofmann, A. &Clokie, S. (2018). *Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology*(8thed.).CambridgeUniversity Press,Cambridge,United Kingdom.
5. Rosner,B. (2015). *Fundamentals of Biostatistics* (8thed.). Cengage Learning Publishers, Massachusetts,United States.
6. Sawhney, S.K.&Singh,R. (2005).Introductory *Practical Biochemistry* (2nded.).Alpha Science International Ltd.Publishers, Oxford,United Kingdom.
7. Sharma,B.K.(2011).*InstrumentalMethods ofChemicalAnalysis*(1sted.). Krishna Prakashan MediaPublishers, Meerut,India.
8. Veerakumari, L.(2009).*Bioinstrumentation*.MJP Publishers, Chennai,India.

SEMESTER–I

**23BTP105A ECOLOGY,BIODIVERSITY AND EVOLUTIONARY BIOLOGY 4H-4C**

**InstructionHours/week:L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total:**100**

**End Semester Exam:**3Hours

**Course Objectives**

The main objectives of the course are

- To know the concepts of ecological principles community ecology.
- To acquire knowledge on conservation ecology.
- To realize the fundamentals of biodiversity.
- To recognize the significance of ecological ethics and human genome project.
- To comprehend the principles of Darwinism and mendalism.
- To escalate the basic concepts of molecular evolution.

**Course Outcomes**

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

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Learn the fundamental principles and concepts of ecology | Understand |
| CO2 | Use this knowledge to conserve ecosystem biodiversity | Understand |
| CO3 | Develope relationships, distribution, abundance and interactions of their organisms, populations andenvironments | Create |
| CO4 | Demonstrate the ecological ethics issues and human genome project | Understand |
| CO5 | Learn the basics of Darwinism and mendalism in evolutionary biology. | Apply |
| CO6 | Analyze the concepts of molecular evolution using various tools. | Understand |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | S | S |
| **CO2** | S | S | S | S | L | S | S |
| **CO3** | S | S | S | S | L | S | S |
| **CO4** | M | M | M | M | L | M | M |
| **CO5** | M | M | M | M | L | M | M |
| **CO6** | M | M | M | M | L | M | M |

**S-Strong; M-Medium; L-Low**

**UNIT-I Ecological Principles** **10 hours**

The Environment: Physical,biotic environment;interactions.Habitat and Niche:Concepts,types. Population Ecology:Characteristics,growth curves;regulation;life history strategies (r and K selection); concept to meta populations.Species Interactions:Types.Community Ecology, Ecological Succession:Types; mechanisms; changes,concept of climax.

**UNIT–II Ecosystem,Applied and Conservation Ecology** **10 hours**

Ecosystem structure;function; energy flow and mineral cycling(C,N, P),structure and function of some Indian ecosystems:terrestrial (forest,grassland) and aquatic (freshwater,marine,estuarine). Biogeography:Major terrestrial biomes;theory;biogeographical zones of India. Applied Ecology: pollution;global change; biodiversity: status,monitoring and documentation;major rivers, management approaches. Conservation Biology:Principles, approaches,Indian case studies on conservation/management strategy (ProjectTiger, Biosphere reserves).

**UNIT –III Biodiversity** **8 hours**

Introduction, types, concepts, values,uses,Measures of biodiversity.Vegetation types of India. Hotspot biodiversity are as in India,Red Listed plants and RED Data Book,Threatened plants and animals of India.Role of biotechnology;Conservation biodiversity- *Insitu*and *ex situ* methods.Molecular markers and their application in plant conservation.National Biodiversity Authority. Protection of environment and biodiversity

**UNIT –IV Introduction to Evolutionary Biology** **10 hours**

Emergence, Lamarck; Darwin–concepts,Mendelism;Origin of cells and unicellular evolution:Concept of Oparin and Haldane;The first cell; Evolution of prokaryotes,eukaryotic, unicellular eukaryotes. Origins of unicellular and multicellular organisms; plants and animals;Molecular Evolution:Concepts and tools

**UNIT-V Evidences of Evolution** **10 hours**

Paleobiological–Concept of Stratigraphy and geological time scale;fossil study (types,formation and dating methods).Anatomical–Vestigialorgans;Homologous and Analogous organs (concept of parallelism and convergence in evolution). Taxonomic – Transitional forms/evolutionary intermediates;living fossils.Phylogenetic– a) Fossil based–Phylogeny of horse as a model. b) Molecule based–Protein model (Cytochrome C);genemodel (Globin gene family)

**SUGGESTED READINGS:**


1. Gilbert,S.F.&Barresi,M.J.F.(2016).*Developmental Biology*(11$^{th}$ed.).Sinauer Associates (Oxford University Press), Sunderland,United Kingdom.
2. Krishnamoorthy, K.V. (2017). *An advanced Text Book on Biodiversity: Principles and Practice*(1$^{st}$ed.). Oxford&IBH Publishers, New Delhi,India.
3. Minelli, A. (2018). *Plant Evolutionary Developmental Biology: The Evolvability of the Phenotype*(1$^{st}$ed.). Cambridge University Press, Cambridge,United Kingdom.
4. Odum,E.P.&Barrett,G.W.(2004).*Fundamentals of Ecology*(5$^{th}$ed.).Cengage Learning Publishers, Massachusetts,United States
5. Pontarotti, P. (2016). *Evolutionary Biology: Convergent Evolution, Evolution of ComplexTraits,Concepts and Methods*(1$^{st}$ed.). Springer Publishers, New York, United States.
6. T. Pullaiah(2019).Global Biodiversity by Apple Academic Press.Vol;4ISBN :9781771887519

SEMESTER–I

**23BTP105B** **MICROBIAL GENETICS** **4H-4C**

**InstructionHours/week:L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total:**100**

**End Semester Exam:**3Hours

**Course Objectives**

The main objectives of the course are

- To focus on the basic principles of genetics incorporating the concepts of classical molecular and population of genetics.
- To discuss about the microbial genes,genomes,and expression is essential for understanding the biology and evolution of microorganism and their interaction with the environment.
- To Understanding the central dogma of biology
- To understand theTranscription and Translation Process.
- To give a strong charity about genetics principle and genetic engineering.
- To give a vast knowledge about the transposable elements and their importance

**Course Outcomes**

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

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Have basic awareness and outline of Molecular Biology with unique reference to microbial genome. | Understand |
| CO2 | Describe the nature of molecular world and its application in modern Microbiological sectors | Understand |
| CO3 | Understand the process of Mutation and mutagenesis | Understand |
| CO4 | Build knowledge about the central dogma of biology. | Create |
| CO5 | Understand the concepts of genetic recombination techniques | Apply |
| CO6 | Gain the awareness about the transposons and its applications | Understand |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | S | S |
| **CO2** | S | S | S | S | L | S | S |
| **CO3** | S | S | S | S | L | S | S |
| **CO4** | M | M | M | M | L | M | M |
| **CO5** | M | M | M | M | L | M | M |
| **CO6** | M | M | M | M | L | M | M |

**S-Strong; M-Medium; L-Low**

**UNIT–I History of Genetics:** **8 hours**

Concept of genetics, Mendelian principles, DNA as a genetic material, Experimental evidence chromosomal theory of inheritance.DNA structure,models of DNA,RNA structure and types.DNA replication in prokaryotes and eukaryotes.

**UNIT–II: Central Dogma: 10 hours**

Central Dogma: An Overview, Transcription process, Transcription in bacteria - Initiation of transcription at promoters, elongation of an RNA chain, termination of an RNA chain. Transcription in Eukaryotes - Eukaryotic RNA polymerase, Transcription of protein- coding genes by RNA polymerase II, Transcription initiation, The structure and production of Eukaryotic mRNAs, Production of mature mRNA in Eukaryotes, Processing of Pre-mRNA to mature mRNA. Self Splicing of Introns, RNA editing. Genetic code - Nature of genetic code and characteristics of genetic code. Translation process - Transfer RNA, structure of tRNA, tRNA genes, Recognition of the tRNA anticodon by the mRNA codon, Adding of amino acid to tRNA, Ribosomal RNA and Ribosomes, Ribosomal RNA Genes, Initiation of translation, Initiation in Bacteria, Initiation in eukaryotes, Elongation of the polypeptide chain, termination of translation, protein sorting in the cell.

**UNIT–III: Genetic analysis of Bacteria 10 hours**

Gene transfer mechanisms in bacteria, Transformation: Introduction and History, Types of transformation in prokaryotes--Natural transformation in Streptococcus pneumoniae, Haemophilus influenzae, and Bacillus subtilis. Mapping of bacterial genes using transformation.Problems based on transformation. Conjugation: Discovery of conjugation in bacteria, Properties of F plasmid/Sex factor. The conjugation machinery: Hfr strains, their formation and mechanism of conjugation, F' factor, origin and behavior of F' strains

**UNIT–IVRecombination in Bacteria: 10 hours**

Models for homologous recombination, Molecular basis of recombination, Holliday model of recombination (Single strand DNA break model only), Enzymes required for recombination, Site –specific recombination. Homologous recombination protein machines. Homologous recombination in eukaryotes. Genetic consequences of the mechanism of Homologous recombination

**UNIT–VDNA repair mechanisms: 10 hours**

Types of repair mechanisms i. Direct repair, ii. Light dependent repair, iii. Excision repair in E. coli and mammalian cells, iv. Mismatch repair, controlling the direction of mismatch repair, v. Base flipping by methylases and glycosylases, vi. Recombination repair in E. coli, recombination as a mechanism to recover from replication errors, vii. SOS repair, viii. Conserved repair systems in eukaryotic cells, ix. Non-homologous end joining (NHEJ) pathway for repairing double stranded breaks. Inherited human diseases with defects in DNA repair

**SUGGESTED READINGS:**


1. Klug,W.S.,Cummings,M.R., Spencer,C.,Palladino,M.(2011).Concepts of Genetics, 10th edition, Benjamin Cummings.
2. Krebs,J.,Goldstein,E.,Kilpatrick, S.(2013).Lewin'sEssential Genes, 3rdedition,Jones and Bartlett Learning.
3. Pierce, B.A.(2011) Genetics:A Conceptual Approach,4th edition,Macmillan Higher Education Learning.
4. Watson,J,D.,Baker, T.A.,Bell, S.P.,et al. (2008) Molecular Biology of the Gene, 6th edition, Benjamin Cummings.
5. Gardner,E.J.,Simmons,M.J., Snustad,D,P.(2008). Principles of Genetics.8th edition,Wiley- India.
6. Molecular genetics 3rd edition by David P.Clark, Michelle R.Mc Gehee,and NanetteJ.Pazdernik. (2018).
7. Molecular Cell biology sixth edition(2016) by Lodish,Berk, Kaiser, Krieger, Scott,Bretscher, Ploegh,Matsudaira.

SEMESTER–I

23BTP105C **SYSTEM BIOLOGY** 4H-4C

**Instruction Hours/week: L: 4 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3 Hours

**Course Objectives**

The main objectives of the course are

- To give knowledge on system biology and its application
- To offer knowledge on biological databases
- To understand and analyze the protein/nucleotide sequences and to predict its 3D structure
- To understand the various online databases for submitting and retrieving data's
- To understand how the phylogeny plays a vital role in finding ambiguities
- To get practiced with the tools and techniques for analyzing the data

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Understand the relationship between sequence - structure - function of genes | Understand |
| CO2 | Familiarize with the algorithms required to compare sequences and require to know the phylogenetic relationship between the gene sequences | Understand |
| CO3 | To apply knowledge on building 3D structures of genes | Apply |
| CO4 | Locate and use the main databases at the NCBI and EBI resources | Understand |
| CO5 | Know the difference between databases, tools, repositories and be able to use each one to extract specific information | Apply |
| CO6 | Use selected tools at NCBI and EBI to run simple analyses on genomic sequences | Create |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | S | S |
| **CO2** | S | S | S | S | L | S | S |
| **CO3** | S | S | S | S | L | S | S |
| **CO4** | M | M | M | M | L | M | M |
| **CO5** | M | M | M | M | L | M | M |
| **CO6** | M | M | M | M | L | M | M |

**S-Strong; M-Medium; L-Low**

**UNIT - I** **10 hours**

**Introduction to Systems Biology:** Introduction to Systems Biology. Need for System Analysis in Biology. Basic Concepts in System Biology: Component vs System, Links and Functional States, Links to Networks, Hierarchical Organization in Biology. systems, scales, static/dynamic, approaches, limitations, reductionism; central dogma; mathematical models; computational analysis; statistics of prokaryotes and eukaryotes.

**UNIT – II** **10 hours**

**Metabolic Networks and Models in System Biology:** Basic Features of Metabolic Networks. Reconstruction Methods of Metabolic Networks. Models as Dynamical Systems. SYN1, SYN3 and molecular simulation, Parameter Problem. Meanings of Robustness.

**UNIT – III** **8 hours**

**Systems Biology Databases** KEGG (Kyoto Encyclopedia of Genes and Genomes). BRENDA (BRaunschweig ENzyme DAtabase). BioSilico. EMP (Embden-Meyerhof-Parnas). MetaCyc and AraCyc. SABIO-RK (System for the Analysis of Biochemical Pathways - Reaction Kinetics). BioModels.

**UNIT – IV** **10 hours**

**Tools for System Biology:** Cell Designer. Ali Baba. Cell Profiler. JDesigner. Bio-SPICE (Biological Simulation Program for Intra and Inter Cellular Evaluation). SBML (Systems Biology Markup Language). SBGN (Systems Biology Graphical Notation). SBML-SAT (SBML based Sensitivity Analysis Tool).

**UNIT – V** **10 hours**

**Premises & Promises of Systems Biology:** Premise of Systems Biology. Promise of Systems Biology. Challenges of Systems Biology. Applications of Systems Biology.

**Suggested Readings**


1. Palsson, B.O. (2006). *Systems Biology: Properties of Reconstructed Networks.* Cambridge University Press, Cambridge, United Kingdom.

2. Junker, B.H. & Schreiber, F. (2011). *Analysis of Biological Networks.* Wiley-Interscience Publishers, New Jersey, United States.

3. Lodhi, H.M. & Muggleton, S.H. (2010) *Elements of Computational Systems Biology.* Wiley-Blackwell Publishers, New Jersey, United States.

4. Cánovas, M., Iborra, J.L., & Manjón, A. (2006). *Understanding and Exploiting Systems Biology in Biomedicine and Bioprocesses.* CajaMurcia Foundation, Spain.

5. Sensen, C.W. (2002). *Essentials of Genomics and Bioinformatics*. Wiley-VCH Publishers, New Jersey, United States.

6. Pennington, S.R. & Dunn, M.J. (2002). *Proteomics.* Viva Books Pvt. Ltd., New Delhi, India.

7. Voit, E. (2017). *A First Course in Systems Biology* (2nd ed.).Garland Science Publishers, United States.

8. http://www.systemsbiology.org

9. http://www.systems-biology.org

SEMESTER–I

**23BTP111** **ANALYTICAL BIOCHEMISTRY PRACTICAL–I** **4H - 2C**

**Instruction Hours/week: L:0 T:0 P:4** **Marks:** Internal:**40** External:**60** Total:**100**

**End Semester Exam:** 3Hours

**Course Objectives**

The main objectives of the course are

1. To execute the laboratory experiments, independently using the standard methods and techniques in Biochemistry
2. Offer knowledge to execute the experiments flawlessly
3. To train the students of the subjecton handling various experimental methods and techniques in order to analyze the given biological samples from biochemical standpoints
4. To provide quantitative analysis of the macromolecules in the given sample and analyze the results
5. Carry out the purification of a variety of enzymes
6. Understand quantification of sugars, aminoacids and lipids

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Apply the knowledge of various biochemical techniques in the laboratory | Apply |
| CO2 | Acquire skills to quantitatively estimate the range of biomolecules using appropriate biochemical techniques | Understand |
| CO3 | Implement the knowledge of biochemistry in the analysis of various biological macromolecules | Create |
| CO4 | Describe the quantification methods of sugars, amino acids and lipids | Understand |
| CO5 | Determine the quality and quantity of enzymes | Evaluate |
| CO6 | Perform the purification of enzymes | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | S | S |
| **CO2** | S | S | S | S | L | S | S |
| **CO3** | S | S | S | S | L | S | S |
| **CO4** | M | M | M | M | L | M | M |
| **CO5** | M | M | M | M | L | M | M |
| **CO6** | M | M | M | M | L | M | M |

**S-Strong; M-Medium; L-Low**

**Biochemistry** **48 hours**

1. Quantification of proteins–Lowry etal/ Bradford method
2. Quantification of carbohydrates by Phenol sulphuric acidmethod
3. Quantification of sugars–Anthronemethod
4. Estimation of Total free amino acids by Ninhydrinmethod

5. Quantification of lipids by Folch method
6. Quantification of Ascorbicacid
7. Membrane-based separation(e.g.Microfiltration/Ultrafiltration)
8. Separation of Amino acids /fattyacids/sugar/nucleicacid bases by Thin Layer Chromatography
9. Purification of amylase enzyme by precipitation and dialysis
10. Effect of pH, temperature and substrate concentration on amylase enzyme

**SUGGESTED READINGS:**


1. KeithWilson,&JohnWalker (Eds.). (2010). PrinciplesandTechniquesof Biochemistry and Molecular Biology.NewYork,NY:CambridgeUniversity Press
2. Boyer, R.F. (2011). Biochemistry Laboratory: Modern Theory and Techniques (2nd ed.). Pearson EducationPublishers, New Jersey,UnitedStates.
3. Sadasivam.S.&Manickam,A.(2008).BiochemicalMethods.(3rd ed.).NewAgeInternational Private Limited Publishers,New Delhi,India.
4. Palanivelu, P. (2016). Analytical Biochemistry and Separation Techniques (5th ed.). TwentyfirstCentury Publications,Coimbatore,India.
5. Hofmann, A. &Clokie, S. (2018). Wilson and Walker's Principles and Techniques of BiochemistryandMolecularBiology(8th ed.).CambridgeUniversityPress,Cambridge,United Kingdom


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SEMESTER–I

**23BTP112 MICROBIOLOGY AND MOLECULAR GENETICS PRACTICAL–II 4H-2C**

**Instruction Hours/week: L:0 T:0 P:4** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3Hours

**Course Objectives**

The main objectives of the course are

- To gain knowledge on identifying prokaryotic and eukaryotic cell types
- To understand various eukaryotic cellular components
- To recognize the cell permeability in plant and animal cells
- To identify the different types of cell division
- To study the structure of nucleus
- To perform conjugation and transduction experiments

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Identify and confirm the prokaryotic and eukaryotic cell types by morphological and intercellular organelles arrangement | Understand |
| CO2 | Discuss the presence of various cellular components in eukaryotic cells | Create |
| CO3 | Demonstrate the cell permeability in plant and animal cells | Understand |
| CO4 | Determine the mitotic and meiotic cell divisions | Evaluate |
| CO5 | Examine the structural variations in the nucleus using different staining methods | Apply |
| CO6 | Get practiced with the tools and techniques for analyzing conjugation and transduction | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | S | S |
| **CO2** | S | S | S | S | L | S | S |
| **CO3** | S | S | S | S | L | S | S |
| **CO4** | S | S | M | M | L | M | M |
| **CO5** | S | S | M | M | L | M | M |
| **CO6** | S | S | M | M | L | M | M |

**S-Strong; M-Medium; L-Low**

**MICROBIOLOGY** **24 hours**

1. Pure culture technique–Pour plate,spread plate and streaking methods.
2. Staining technique–Grams staining and Fungal staining
3. Motility test –Hanging dropmethod.
4. Growth curve (Bacteria and Fungi)- Turbidity cell counting with reference to dilution and biomass estimation.

5. Screening of antibiotic sensitive test by agar well diffusion and disc diffusion methods.

**MOLECULAR GENETICS** **24 hours**

1. Drosophila Giant Chromosome preparation.
2. Nuclear staining (Giemsa/acridine orange /feulgen)
3. Metaphase preparation and karyotyping (Humanleucocytes/onionroottip)
4. Conjugation
5. Transduction
6. Competent cell preparation and transformation

**SUGGESTED READINGS:**


1. Cappuccino,J.H.and Sherman,N. (2014). Microbiology–ALabManual (10thEdition), The Benjamin Publishing Company, Singapore.
2. Goering R,Dockrell H,Zuckerman M, and Wakelin D.(2012). Mims' Medical Microbiology. 5th edition. Elsevier.
3. WilleyJM, Sherwood L M,and Woolverton C J.(2013).Prescott,Harley and Klein's Microbiology.9th edition.McGraw Hill Higher Education
4. Sundararaman,G.and Arumugam, A.(2017). Labin Cell Biology,Microbiology and Bioinstrumentation:Laboratory Manual. Independently Published.
5. Pierce, B.A.(2011) Genetics:A Conceptual Approach,4th edition,Macmillan Higher Education Learning.
6. Laboratory Manualfor Principles of Genetics (First ed.).(2019).LAMBERT Academic Publishing.

**23BTP201** **RECOMBINANT DNA TECHNOLOGY** **4H-4C**

**Instruction Hours/week: L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total:**100**
**End Semester Exam:**3Hours

**Course Objectives**

The main objectives of the course are

- To familiarize with emerging field of biotechnology: Recombinant DNA Technology
- To understand the basic concepts of recombinant DNA Technology and genetic engineering
- To acquaint versatile plasmid- and vector-based tools and techniques employed in recombinant DNA technology
- To obtain the principles of versatile cloning strategies for selection and screening of recombinant clones
- To understand the concepts of nucleic acid labeling techniques
- To illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences in biotechnological research

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Understand the fundamental steps in recombinant DNA technology | Remember |
| CO2 | Demonstrate the mechanism of action and the use of restriction enzymes in biotechnology research and recombinant protein production | Understand |
| CO3 | Explain the value of plasmid and vector preparations and how the concentration and purity of plasmid and vector samples can be determined | Apply |
| CO4 | Confer cloning strategies and techniques used in DNA probing for specific genes of interest | Create |
| CO5 | Conceptualize hybridization and PCR techniques in clinical research | Apply |
| CO6 | Recapitulate various applications of recombinant DNA technology in human healthcare and safety regulations. | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | S | S |
| **CO2** | M | M | M | M | L | M | M |
| **CO3** | S | S | S | S | L | S | S |
| **CO4** | S | S | S | S | L | S | S |
| **CO5** | S | S | S | S | L | S | S |
| **CO6** | S | S | S | S | L | S | S |

**S-Strong; M-Medium; L-Low**

**UNIT–I Tools in genetic engineering:** **8 hours**

Nucleic acid manipulating enzymes: Classification of restriction endonucleases, ligases, polymerases, modification enzymes-kinases, phosphatases, adapters and linkers, polynucleotide tailing and topoisomerase.

**UNIT –II Vectors:** **8 hours**

Properties of good vector and host. Cloning vectors: Plasmid-Conjugative and non-conjugative plasmid, Types of Plasmid- Natural plasmids, Artificial plasmid-pBR322 and PUC series. Expression vectors and applications: Phage vectors. Plant Vector– Ti-plasmid. Animal viral Vectors-Retroviral viral vectors, shuttle vectors, cosmid, phagemid, phasmid. Artificial chromosomes–BACs, YACs.

**UNIT-III Gene transfer methods:** **8 hours**

Physical, chemical and biological methods of gene transfer-prokaryotes- eukaryotes. Screening and analysis of recombinants, DNA and RNA probes–construction. Analysis of cloned foreign genes hybridization techniques –Southern Blotting, Northern Blotting and Western Blotting.

**UNIT –IV Techniques in genetic engineering:** **8 hours**

Polymerase Chain Reaction – types applications, Molecular markers-RAPD, RFLP, AFLP,SSCP. Microarray, protein engineering- site directed mutagenesis. Alteration of restriction sites.

**UNIT –V Application:** **8 hours**

Molecular diagnosis of diseases. Anti-sense technology, RNAi-technology, terminator gene technology, CRISPR gene therapy- *in-vivo* and *ex-vivo*. DNA fingerprinting, genetically engineered bio-therapeutics and vaccines (Covidvaccines).

**SUGGESTED READINGS:**


1. Brown, T.A. (2016). *Gene Cloning and DNA Analysis: An Introduction* (7th ed.).Wiley-Blackwell Publishers, New Jersey, United States.
2. Glick, B.R.& Patten, C.L. (2017). *Molecular Biotechnology*. (5th ed.) Taylor &Francis Publishers, Abingdon, United Kingdom.
3. http://172.16.25.76/login/index.php
4. https://nptel.ac.in/courses/102103013/
5. Primrose, S.B. & Twyman, R. M. (2016). *Principles of Gene Manipulation and Genomics* (8th ed.). John Wiley and Sons Ltd. Publishers, Chicester, United Kingdom.
6. Recombinant DNA Technology (2019). Siddraljaz, Imran Ul Haq – Cambridge scholars publishing
7. Watson, J.D., Caudy, A.A., Myers, R.M., & Witkowski, J.A. (2007). *Recombinant DNA: Genes and Genomes* (3rd ed.). W.H. Freeman and Company, New York, United States.
8. Winnacker, E. L. (2013). *From Genes to Clones* (1st ed.). Panima Educational Book Agency, New Delhi,

SEMESTER–II

**23BTP202** **IMMUNOLOGY AND IMMUNOTECHNOLOGY** **4H-4C**

**Instruction Hours/week: L:4 T:0P:0** **Marks:** Internal:**40** External:**60** Total:**100**

**End Semester Exam:** 3 Hours

**Course Objectives**

The main objectives of the course are

- To understand the human immune system and the immune response of cells and organs
- To obtain key concepts on gene-re-arrangement of immunoglobulin and T-cell receptor genes, antigen processing and presentation
- To comprehend the principles of immunological techniques like hybridoma technology and catalytic antibodies synthesis
- To recognize the basic concepts on transplantation of organs
- To understand strong fundamental knowledge in tumor immunology
- To attain the principles involved in vaccine technology including recombinant vaccines

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Demonstrate various immunological process including innate and adaptive immunity, cells and organs of immune system, antigen and antibody interaction, immunogenicity and antigenicity, epitopes and antibody structure | Understand |
| CO2 | Describe the organization of genes, class switching in constant regions of genes and expression and regulation of genes | Understand |
| CO3 | Recognize how animal cell culture is explored for monoclonal antibodies production using hybridoma technology | Understand |
| CO4 | Illustrate the role of cancer immunotherapy | Understand |
| CO5 | Develop novel vaccines against infectious diseases | Apply |
| CO6 | To develop novel vaccines | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | S | S |
| **CO2** | M | M | M | M | L | M | M |
| **CO3** | S | S | S | S | L | S | S |
| **CO4** | M | M | M | M | L | M | M |
| **CO5** | M | M | M | M | L | M | M |
| **CO6** | M | M | M | M | L | M | M |

**S-Strong; M-Medium; L-Low**

**UNIT –I Introduction to immune System: 8 hours**

Innate and adaptive immunity. Cells and organs of the immune system. Primary and secondary immune responses: Cell mediated and humoral responses. Antigens and antibodies: structure and function. V(D)J rearrangements. B and T cell receptors and co-receptors. Pathogen recognition receptors (PRR) and pathogen associated molecular pattern (PAMP)

**UNIT –II Generation and regulation of immune responses: 8 hours**

Antigen processing and presentation. MHC complexes and MHC restriction. B and T cells: Maturation, activation and differentiation. Clonal selection and immunological memory. Cytokines and their role in immune regulation. Inflammation. Regulation of immune responses: Cell mediated cytotoxic responses and immunological tolerance. Complement system: Classical, alternate and MBL pathways. Role of MHC in infectious diseases and disease susceptibility, HLA typing.

**UNIT-III Disorders of human immune system: 8 hours**

Primary and secondary immunodeficiency. Autoimmunity: Mechanism and auto immune disorders. Hypersensitivity reactions: I, II, III and IV. Cytokine-related diseases. Tumor immunology: Tumor antigens and immune response to tumors. Immunology of transplant rejection and management: immune-suppressive therapy. Immunity to infection: bacteria, viral, fungal and parasitic infections (Tuberculosis, HIV/ AIDS, Schistosomiasis, Kala Azar, Chikungunya, Dengue);

**UNIT –IV: Immunological techniques 8 hours**

Antigen- antibody interactions: Agglutination. Precipitation. Immuno-diffusion. Immuno-flourescence. Complement fixation. Radio-immunoassay. ELISA. ELIS pot. Immuno-precipitation. Immuno-electrophoresis. Western blotting. Immuno histo-chemistry. Immune cell isolation. Chimeric antigen receptor (CAR) and T cell receptor (TCR) T cell therapeutic techniques. CMI techniques- lymph proliferation assay, mixed lymphocyte reaction, cell cytotoxicity assays, apoptosis, microarrays, transgenic mice, gene knock outs.

**UNIT –V Monoclonal antibodies and vaccines production: 8 hours**

Monoclonal and polyclonal antibodies. Production and applications of monoclonal antibodies. Hybridoma technology. Antibody engineering. Vaccines: Types (Inactivated Vaccines, Live-attenuated Vaccines, mRNA Vaccines, Toxoid Vaccines, Viral vector vaccines and subunit, recombinant, polysaccharide and conjugate Vaccines technology). Indigenous COVID -19 vaccine. Booster vaccines for COVID-19, Immunomodulatory effect of Covaxin and Covishield. Recent trends in vaccine development. Success stories in vaccinology e.g. Hepatitis, Polio, Small pox, DPT.

**SUGGESTED READINGS:**


1. Abbas, A.K., Lichtman, A.H., & Pillai, S. (2017). *Cellular and Molecular Immunology* (Ninth ed.). Elsevier Publishers, Amsterdam, Netherlands.
2. Abbas, A.K., Lichtman, A.H.,& Pillai,S. (2019). *Basic Immunology: Functions and Disorders of the Immune System* (Sixth ed.). Elsevier Publishers, Amsterdam, Netherlands.
3. Delves, P.J., Martin, S.J., Burton, D.R.,& Roitt, I. M. (2017). *Roitt's Essential Immunology.* (13th ed.). Wiley-Blackwell, New Jersey, United States.
4. E-content: http://172.16.25.76/course/view. php?id=2099

5. https://www.cell.com/cancer-cell/libraries/tumor-immunology-and-immunotherapy
6. Levine, M.M. et al. (2017).New Generation Vaccines (Fourthed.). CRC Press.
7. MOOC: https://nptel.ac.in/courses/102103038/
8. Punt, J., Stranford,S., Jones, P.,& Owen,J.A.(2018).*Kuby Immunology*(Eighthed.). W.H. Freeman and Company, New York, United States.
9. Tizard, I.R.(2017). *Veterinary Immunology*(Tenthed.).Saunders Publishers, NewYork, United States.
10. Turgeon,M.L.(2017).*Turgeon:Immunology andSerology in Laboratory Medicine*.(Sixth ed.). Elsevier Publishers, Amsterdam,Netherlands.

**23BTP203** **MOLECULAR AND DEVELOPMENTAL BIOLOGY** **SEMESTER–II 4H-4C**

**Instruction Hours/week: L:3 T:1 P:0** **Marks:** Internal: **40** External:**60** Total:**100**

**End Semester Exam:** 3Hours

**Course Objectives**

The main objectives of the course are

- To emphasize the basic knowledge about the structure and functions of nucleic acids (DNA/RNA) and proteins
- To understand the role of macromolecules, membranes, and organelles in cells
- To understand the mechanisms behind gene regulations
- To understand the mechanism behind translation and transcription
- To understand the mutations and its significance
- To know about cellular development and progression

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Achieve knowledge about the functions of nucleic acids and proteins | Understand |
| CO2 | Acquire an in-depth knowledge of chemical and molecular processes that occur within and between the cells | Understand |
| CO3 | Gain an insight into the mechanisms behind gene regulations | Understand |
| CO4 | Gain knowledge about mechanism behind translation and transcription | Understand |
| CO5 | Acquire an in-depth knowledge about developmental biology | Apply |
| CO6 | Understand the concept of Metamorphosis | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | S | S |
| **CO2** | S | S | S | S | L | S | S |
| **CO3** | S | S | S | S | L | S | S |
| **CO4** | S | S | S | S | L | S | S |
| **CO5** | M | M | M | M | L | M | M |
| **CO6** | M | M | M | M | L | M | M |

**S-Strong; M-Medium; L-Low**

**UNIT –I Nucleic acid organization** **8 hours**

DNA as genetic material, Types of DNA: A-DNA, B-DNA and Z-DNA. Organization of DNA in prokaryote and eukaryotic cells, Chromosome biology - histone and non-histone proteins, organization, structure and functions. Replication of DNA in prokaryotes and eukaryotes: Semi- conservative nature of DNA replication, Bi-directional replication, DNA polymerases and its types, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

**UNIT –II Transcription and RNA processing: 8 hours**

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, r-RNA and t-RNA splicing.

**UNIT –III Regulation of gene expression and translation: 8 hours**

Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of t-RNA, aminoacyl t-RNA synthetases, mechanism of initiation, elongation and termination of polypeptides, fidelity of translation, Inhibitors of translation, Post translational modifications of proteins.

**UNIT –IV Introduction to developmental biology: 8 hours**

Concepts, spermatogenesis and oogenesis in mammals, menstrual cycle, monitoring of estrus cycle, sperm banking. Hormones involved in reproduction. Activation of sperm and egg–interaction of sperm and egg– Sequence of events in sperm entry–Egg surface changes. Post–fertilization changes. Embryo development, morphogenetic gradients; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.

**UNIT-V Cellular development and progression: 8 hours**

Cell cleavage–pattern of cleavage–Chemical changes – Distribution of cytoplasmic substances in the egg –Metamorphosis (Insects and amphibians) – Hormone control of metamorphosis. Development of Microsporangium and Mega-sporangium, Pollination, Embryo- Embryo-sac development and double fertilization in plants, seed formation and germination. Outline of experimental embryology. Organization of shoot and root apical meristem and development. Leaf development and phyllotaxy.

**SUGGESTED READINGS:**


1. Chattopadhyay.S.2016. An Introduction to Developmental Biology, Books and Allied(P) Ltd, Kolkata. First Edition.
2. Karp, G. (2013). Cell and Molecular Biology: Concepts and Experiments(7th ed.). Hoboken, US: John Wiley & Sons. Inc.
3. Gilbert, Scott's. 10 edition (2014). Developmental biology. Sinauer Association, Inc., Publishers.2.
4. Watson, J.D., Baker T.A., Bell,S.P.,Gann,A.,Levine,M.,&Losick,R.(2008).Molecular Biology of the Gene (6th ed.). Cold Spring Harbour Lab. Press, Pearson Pub.
5. De Robertis, E.D.P., & De Robertis, E.M.F.(2006).Cell and Molecular Biology(8thed.).Lippin cott Williams and Wilkins, Philadelphia

SEMESTER–II

**23BTP204 FERMENTATION AND BIOPROCESS TECHNOLOGY 4H-4C**

**Instruction Hours/week: L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total:**100**

**End Semester Exam:**3Hours

**Course Objectives**

The main objectives of the course are

- To familiarize with knowledge about biological and biochemical technology, with a focus on biological products, the design and operation of industrial practices
- To describe power requirements in bioreactors, modeling of bioprocesses, and traditional and new concepts in bioprocess monitoring
- To understand biological and engineering principles for cultivating microorganisms in fermenters
- To obtain knowledge on fermentation process from shake flask to bench top fermentor
- To understand the importance of monitoring foam control, nutrient dosing,sterile sampling and filter sterilization
- To attain key concepts in calibration and maintenance of process critical for fermentation such as aeration, agitation and pH

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Evaluate factors that contribute in enhancement of cell and product formation during fermentation process | Understand |
| CO2 | Analyze kinetics of cell and product formation in batch, continuous and fed-batch cultures | Understand |
| CO3 | Differentiate the rheological changes during fermentation process | Understand |
| CO4 | Develop protocol for scale-up and harvesting from shake flask to bench top fermentor | Understand |
| CO5 | Analyze the bioprocess paradigms including scale-down, bioprocess simulation and economics in biological manufacturing | Apply |
| CO6 | Examine consideration in bioprocess simulation, sterilization and fermentation in bio-product manufacturing | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | M | M | M | M | L | M | M |
| **CO2** | S | S | S | S | L | S | S |
| **CO3** | S | S | S | S | L | S | S |
| **CO4** | S | S | S | S | L | S | S |
| **CO5** | M | M | M | M | L | M | M |
| **CO6** | M | M | M | M | L | M | M |

**S-Strong; M-Medium; L-Low**

**UNIT –I Introduction to bioprocess technology: 8 hours**

History and milestones of bio-process technology, scope of bio-process technology. Isolation and screening of industrially important strains-primary and secondary screening. Strain improvement, mutation, selection of mutants, recombination–bacteria, fungi and actinomycetes, assay and fermented products. Fermentations- submerged, solidstate.

**UNIT–II Fermenter: Design, control and monitor: 8 hours**

Design of fermenter, Types–CSTR, Tower, jet loop, air lift fermenter, bubble column, packed bed. Fundamentals of process control and monitoring–online and offline analysis, feed-back control– pH, temperature, pressure, $O_2$ and $CO_2$ control, PID controller, computer aided control. Role of aeration and agitation.

**NIT–III Upstream processing: 8 hours**

Media formulation–sterilization– Air and media sterilization. Microbial kinetics: batch, fed-batch and continuous cultures, phases of batch growth. Kinetics of cell growth, product formation, substrate utilization, product inhibition kinetics, yield concept and productivity.

**UNIT–IV Downstream processing: 8 hours**

Introduction, removal of microbial cells and solid matters, foam separation, precipitation, filtration, centrifugation, cell disruption. Solvent extraction- chromatographic separation-FPLC, HPLC, dialysis, distillation, crystallization. Effluent treatment. Fermentation products available in market.

**UNIT–V Application of bioprocess and fermentation technology: 8 hours**

Whole cell immobilization, protein-immobilization and their industrial application. Industrial production of chemicals: alcohol, acids (citric, acetic and gluconic acid),solvents (glycerol, acetone and butanol), antibiotic(penicillin, streptomycin and tetracycline),amino acids(lysine and glutamic acid), Single cell protein, use of microbes in mineral beneficiation and oil recovery, probiotics and prebiotics.

**SUGGESTED READINGS:**


1. Bailey, J.S. & Ollis,D.F. (2017). *Biochemical Engineering Fundamentals* (2nd ed.). McGraw- Hil lEducation/ Medical, London, United Kingdom.
2. Crueger, W.& Crueger, A.(2017). Cruegers Biotechnology: A *Text book of Industrial Microbiology*. Med tech Publishers, New Delhi, India.
3. Doran,P.M. (2013).*Study guide for Bioprocess Engineering Principles*. New York, United States.
4. Dutta,R. (2008).*Fundamentals of Biochemical Engineering*(1st ed.). Springer Publishers, New York, United States.
5. Shuler, M.L.& Kargi, F. (2015).*Bioprocess Engineering Basic concepts*(2nd ed.). Pearson India Education Services Pvt. Ltd., Bengaluru, India
6. Stanbury, P.F.,Whitaker,A.,&Hall,S.J. (2016).*Principles of Fermentation Technology* (3rd ed.). Butterworth-Heinemann Publishers, Oxford, United Kingdom.

**M.Sc., Biotechnology** **2023-2024**

**SEMESTER–II**

**23BTP205A** **MICROBIAL BIOTECHNOLOGY** **4H-4C**

**Instruction Hours/week: L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total:**100**

**End Semester Exam:**3Hours

**Course Objectives**

The main objectives of the course are

- To provide an in-depth look at how microbes and their metabolic pathways and products can be used in biotechnology
- To develop genetically engineered microbes for biomedical industries and research
- To impart the basics of microalgae
- To understand the microbial bio-conservation rate in the yield of agriculture
- To understand fundamentals of bioconversion
- To describe the waste utilization of sewage

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Critically evaluate the role of micro-organisms in specific biotechnological processes. | Understand |
| CO2 | Explain the complex processes behind the development of genetically manipulated organisms. | Understand |
| CO3 | Apply the knowledge of microalgae in pharmaceutical industries | Understand |
| CO4 | Discuss state-of-the-art technologies of genetics of antimicrobial metabolite production in biocontrol bacteria. | Understand |
| CO5 | Define the major groups of microorganisms used in microbial bioconversion | Apply |
| CO6 | Collect the proficient knowledge on the utilization of waste to commercially important compounds | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | M | M | M | M | L | M | M |
| **CO2** | S | S | S | S | L | S | S |
| **CO3** | S | S | S | S | L | S | S |
| **CO4** | S | S | S | S | L | S | S |
| **CO5** | M | M | M | M | L | M | M |
| **CO6** | M | M | M | M | L | M | M |

**S-Strong; M-Medium; L-Low**

**UNIT–I Introduction** **8 hours**

History and scope of microbial biotechnology, General concepts of microbial biotechnology. Genetic engineering of microbes to improve production of industrial products: Antibiotics, amino acids, lipids, enzymes, steroids and secondary metabolites. Biopolymers and bioplastics.

**UNIT–II Microalgae** **8 hours**

History and biotechnological potentials of microalgae, food, feed. Colorant, fuel and pharmaceutically valuable compounds. Cultivation methods of algae with reference to *Dunaliella sp.*and *Phormidium valderianum*. Microalgae as live feed.

**UNIT–III Agricultural microbiology** **8 hours**

Plant microbes interaction; Microbial herbicides, agricultural antibiotics, microbial Bio-fertilizers and bio-insecticides; Biological pest control. Mode of action of biological control involved in different biocontrol agents. Entomo-pathogenic Nematodes; Entomo-pathogenic Fungi Genetics of antimicrobial metabolite production in biocontrol bacteria. Risks associated with genetically modified organisms(GMOs), Potential impacts on the environment and human health.

**UNIT–IV Microbial bioconversion** **8 hours**

Biomass and its conversion. Bioconversion of cellulosic and non-cellulosic wastes. Mechanism of novel carboxylase genes involved in bioconversion. Agro byproducts. Bioremediation of wood, fuels lubricants, rubber, plastics.

**UNIT–V Application of microbial biotechnology in waste management** **8 hours**

Wastewater treatment- Aerobic and anaerobic processes, treatment schemes for waste waters of dairy, distillery tannery, sugar, antibiotic industries. Sewage disposal, compost making, methane generation. Microbiology of degradation of xenobiotics in environment: Ecological considerations, decay behavior, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides. Mineral recovery and removal of heavy metals from aqueous effluents.

**SUGGESTED READINGS:**


1. Bernad.R. Glick andJack J. Pasternak.(2002). Molecular Biotechnology Principles and Applications of Recombinant DNA.WCB.
2. Glazer, A.N. and Nikaido,H.(2007) Microbial Biotechnology.Cambridge,NewYork.
3. Harzevili, D.F. and Chen,H.(2015).Microbial Biotechonology:Progressand trends.Taylor and Francisgroup.
4. Kun,Y.L(2013). Microbial Biotechnology: Principles and applications. World Scientific PublishingCompany;3rd reviseded. Edition.

SEMESTER–II

23BTP205B MARINE BIOTECHNOLOGY 4H-4C

**Instruction Hours/week:L:4 T:0 P:0** **Marks:**Internal:**40** External:**60** Total:**100**

**End Semester Exam:**3Hours

**Course Objectives**

The main objectives of the course are

- The course aim to understand the knowledge on Marine organisms, Marine hydrocolloids, applications of Genetic engineering, extraction of Marine Bioactive Compounds and extremophile.
- The major objective of this course is to build upon the knowledge of different metabolic pathways and their integration.
- Attention is drawn to the structure-function relationships of biomolecules
- To understand the basics in marine biotechnology and its applications.
- To understand the structural and functional organisation of marine organisms and their biological diversity.
- To understand the basic principles of ecology, the structure and function of ecosystems, developing it for the marine and coastal environment.

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | To Know and to understand the essential facts and concepts related to marine biotechnology. | Understand |
| CO2 | To analyze the marine organisms of interest in biotechnology, their basic functions and role in the ecosystem. | Understand |
| CO3 | To acquire the ability to analyze and determine those marine organisms that may be useful in biotechnology. | Understand |
| CO4 | To apply biotechnology methodologies to the marine environment. | Understand |
| CO5 | To develop knowledge on the marine biotech companies and the legal aspects of marine biotech. | Apply |
| CO6 | Understand principles underlying design of marine drugs, functional foods, neutraceuticals , bioprospecting, and bioresources. | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | M | M | M | M | L | M | M |
| **CO2** | S | S | S | S | L | S | S |
| **CO3** | M | M | M | M | L | M | M |
| **CO4** | S | S | S | S | L | S | S |
| **CO5** | S | S | S | S | L | S | S |
| **CO6** | M | M | M | M | L | M | M |

**S-Strong; M-Medium; L-Low**

**Course Objectives:** The course aim to understand the knowledge on Marine organisms, Marine hydrocolloids, applications of Genetic engineering, extraction of Marine Bioactive Compounds and extremophile.

**UNIT I** **8 hours**

Biotechnology in Marine Sciences. Aquaculture: culture of shrimp, crab, edible mollusc, oysters and pearl oysters, Culture of milkfish, mullets and eel. Culture of sea weeds. Culture of live feed organisms brine shrimp, rotifers. Marine micro algae- aquaculture, antioxidants-carotenoids, as taxanthin

**UNIT II** **8 hours**

Marine hydrocolloids-agar, agarose, carageenan, alginates, chitosans and chitin. Marine enzymes - Applications of enzyme for fish processing. Marine Lipids- application of lipases for modification of fats and oils. Marine flavourants. Bioconversion of organic materials and fish ensilage.

**UNIT III** **8 hours**

Aquaculture biotechnology- hormonal manipulation of sex, chromosomal manipulation of sex fish, cryopreservation of fish gametes and embryo. Diseases of cultured shrimp, fish. Diagnostics and their application to aquaculture.

**UNIT IV** **8 hours**

Production of transgenic fishes-growth hormone, antifreeze protein, disease resistant fish, application of hormones in induced breeding in aquaculture. Antifreeze protein and its applications.

**UNIT V** **8 hours**

Pharmaceuticals from marine realms, type of drugs from marine organisms and their medical applications. Biofouling and their control. Marine bioremediation-Bio-surfactants and Control of oil spills. Extremophiles

Text Books:

1. Aquaculture: Principles and Practices - T.V.R. Pillay -1990
2. Steven M. Colegate and Russel J. Molyneux. 2008. Bioactive Natural Products (II Ed.). CRC Press.
3. Aquaculture: The farming and husbandry of Freshwater & Marine organisms by J.Bardach, Ryther J.Mclarhey.W. 1972.

References:

1. Advances in Fisheries Technology and biotechnology for increased profitability - Ed. Michael N. Voigt, J. Richard Botta. Technomic Publishing Co. Inc.(1990)
2. Biotechnology in the Marine Science- Proceedings of the first Annual MIT Sea Grant Lecture and Seminar - Colwell R.R. 1982.
3. New Developments in Marine BiotechnologyEd. LeGal and H.O.Halvorson Plenum press 1998.

SEMESTER–II

**23BTP205C** **BIOSAFETY AND IPR** **4H –4C**

**Instruction Hours/week: L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total:**100**

**End Semester Exam:** 3Hours

**Course Objectives**

The main objectives of the course are

- To obtain the fundamental knowledge in biodiversity and conservation
- To acquire information about Hotspot biodiversity and RED data book
- To introduce basic concepts of biosafety that is essential for different disciplines of biotechnology
- To discuss about various aspects of biosafety regulations
- To understand IPR concerns arising from the commercialization of biotech products
- Toknowtheproceduresinvolvedinprotectionofintellectualpropertyandrelatedrightsin biotechnology

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Gain the basic concepts of biodiversity and conservation | Understand |
| CO2 | Obtain the perceptions on conservation of endangered species | Understand |
| CO3 | Interpret basics of biosafety and its impact on all the biological sciences and the quality of human life | Understand |
| CO4 | Recognize importance of biosafety practices and guidelines in research | Understand |
| CO5 | Apply intellectual property law principles including copyright, patents, designs and trademarks in the production and marketing of biotech products | Apply |
| CO6 | Describe various agreements and treaties related to the protection of intellectual property in biotechnology | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | S | S |
| **CO2** | S | S | S | S | L | S | S |
| **CO3** | M | M | M | M | L | M | M |
| **CO4** | S | S | S | S | L | S | S |
| **CO5** | S | S | S | S | L | S | S |
| **CO6** | S | S | S | S | L | M | M |

**S-Strong; M-Medium; L-Low**

**UNIT –I Biosafety-Introduction:** **8 hours**

Primary Containment for biohazards; Biosafety Levels; Biological Safety Cabinets, Good laboratory practices(GLP) and Good manufacturing practices(GMP).Definition of GMOs & LMOs; principles of safety assessment of transgenic plants Guidelines for research in transgenic plants.

**UNIT –II Biological risk assessment: 8 hours**

Biosafety guidelines for Genetically Modified Microorganisms(GMM) and Plants(GMP)-Risk assessment, guidelines for research activities, Guidelines for environmental release of GMM, GMP and GLP. Establishment and functions of GATT, WTO and WIPO. Roles of IBSC, RCGM and GEAC. GM labeling –Food Safety and Standards Authority of India(FSSAI)Cartagena protocol on biosafety.

**UNIT –III Bioethics: 8 hours**

Introduction. Animal Rights. Ethical conflicts in biological sciences - interference with nature, Bioethics in health care - patient confidentiality, informed consent, euthanasia, artificial reproductive technologies, prenatal diagnosis, genetic screening, gene therapy, transplantation. general issues related to environmental release of transgenic plants, animals and microorganisms. Ethical issues related to research in embryonic stem cell cloning. Ethical, legal and social Implications (ELSI) of Human Genome Project

**UNIT –IV Intellectual property rights: 8 hours**

Types of IP: Patents, Trademarks, Copyright and Related Rights. Physical and Intellectual Property. Tangible and Intangible property. **Agreements and Treaties:** History of GATT and TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty ;PCT; Indian Patent Act 1970 and recent amendments.

**UNIT–V Patent application: 8 hours**

Rules governing patents. International Patent guidelines. Patent related cases. Licensing-Flavr Savr™ tomato as a model case. Bio-piracy and case studies on patents (Basmati rice, Turmeric and Neem). Biotechnological examples of patent, trademark, trade secret, copyright. Traditional knowledge.

**SUGGESTED READINGS:**


1. Balasubramanian,S.(2017).India:Traditiona lKnowledge and Patent Issues: An Overview of Turmeric, Basmati,Neem Cases.
2. Biodiversity and Conservation.http://ncert.nic.in/ncerts/l/lebo115.pdf
3. Gaston, K.J.&Spicer, J.I.(2013)*Biodiversity:An Introduction*(2nd ed.). Wiley-Blackwell Publishers, New Jersey,UnitedStates.
4. GEAC India. http://geacindia.gov.in/resource-documents/biosafety-regulations/guidelines-and-protocols/Guidelines for the ERA of GE plants.pdf
5. Goel, D.&Parashar,S. (2013).*IPR, Biosafety and Bioethics* (1st ed.).Pearson Publishers, London,United Kingdom.
6. http://www.mondaq.com/india/x/586384/Patent/Traditional+Knowledge+And+Patent+Issues+An+Overview+Of+Turmeric+Basmati+Neem+Cases
7. Intellectual Propertry India.ThePatentsAct, 1970.http://www.ipindia.nic.in/writereaddata/Portal/IPOAct/1311_patent-act-1970-11march2015.pdf
8. IPR inUK.https://www.wilsongunn.com/guide-to-ip/
9. Kankanala,C. (2007).*Genetic Patent Law and Strategy* (1st ed.). Manupatra Information Solution Pvt. Ltd.India.

10. Legal and Public Aspects of Biotechnology.http://www.actahort.org/members/showpdf?Book nrarnr=447_125.
11. Llewelyn,D.&Aplin,T. (2019). Intellectual Property: Patents,Copyrights,Trademarks &AlliedRights(9th ed.).Sweet& MaxwellPublishers, London,UnitedKingdom.
12. Ministry of Environment,Forest andClimateChange,India. http://moef.gov.in/environment/biodiversity/
13. NationalBiodiversityAuthority ofIndia.http://nbaindia.org/.
14. OfficeoftheController Generalof Patents,Designs &TradeMarks,India.http://www.ipindia.nic.in/
15. Transgenic Crops-Bio safety Concerns and Regulations in India.http://vikaspedia.in/agriculture/crop production/advanced-technologies/transgenic-crops-biosafety-concerns-and-regulations-in-india
16. U.S.Department of Health and Human Services.(2016). Biosafety in Microbiological and Biomedical Laboratories.Lulu Publishers, North Carolina,United States.
17. World Intellectual PropertyOrganization.http://www.wipo.int/portal/index.html.en

**SEMESTER–II**

**23BTP211 RECOMBINANT DNA, FERMENTATION AND BIOPROCESS TECHNOLOGY PRACTICAL –III 4H-2C**

**Instruction Hours/week:L:0 T:0 P:4** **Marks:**Internal:**40** External:**60** Total:**100**

**End Semester Exam:**3Hours

**Course Objectives**

The main objectives of the course are

- To familiarize with practical knowledge in the emerging field of biotechnology: Recombinant DNA technology
- To perform basic molecular biology techniques including DNA and RNA isolation from microbes, plants and animals
- To obtain key concepts of different blotting techniques
- To gain adequate knowledge on production of amylase or protease
- To comprehend the enzyme immobilization techniques
- To get knowledge on production of wine and alcohol determination

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Perform recombinant DNA techniques including restriction and digestion, transformation and PCR | Understand |
| CO2 | Carry out DNA and RNA isolation from microbes, plants and animals | Understand |
| CO3 | Demonstrate various blotting techniques | Understand |
| CO4 | Recognize importance of biosafety practices and guidelines in research | Understand |
| CO5 | Perform the enzyme immobilization assays | Apply |
| CO6 | Explain the methods of wine production and alcohol determination | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | S | S |
| **CO2** | S | S | S | S | L | S | S |
| **CO3** | M | M | M | M | L | M | M |
| **CO4** | S | S | S | S | L | S | S |
| **CO5** | S | S | S | S | L | S | S |
| **CO6** | S | S | S | S | L | M | M |

**S-Strong; M-Medium; L-Low**

**Recombinant DNA technology practical's** **40 hours**

1. Isolation and analysis of total genomic DNA from Microbes (*E.coli*) and plant.
2. Isolation and analysis of plasmid DNA.
3. Isolation and analysis of total RNA.

4. Restriction digestion, ligation of DNA and vector.
5. Transformation of plasmid DNA using calcium chloride.
6. DNA Amplification by PCR.
7. Southern blotting(Demonstration).
8. Northern blotting(Demonstration).
9. Western blotting(Demonstration)

**Fermentation and bioprocess technology practical's**

1. Isolation and screening of industrially important enzymes
2. Production of amylase/protease
3. Production of organic acid-lactic acid
4. Wine Production and alcohol determination by chromic acid method
5. Down stream processing by solvent extraction
6. Operation of fermenter(Demonstration)

**SUGGESTEDREADINGS:**


1. Green,M.R.&Sambrook,J.(2012).*Molecular Cloning:A Laboratory Manual*.(4$^{th}$ed.). Cold SpringHarbor Laboratory Press, New York, United States.
2. Greene,J.J.&Rao,V.B.(2001).*RecombinantDNA Principles andMethodologies.*(2$^{nd}$ed.) CRC Press, Florida,UnitedStates.
3. Kulandaivelu, S.&Janarthanan,S.(2012).*Practical ManualonFermentationTechnology*.IK International Publishers, New Delhi,India.
4. Schuler, M.A.& Zielinski,R.E.(2012).*Methods in Plant Molecular Biology.*(1$^{st}$ed.).Academic Press Publishers, NewYork,UnitedStates.

SEMESTER–II

**23BTP212 IMMUNOLOGY AND IMMUNOTECHNOLOGY PRACTICAL–IV 4H-2C**

**Instruction Hours/week: L:0 T:0 P:4** **Marks:** Internal:**40** External:**60** Total:**100**

**End Semester Exam:**3Hours

**Course Objectives**

The main objectives of the course are

- To perform and understand basic immuno techniques
- To acquaint versatile tools and techniques employe dinimmuno technology such as ABO Blood grouping
- To gain knowledge in immuno electrophoresis
- To understand different types of immunodiffusion methods
- Togainhandsonexperienceinimmunologicaltoolssuchasimmunoelectrophoresisand WIDAL test
- To understand the concepts of ELISA and ELISpot

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Carry out the laboratory immuno techniques | Understand |
| CO2 | Explain the preparation of samples for immuno technological analyses | Understand |
| CO3 | . Describe antigen-antibody interactions using immuno diffusion methods | Understand |
| CO4 | Utilize the immune techniques in diagnostic laboratories | Understand |
| CO5 | Demonstrate antigen-antibody specificity | Apply |
| CO6 | Perform Western blotting experiment to quantify the protein | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| CO1 | S | S | S | S | L | M | M |
| CO2 | S | S | S | S | L | S | S |
| CO3 | M | M | M | M | L | M | M |
| CO4 | S | S | S | S | L | S | S |
| CO5 | M | M | M | M | L | M | M |
| CO6 | M | M | M | M | L | M | M |

**S-Strong; M-Medium; L-Low**

**Immuno-technology Practical's** **40 hours**

1. ABO blood grouping, preparation of serum from blood
2. Differential leucocyte count under microscope
3. Separation of mononuclear cells by Ficoll-Hypaque
4. Single and double radial immunodiffusion
5. Rocket immunoelectrophoresis

6. Haemagglutination
7. WIDAL test
8. DOT-ELISA
9. ELISpot
10. Western blotting

**SUGGESTED READINGS:**


1. Vashist,S.K.&Luong,J.H.T. (2018).*Handbook ofImmunoassay Technologies:Approaches, Performances,andApplications*(First ed.).AcademicPress.
2. Webley,W. (2017). Immunology LabManual (Twelfthed.). LAD CustomPublishing.

SEMESTER–III

**23BTP301 PLANT BIOTECHNOLOGY 4H – 4C**

**Instruction Hours/week: L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total:**100**

**End Semester Exam:**3Hours

**Course Objectives**

The main objectives of the course are

- To cognize and get the knowledge on plant tissue culture
- To give knowledge about various methods of gene transfer and gene expression in plants
- To introduce biotechnological methods for production of transgenic plant
- To understand the processes involved in gene transfer methods in plant
- To infer the production of edible vaccines using primary and secondary metabolites
- To acquaint recent developments in plant based engineering

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Understand the growth conditions required to culture the plants in *in-vitro* conditions | Understand |
| CO2 | Inculcate the deep information of genetic engineering of plants | Understand |
| CO3 | Acquire strong knowledge on transgenic plant production | Understand |
| CO4 | Implement gene transfer methods to develop transgenic plants | Understand |
| CO5 | Develop plant-based enzyme engineered edible vaccines | Apply |
| CO6 | Recognize various progresses involved in plant tissue culture | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| CO1 | S | S | S | S | L | M | M |
| CO2 | M | M | M | M | L | M | M |
| CO3 | M | M | M | M | L | S | S |
| CO4 | S | S | S | S | L | S | S |
| CO5 | M | M | M | M | L | S | S |
| CO6 | S | S | S | S | L | S | S |

**S-Strong; M-Medium; L-Low**

**UNIT–I Introduction: 8 hours**

Principles of Plant Breeding: Important conventional methods of breeding–self, cross pollinated and vegetatively propagated crops. Non-conventional methods. Polyploidy, Genetic variability. Genome organization in plants– mitochondria and chloroplast. Cytoplasmic male sterility.

**UNIT- II Micropropagation:** **10 hours**

Tissue culture media–composition and preparation, Callus and suspension culture, somaclonal variation, micropropagation,organogenesis,somaticembryogenesis,Embryocultureand embryo rescue. Haploidy; protoplast fusion and somatic hybridization; cybrids; anther, pollen and ovary culture for production of haploid plants and homozygous lines. Plant hardening transfer to soil, green house technology.

**UNIT-III Plant genome organization:** **10 hours**

Chloroplast, Mitochondria, and Nucleus Strategies in bioconversion. Production of pharmaceutical compounds. Mass cultivation of plant cells. Secondary metabolite Production from Suspension Culture, Bioreactors– Photo-bioreactor. Production of secondary metabolite in plants, stages of secondary metabolite production, uses of tissue culture techniques in secondary metabolites.

**UNIT-IV Plant genetic engineering:** **10 hours**

Methodology; Plant transformation with Ti-plasmid of *Agrobacterium tumifacians*; Ti-plasmid derived vector systems, Ri plasmids; Physical methods of transferring genes to plants –Micro-projectile bombardment, Electroporation; Manipulation of gene expression in plants; Production of marker free transgenic plants.

**UNIT- V Application of genetic transformation:** **10 hours**

Productivity and performance: herbicide resistance, insect resistance, virus resistance, fungal resistance, nematode resistance, Induction of abiotic stress and cold stress. Delay in fruit ripening, LEA protein, plantibodies, edible vaccines- primary and secondary metabolite modification, biopolymers, plant-based enzyme engineering.

**SUGGESTED READINGS:**


1. Slater, A., Scott,N.W.,&Fowler, M. R.(2008).*Plant Biotechnology.*Oxford: Oxford University Press.
2. Ignacimuthu,S.(2004).*Plant Biotechnology.* New Delhi: Oxford and IBH Publishing House.
3. Chawla, H.S.(2002).*Introduction to Plant Biotechnology.* New Delhi: Oxford and IBHP Publishing Co. Pvt. Ltd.
4. Kumar,U. (2008). *Plant Biotehnology and biodiversity conservation.* Jodhpur: Agrobios.
5. Stewart, N.C.(2016).*Plant Biotechnology andGenetics.*2nd Edition. New Jersey: John Wiley &Sons,Inc.
6. Halford, N.,& Halford, N. G.(2007).*Plant Biotechnology: Current and Future Applications of Genetically Modified Crops*. New Jersey: John Wiley & Sons.
7. Nirmala,C.B.,Rajalakshmi,G.,&Karthik,C. (2009).*Plant Biotechnology.* Chennai:MJP Publication

SEMESTER–III

23BTP302 **ANIMAL BIOTECHNOLOGY** 4H – 4C

**Instruction Hours/ week: L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total:**100**

**End Semester Exam:**3Hours

**Course Objectives**

The main objectives of the course are

- To cognize and get the knowledge on animal tissue culture
- To give knowledge about various methods of gene transfer and gene expression in animals
- To introduce biotechnological methods for production of transgenic animal
- To understand the processes involved in gene transfer methods in animal
- To infer the production and preservation of embryos
- To acquaint knowledge on ethical issues in animal biotechnology

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Understand the growth conditions required to culture the animal in *in-vitro* conditions | Understand |
| CO2 | Inculcate the deep information of genetic engineering of animal | Understand |
| CO3 | Acquire strong knowledge on transgenic animal | Understand |
| CO4 | Implement gene transfer methods to develop transgenic animal | Create |
| CO5 | Develop animal-based growth hormone | Apply |
| CO6 | Recognize various progresses involved in development of transgenic animal | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | M | M |
| **CO2** | M | M | M | M | L | M | M |
| **CO3** | M | M | M | M | L | S | S |
| **CO4** | S | S | S | S | L | S | S |
| **CO5** | M | M | M | M | L | S | S |
| **CO6** | S | S | S | S | L | S | S |

**S-Strong; M-Medium; L-Low**

**UNIT I Animal cells:** **10 hours**

Culture media, types of media, balances salt solutions. Physical, chemical and metabolic functions of different constituents of culture medium; Role of carbon dioxide, serum, growth factors, glutamine in cell culture; Serum and protein free defined media and their applications.

**UNIT II Cell culture:** **10 hours**

Types, disaggregation of tissue, primary culture, established culture; Suspension culture, organ culture, three dimensional culture and tissue engineering, feeder layers; Cell synchronization; cryo-preservation. Biology and characterization of cultured cells, tissue typing; cell–cell interaction; measuring parameters of growth; Measurement of cell death–apoptosis and its determination.

**UNIT III Molecular cell techniques:** **8 hours**

Cell transformation-physical, chemical and biological methods; Manipulation of genes; Cell and organism cloning; Green fluorescent protein and its application. Gene therapy.

**UNIT IV Embryology:** **10 hours**

Collection and preservation of embryos; Culturing of embryos; Gametogenesis and fertilization in animals; Types of cleavage pattern; Role of maternal contributions in early embryonic development; *In-vitro* fertilization and stem cell research.

**UNIT V Transgenics:** **10 hours**

Transgenic animals; Production and application; Transgenic animals as models for human diseases; Transgenic animals in live- stock improvement; Expression of the bovine growth hormone; Transgenics in industry. Ethical issues in animal biotechnology

**SUGGESTED READINGS:**


1. Ranga, M.M.(2007).Animal Biotechnology.(3rd ed.).Jodhpur: Agrobios.
2. Freshney, R.I.(2000).Animal Cell Culture: A Practical Approach(4thed.).New York: John Wiley Publications.
3. Glick,B.R.,& Pasternack,J.J.(2003).Molecular Biotechnology (3rded.).UK: Black well Science.
4. Gordon,I.(2003).Laboratory Production of Cattle Embryos (2nded.).New Delhi: CAB International.
5. Yagasaki,K.,Miura,Y.,Hatori,M.&Nomura,Y.(2008).Animal Cell Technology: Basicand Applied Aspects(Vols13).New York: Springer- Verlag.
6. Primrose,S.B.,Twyman,R.M.,&Old,R.W.(2001).Principles of Gene Manipulation (6th ed.). Germany: Blackwell Science Publishing Company.
7. Portner, R. (2014). Animal Cell Biotechnology: Methods and Protocols. 3rd edition. New York: Springer-Verlag.

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**SEMESTER–III**

**23BTP303** **ENVIRONMENTALBIOTECHNOLOGY** **4H– 4C**

**Instruction Hours/week: L:4 T:0 P:0** **Marks:** Internal:**40** External:**60** Total:**100**

**End Semester Exam:** 3Hours

**Course Objectives**

The main objectives of the course are

- To understand the various components of the environmental biotechnology including ecosystems, environmental problems
- To obtain knowledge on the sources for environmental pollution and its bio remedial measures
- To attain key concepts on sewage and waste water treatment
- To understand the biotic and abiotic degradation of xeno-biotics
- To learn about various types of biofuels in the field of environmental biotechnology
- To investigate environmental air pollution and their impacts

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Demonstrate various types of eco-systems, environmental threats and management | Understand |
| CO2 | Discuss the different methods of bio-remediation and its impact on environmental pollution | Understand |
| CO3 | Appreciate recent approaches to biological waste water treatment | Understand |
| CO4 | Recognize the importance of bio augmentation for the degradation of xenobiotics | Understand |
| CO5 | Implement different types of biofuels such as biogas, bioethanol and bio-hydrogen for betterment of green environment | Apply |
| CO6 | To understand the importance of biological techniques in controlling air pollution | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | M | M |
| **CO2** | M | M | M | M | L | M | M |
| **CO3** | M | M | M | M | L | S | S |
| **CO4** | S | S | S | S | L | S | S |
| **CO5** | M | M | M | M | L | S | S |
| **CO6** | S | S | S | S | L | S | S |

**S-Strong; M-Medium; L-Low**

**UNIT–I Environment** **10 hours**

Biogeochemical cycling in ecological systems, limiting factors, energy transfer; Response of microbes, plant and animals to environmental stresses; Concept of ecosystems and ecosystem management, environmental problems-ozone depletion, greenhouse effect, water, air and soil pollution and degradation.

**UNIT–II Bioremediation** **10 hours**

Genetically Engineered Microorganisms (GEMs) in environment; Role of superbug in oil and petroleum degradation in soil and water, Role of environmental biotechnology in management of environmental problems, Bioremediation, advantages and dis-advantages; *In-situ* and *ex-situ* bio-remediation; slurry bioremediation; Bioremediation of contaminated ground water and phytoremediation of soil metals; Microbiology of degradation of xenobiotics. Green audit and carbon credit.

**UNIT–III Waste management** **10 hours**

Sewage and waste water treatment and solid waste management, chemical measure of water pollution, conventional biological treatment, role of microphyte and macrophytes in water treatment; Recent approaches to biological waste water treatment, composting process and techniques, use of composted materials, vermicomposting (Role of *Eudrilus eugeniae*and *E.fistea).*

**UNIT–IV Decomposition and treatment strategies** **8 hours**

Biological decomposition of organic carbon, Nitrogen and phosphate removal. Biological removal, biotransformation, and bio-sorption of metalions. Aerobic- and anaerobic degradation of xenobiotics. Bio-augmentation for degradation of xenobiotics. Industrial sources of waste water. Treatment strategies.

**UNIT–V Fuels and Hazards** **10 hours**

Biofuels and biological control of air pollution, plant derived fuels, biogas, land fill gas, bioethanol, biohydrogen; use of biological techniques in controlling air pollution; Removal of chlorinated hydrocarbons from air**,** Types of environmental hazards and disasters; Natural- volcanic eruption, earthquakes, landslides, cyclones, lightning, hailstorms. Hazardous Waste Management and Handlingrules.EnvironmentalProtectionAct,1986, Water (Prevention and Control of Pollution) Act, 1974.

**SUGGESTED READINGS:**


1. Agarwal, S.K. (2002). *Environmental Biotechnology*. New Delhi: APH Publishing Corporation.
2. Dubey,R.C. (2010) A text book of Biotechnology,S.Chand and Company Ltd, NewDelhi
3. Evans,G.M.,& Furlong,J.C.,(2003).*Environmental Biotechnology: Theory and Applications*. (2nd ed.) England:J ohnWiley & Sons Ltd.
4. Jördening,H.J.,& Winter, J.(2005).*Environmental Biotechnology.* Germany: Wiley-VCH Verlag GmbH& Co. KGaA.
5. Mara, D. (2003).*The Hand book of Water and Wastewater Microbiology.*(1 sted.) London: Academic Press.
6. Wang, L.K.(2010), Environmental Biotechnology,1stedition,A Product of Human a Press.

SEMESTER–III

23BTP304 **GENOMICS, PROTEOMICS AND BIOINFORMATICS** 4H – 4C

**Instruction Hours/ week: L:3 T:1 P:0** **Marks:** Internal:**40** External:**60** Total:**100**

**End Semester Exam:** 3Hours

**Course Objectives**

The main objectives of the course are

- To import the basic and recent developments in the field of genome sequencing, genome mapping, proteomic data analysis
- To develop the knowledge on genomic and proteomic sequencing methods
- To know about the genomic and proteomic databases
- To describe sequence and structural alignments
- To use bioinformatics techniques to construct phylogenetic tree
- To understand three-dimensional structure prediction of proteins

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Have a clear understanding on the application of genome sequencing, genome mapping, proteomic data analysis | Understand |
| CO2 | Analyze the genomic and proteomic data | Understand |
| CO3 | Utilize the omics data bases for genomic and proteomic data analysis | Understand |
| CO4 | Demonstrate sequence and structural alignments using softwares such as BLAST, tBLASTn and DALI | Understand |
| CO5 | Discuss the application of phylogenetic tree in protein analysis | Apply |
| CO6 | Describe the tools used in the prediction of three-dimensional structure of proteins | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | M | M |
| **CO2** | S | S | S | S | L | S | S |
| **CO3** | S | S | S | S | L | S | S |
| **CO4** | S | S | S | S | L | S | S |
| **CO5** | M | M | M | M | L | S | S |
| **CO6** | S | S | S | S | L | S | S |

**S-Strong; M-Medium; L-Low**

**UNIT I Genomics:** **10 hours**

Genome–Human Genome project(HGP)-Merits and limitations of chemical sequencing method– Dideoxy method–mRNA sequencing–cDNA library– Shotgun method–Auto mated sequencing– Next generation sequencing–Pyrosequencing–Genome mappings–Restriction mappings– Fluorescence *in-situ*

hybridization(FISH)–Genetic markers–SNP, VNTR, RFLP, Mini-satellite and Microsatellite–Applications of genome mappings.

**UNIT II Proteomics: 10 hours**

Proteome–SDS-PAGE–IEF–2D Gel electrophoresis–Sample preparations–Merits and limitations –Mass spectrometry–ESI-MS–Molecular weight estimations–Studying protein-protein interactions –Structural analysis–Protein folding pathways analysis–Tandem Mass spectrometry-Protein sequencing methods–MALDI-MS.

**UNIT III Omics data bases: 8 hours**

Genome databases –ENSEMBL- VISTA–Fly Base –OMIM – Protein data bases–NCBI–UniProt–Secondary data bases–PROSITE- 2DPAGE Database- Structural databases –PDB– SCOP– CATH.

**UNIT IV Sequence and structural alignments: 10 hours**

Sequence similarity searching tools– Protein BLAST–Nucleotide BLAST– tBLASTn – BLASTx–Pairwise alignments–Multiple sequence alignments–Clustal Omega- Protein structure alignment– DALI, Genome editing with CRISPR-Cas 9- Phylogenetic tree construction and analysis.

**UNIT V Structure prediction tools: 10 hours**

Secondary structure predictions – Empirical and knowledge-based methods –Predicting three- dimensional structures of proteins–Strategies, tools, merits and limitations of comparative modeling – Threading/fold recognition and *Ab initio* methods – Stereo chemical and structural analysis – Molecular visualization tools and Next Generation Sequencing(NGS).

**SUGGESTED READINGS:**


1. Attwood,T.K.(2007).*Introduction to Bioinformatics*(1st ed.).Pearson Education, London, United Kingdom.
2. Bhat,S.(2008).*Genomics*.Duck worth Press, London, United Kingdom.
3. Gu,J.&Bourne,P.E.(2018).*Structural Bioinformatics*(2nd ed.).Wiley-Blackwell Publishers, New Jersey, United States.
4. Ibrahim,K.S.,Gurusubramanian,G.,Zothansanga,Yadav,R.P.,Kumar,N.S.,Pandian,S.K., Borah,P.,&Mohan,S.(2017).Bioinformatics-AStudent's Companion.Springer Publishers, New York, United States.
5. Lesk,A.M.(2014).*Introduction to Bioinformatics*(4th ed.).Oxford University Press, Oxford, United Kingdom.
6. Mount, D.W. (2005). *Bioinformatics –Sequence and Genome Analysis* (2nd ed.). CBS Publishers, CSHL Press, New York, United States.
7. Palzkill,T. (2007).*Proteomics*. Springer Publishers, New York, United States.
8. Primrose,SB&Twyman,R.(2006).*Principles of genome analysis and Genomics*.Wiley- Blackwell Publishers, New Jersey, United States.

SEMESTER–III

23BTP305A FOOD BIOTECHNOLOGY 3H – 3C

**Instruction Hours/ week: L:3 T:0 P:0** **Marks:**Internal:**40** External:**60 Total:100**

**End Semester Exam:**3Hours

**Course Objectives**

The main objectives of the course are

- To understand the concepts of food biotechnology along with role of microbes in fermentation
- To attain strong knowledge on primary sources of microorganisms in food
- To explore the methods for development and preservation of fermented foods
- To obtain strong knowledge on food spoilage
- To recognize the methods used in food preservation
- To understand the concepts of food adulteration and food safety

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Understand the beneficial role of microorganisms in fermented foods and food processing | Understand |
| CO2 | Understand the significance and activities of microorganisms in food and role of intrinsic and extrinsic factors on growth and survival of microorganisms in foods | Understand |
| CO3 | Learn the various technological aspects of fermented products such as beer and wine in larger scale production | Understand |
| CO4 | Know the spoilage mechanisms in foods and thus identify methods to control deterioration and spoilage | Understand |
| CO5 | Identify ways to control microorganisms in foods and thus know the principles involving various methods of food preservation | Apply |
| CO6 | Recognize and describe the characteristics of food adulterants and their safety measures | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | M | M | M | M | L | M | M |
| **CO2** | M | M | M | M | L | M | M |
| **CO3** | S | S | S | S | L | S | S |
| **CO4** | S | S | S | S | L | S | S |
| **CO5** | M | M | M | M | L | S | S |
| **CO6** | S | S | S | S | L | S | S |

**S-Strong; M-Medium; L-Low**

**Unit –I Introduction**: **6 hours**

History and scope of food biotechnology, nutritive value of food, role of microbes in food biotechnology–bacteria, fungi and yeast. Development and formulation of probiotic foods**.** Fermented foods–Types, changes during fermentation, nutritive value of fermented foods.

**Unit –II Food microbiology: 8 hours**

Primary sources of microorganisms in food. General principles and techniques in microbiological examination of food samples. Food-borne bacteria, molds and yeasts. Intrinsic- and extrinsic parameters of food affecting microbial count. Detection of microorganisms in food- SPC, membrane filters, dry films. Bacterial toxins- Botulism and staphylococcal toxin. Fungal toxins-Aflatoxins..

**Unit –III Fermented foods: 6 hours**

Origin, scope and development and preservation- Cheese, yogurt, butter, miso, tempeh, kefir, koumiss, acidophilus milk, sauerkraut, pickles and vinegar. Technological aspects of industrial production of beer, wine and baker's yeast.

**Unit–IV Foods poilage and preservation: 8 hours**

Causes of food spoilage, spoilage of fruits, vegetables, meat, soft Drinks, eggs, sea food products, dairy products. Food Preservation through chemicals- acids, salts, sugars, antibiotics, ethylene oxide, antioxidants. Other methods of food preservation-Radiations, low and high temperature, drying. Food packaging materials and their properties.

**Unit –V Food adulteration and food safety: 8 hours**

Adulteration, Responsibility for food safety, Food additives -Definition, types and functional characteristics. Natural colors and artificial colors-Types, applications, advantages of natural colors. Sweeteners-Types and applications. Enzymes used in food industry. Food safety-HACCP System to food protection, FSSAI guidelines.

**SUGGESTED READINGS**


1. Adam,M.R.& Moss,M.O.(2018).*Food Microbiology*.New Age Internationa lPublishers, New Delhi,India.
2. Bell,C.,Neaves,P.,& Williams, A.P.(2005).*Food Microbiology and Laboratory Practice.* Wiley-BlackwellPublishers,New Jersey, UnitedStates.
3. Bhatia, S.C.(2017).*Food Biotechnology*.WPI Publishers, New Delhi,India.
4. Export/import data by DGCIS-Calcutta.
5. Export/importpolicy by Govt. of India.
6. Frazier, W.C., Westhoff,D.C.,&Vanitha,N.M.(2017).*Food Microbiology* (5$^{th}$ed.).Mc Graw-Hill Education/Medical, London,United Kingdom.
7. Harrigan,W.F. (2013).*Laboratory methods in Food Microbiology* (3$^{rd}$ed.). Elsevier Publishers,Amsterdam,Netherlands.
8. Jain, K.S.&Jain,A.V.(2017).*ForeignTrade - Theory,Procedures, Practices and Documentation*(7$^{th}$ed.). HimalayaPublishingHouse, Mumbai,India.
9. Jay,J.M.,Loessner, J.M.,&Golden,A.D.(2008).*Modern FoodMicrobiology*(7$^{th}$ed.). SpringerPublishers, New York, UnitedStates.
10. Suri, S.& Malhotra,A.*FoodScience,NutritionandSafety*. PearsonEducation India Publishers,London,United Kingdom.

SEMESTER–III

23BTP305B **AGRICULTURAL BIOTECHNOLOGY** 3H – 3C

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal:**40** External:**60** Total:**100**

**End Semester Exam:** 3Hours

**Course Objectives**

The main objectives of the course are

- To learn the fundamentals of plant tissue culture and its applications
- To provide various concepts in genetics and its aspects in cultivation practice
- To attain the basic concepts in developing transgenic crops
- To understand the key knowledge in producing stress resistant crops
- To study the importance of metabolic engineering and agricultural farming in plants
- To obtain information on biosafety and risk assessment of genetically modified crops

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Demonstrate the techniques in plant tissue culture | Understand |
| CO2 | Explain the genetic transformation techniques in plants | Understand |
| CO3 | Develop transgenic plants in crop improvement | Create |
| CO4 | Produce stress resistant crops against microbes and insects | Understand |
| CO5 | Validate the applications of genetic transformation, metabolic engineering, production of pharmaceuticals and industrial products | Apply |
| CO6 | To get a career in Industry /Research and Development | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | M | M | M | M | L | M | M |
| **CO2** | M | M | M | M | L | M | M |
| **CO3** | S | S | S | S | L | S | S |
| **CO4** | M | M | M | M | L | M | M |
| **CO5** | M | M | M | M | L | S | S |
| **CO6** | S | S | S | S | L | S | S |

**S-Strong; M-Medium; L-Low**

**UNIT –I Plant tissue culture and its applications:** **6 hours**

Recombinant DNA technology, methods of gene transfer in plants, development of transgenic plants for abiotic & biotic stress tolerance. Tools and techniques used in agriculture biotechnology.

**UNIT –II Genetic and molecular basis:** **8 hours**

Heterosis and Apomixis and their significance, Mutations and polyploidy in crop improvement, Molecular markers, Marker assisted breeding, QTL mapping, Origin, evolution and cultivation practices of the major crop plants

**UNIT –III Improvement of crop plants: 6 hours**

Biofortification - increase in iron, protein and amino acids. Golden rice, Bt Cotton, GM crop transformations, Plants as biofactories- Developing vaccine and plantibodies, terminator technology and male sterility.

**UNIT–IV Stress resistance on crops: 8 hours**

Virus- coat protein mediated, nucleocapsid gene, antisense and RNAi,Fungal diseases:chitinase,1-3beta glucanase, RIP, antifungal proteins, thionins, PRproteins, Insect pests resistance: Btgenes, Non-Btlike protease inhibitors, alpha amylase inhibitor, nematodes resistance and herbicide resistance: phosphoinothricin, glyphosate, sulfonyl urea, atrazine.

**UNIT–V Genetic engineering for increasing crop productivity: 8 hours**

Enhancing photosynthetic, nutrient use and nitrogen fixing efficiencies of plants, genetic engineering for quality improvement: Seed storage proteins; essential amino acids, Vitamins and minerals, heterologous protein production in transgenic plants, Biosafety and risk assessment of GM crops.

**SUGGESTED READINGS:**


1. Adrian Slater, NigelScottandMark Fowler,PlantBiotechnology:Thegenetic manipulationof plants,1stEdition,Oxford University Press,2003
2. Chakraborty.U, BishwanathChakraborty, 2005. Stressbiology,Vidhyasekaran,P.2007. NarosaPublishingHouse.
3. Denis Murphy,Plant BreedingandBiotechnology:Societal Contextand theFutureof Agriculture, CambridgeUniversity Press, 2007.
4. GuptaPK Plant Biotechnology,RastogiPublication,Meerut,India.
5. Jaiwal P K&SinghRP (eds) PlantGenetic Engineering Vol-1toVol. 9. Studium Press, USA, 2006.

SEMESTER–III

23BTP305C **PHARMACEUTICAL BIOTECHNOLOGY** 3H – 3C

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal:**40** External:**60** Total:**100**

**End Semester Exam:**3Hours

**Course Objectives**

The main objectives of the course are

- To obtain basic skills necessary for employing biotechnology principles in together with various pharmaceutical parameters
- To understand novel formulation approaches for better delivery of biotechnology-derived drugs
- To attain knowledge on drug safety and effectiveness
- To comprehend the physical and chemical properties of drugs
- To impart information on the delivery of peptide and proteins by conventional routes of administration
- To learn about special storage, handling, reconstitution and administration conditions and techniques for drug delivery systems containing bioactive macromolecules

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Evaluate different pharmaceutical parameters of current biotechnology products | Understand |
| CO2 | Determine parameters related to stability and formulation of biotechnology-derived drugs | Evaluate |
| CO3 | Discuss quality control procedures related to biotechnology products | Create |
| CO4 | Apply the knowledge of physicochemical properties of drugs in novel drug designing | Understand |
| CO5 | Demonstrate novel formulation methods for better delivery of biotechnology derived drugs | Apply |
| CO6 | Join pharmaceutical biotechnology lab and industries as a research assistant | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | S | S |
| **CO2** | S | S | S | S | L | S | S |
| **CO3** | S | S | S | S | L | S | S |
| **CO4** | S | S | S | S | L | S | S |
| **CO5** | M | M | M | M | L | S | S |
| **CO6** | S | S | S | S | L | S | S |

**S-Strong; M-Medium; L-Low**

**UNIT –I Introduction:** **8 hours**

Introduction to Pharmaceuticals; History and age of Biopharmaceuticals. History and age of biopharmaceuticals; Classification of pharmaceuticals-solutions, suspensions, tablets, capsules. Drugs and its sources, routes of drug administration, absorption and bioavailability, distribution, drug metabolism, drug theories, drug receptor interactions, pro-drug concept.

**UNIT –II Drug design and Drug discovery:** **8 hours**

Drug design; drug development, random screen up, target identification and validation, biochips, Quantitative structure activity relationship (QSAR), proteomics, genomics. DNA/Protein microarray, SAGE. Structural genomics and pharmacogenetics**.**

**UNIT –III Pharmacokinetics:** **6 hours**

Pharmacogenomics. Pharmacokinetics – Order of kinetics–drug safety and effectiveness-Drug interactions. Pharmaco dynamic interactions- Drug tolerance–Adverse drug reactions. Drug tolerance – Adverse drug reactions, Drug repurposing.

**UNIT –IV Genetically engineered protein:** **6 hours**

Genetically engineered protein and peptide agents, Anti-AIDS drug development, oncogenes as targets for drugs, multi-drug resistance, vaccine development and role of genetic engineering in controlling infectious diseases, stem cell therapy

**UNIT-V Novel drug delivery systems:** **8 hours**

Novel drug delivery systems–non conventional routes of administration, micro encapsulation, implantable drug delivery system, mucosal drug delivery system and nasopulmonary drug delivery system. Introduction to the drug carrier, liposome as a drug carrier, biodegradable polymers as a drug-carrier. Modified Drug Release: The sustained release, first order release approximation, multiple dosing.

**SUGGESTED READINGS:**


1. Abraham,D.J.&Rotella,D.P.(2010).*Burger's Medicinal Chemistry, DrugDiscoveryand Development*(7th ed.). Wiley Publishers, New York, UnitedStates.
2. Banga, A.K. (2015). *Therapeutic Peptides and Proteins: Formulation, Processing, and Delivery Systems*(3rd ed.).CRC Press, Florida,UnitedStates.
3. Bhagavan,N.V.&Ha,C-E.(2015).*EssentialofMedicalBiochemistry*(2nd ed.).Academic Press Publishers, New York,United States.
4. Crommelin,D.J.A.,Sindelar,R.D.&Meibohm,B.(2019).*PharmaceuticalBiotechnology: Fundamentals andApplications*(5th ed.).Springer Publishers, New York, UnitedStates.
5. Golan,D.E.,Armstrong,E.J.,&Armstrong,A.W.(2016).*PrinciplesofPharmacology:The PathophysiologicBasisofDrugTherapy*(4th ed.).LWWPublishers,Pennsylvania,United States.
6. Rho,J.P.&Louie,S.G.(2003).*HandbookofPharmaceuticalBiotechnology*(1st ed.).CRC Press, Florida,UnitedStates.
7. Satoskar,R.S.,Rage,N.N.,Tripathi,R.K.,&Bhandarkar,S.D.(2017).*Pharmacologyand Pharmacotherapeutics*(25th ed.). Elsevier IndiaPublishers, Chennai,India.
8. Sethi,P.D.(2008).*QuantitativeAnalysisofDrugsinPharmaceuticalFormulations*(3rd ed.). CBS Publishers andDistributers, New Delhi,India.

SEMESTER–III

**23BTP311 PLANT AND ANIMAL BIOTECHNOLOGY PRACTICAL–V 4H – 2C**

**Instruction Hours/week: L:0 T:0 P:4** **Marks:** Internal:**40** External:**60** Total:**100**

**End Semester Exam:**3Hours

**Course Objectives**

The main objectives of the course are

- To gain hands-on experience and to learn the principles behind plant and animal biotechnology
- To know the processes involved in isolation, separation, manipulation of plant and animal tissues
- To perform invitro seed germination, synthetic seed production and micropropagation from plant parts
- To analyze agrobacterium-mediated gene transformation
- To accomplish various preparation and sterilization methods in the production of animal tissue culture medium
- To learn the basic techniques used in animal cell culture

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Acquaint with principles, technical requirement, scientific and commercial applications in plant and animal biotechnology | Understand |
| CO2 | To support methodologies in plant and animal tissue/cell culture | Evaluate |
| CO3 | Describe basic gene transfer technologies in plants | Understand |
| CO4 | Designate problems associated with plant and animal tissue culture | Understand |
| CO5 | T gain strong knowledge in routine practices of plant and animal tissue culture | Apply |
| CO6 | Join as lab manager or key scientist in plant and animal biotechnological research institute and industries. | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | S | S |
| **CO2** | S | S | S | S | L | S | S |
| **CO3** | S | S | S | S | L | S | S |
| **CO4** | S | S | S | S | L | S | S |
| **CO5** | S | S | S | S | L | S | S |
| **CO6** | S | S | S | S | L | S | S |

**S-Strong; M-Medium; L-Low**

**Plant Tissue Culture Practicals** **24 hours**

1. *Invitro* germination of seeds
2. Multiple shoot induction
3. Hairy root culture

4. Suspension culture and estimate the product yield(Flavanoid)
5. Embryo culture
6. Synthetic seed production.
7. Protoplast isolation
8. *Agrobacterium*-mediated gene transformation
9. Demonstration of gene transfer by particle bombardment.
10. Hardening of PTC plants

**Animal Biotechnology practicals** **24 hours**

1. Preparation and filter-sterilization of animal tissue culture medium
2. Chicken embryo fibroblast culture
3. Quantification of cells by haemocytometer
4. Quantification of viable and non-viable cells by trypan blue dye exclusion method
5. Identification of leukocyte subsets and total count.
6. Blood leukocyte culture
7. Hoechst nuclear staining (Fluorescent microscopy)
8. Cryopreservation and revival of cell lines.
9. Cytotoxicity of phyto molecules by MTT assay

**SUGGESTED READINGS:**


1. Bhojwani,S.S.&Dantu,P.K.(2013).*PlantTissueCulture:AnIntroductoryTextand Practice.*Springer Publishers,New York, United States.
2. Butler,M. (2003).*Animalcellcultureandtechnology:Thebasics*(2nd ed.).Taylor&Francis Publishers,Abingdon,UnitedKingdom.
3. Slater, A., Scott,N.W. &Fowler, M.R. (2008).*Plant Biotechnology:TheGenetic Manipulation of plants*(2nd ed.).Oxford University Press, Oxford, UnitedKingdom.

SEMESTER–III

**23BTP312 GENOMICS, PROTEOMICS AND BIOINFORMATICS PRACTICAL– VI 3H – 2C**

**Instruction Hours/week:L:0 T:0 P:3** **Marks:**Internal:**40** External:**60** Total:**100**

**End Semester Exam:**3Hours

**Course Objectives**

The main objectives of the course are

- To give knowledge on genomics, proteomics and bioinformatics and their application
- To gain knowledge to assess biological databases
- To understand and to analyze protein/nucleotide sequences and to predict its3D structure
- To comprehend the various online databases for submitting and retrieving data
- To recognize how the phylogeny plays a vital role in finding ambiguities
- To get practiced with the tools and techniques for analyzing the data

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Understand the relationship between sequence- structure- function of genes | Understand |
| CO2 | Familiarize with the algorithms required to compare sequences and require to know the phylogenetic relationship between the gene sequences | Understand |
| CO3 | To adapt basic knowledge on building 3D structures of genes | Create |
| CO4 | Locate and use the main databases at the NCBI and EBI resources | Understand |
| CO5 | Know the difference between databases, tools, repositories and be able to use each one to extract specific information | Apply |
| CO6 | Use selected tools at RasMol, JMol and PyMol to run simple analyses on genomic sequences | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | S | S |
| **CO2** | S | S | S | S | L | S | S |
| **CO3** | S | S | S | S | L | S | S |
| **CO4** | S | S | S | S | L | S | S |
| **CO5** | S | S | S | S | L | S | S |
| **CO6** | S | S | S | S | L | S | S |

**S-Strong; M-Medium; L-Low**

**Practicals** **36 hours**

1. Exploring of primary databases (Proteins)and sequence retrieval
2. Exploring of primary databases (Nucleic acids) and sequence retrieval
3. Exploring of secondary databases (Nucleic acids) and sequence retrieval
4. Physicochemical and structural analyses of primary sequences (Proteins and Nucleic acids)
5. Multiple sequence alignments and phylogenetic analysis

6. Comparative modeling using online and standalone tools
7. Structural analysis and verification tools
8. 3D structure prediction and validation tools
9. Molecular visualization tools: RasMol, JMol and PyMol
10. Molecular dockings of biological macromolecules

**SUGGESTED READINGS:**


1. Baxevanis,A.D.& Ouellette,B.F.(2001).*Bioinformatics–A practical guide to the analyze of genes and proteins*(2nd ed.). Wiley-BlackwellPublishers,New York, UnitedStates.
2. Ibrahim,K.S.,Gurusubramanian,G.,Zothansanga,Yadav,R.P.,Kumar,N.S.,Pandian,S.K., Borah,P.,& Mohan,S.(2017).*Bioinformatics-A Student's Companion*.Springer Publishers, New York, United States.
3. Leach, A.R. & Gillet,V.J.(2009).*AnIntroduction to Chemoinformatics*.Springer Publishers, New York, UnitedStates.

**23MBAPOE301** **ORGANIZATIONAL BEHAVIOUR** **SEMESTER- III 3H – 2C**

**InstructionHours/week:L:3 T:0 P:0** **Marks:**Internal:**40** External:**60** Total:**100**

**End Semester Exam:**3Hours

**COURSE OBJECTIVES:**

To make the students

- To understand the basic concepts of organizational behavior.
- To analyze the individual behavior traits required for performing as an individual or group.
- To obtain the perceiving skills to judge the situation and communicate the thoughts and ideas.
- To understand how to perform in group and team and how to manage the power, politicsand conflict.
- To recognize the importance of organizational culture and organizationalchange.
- To realise the importance of groups and teamwork and managing of conflict between themembers ofthe organization

**COURSE OUTCOMES:**

Learners should be able to

1. Analyse organizational behavior issues in the context of the organizational behavior theories and concepts.
2. Assess the behavior of the individuals and groups in organization and manage the stress.
3. Manage team, power, politics and conflict arising between the members.
4. Explain how organizational change and culture affect the working relationship within organizations.
5. Understand and exhibit the communication skills to convey the thoughts and ideas of case analysis to the individuals and group.
6. Understand the application of OB using appropriate concepts, logic and thetorical conventions

**UNIT I Organization behaviour : Introduction** **8 hours**

Organization Behavior: Meaning and definition - Fundamental concepts of OB - Contributing disciplines to the OB field – OB Model - Significance of OB in the organization success - Challengesand Opportunities for OB.

**UNIT II Behaviour and Personality** **6 hours**

Attitudes – Sources - Types - Functions of Attitudes. Values – Importance - Types of Values. Personality – Determinants of personality- Theories of Personality - psycho-analytical, social learning, job-fit, and trait theories.

**UNIT III Perception** **8 hours**

Perception – factors influencing perception - Person Perception – Attribution Theory – Frequently Used Shortcuts in Judging Others- Perceptual Process- Perceptual Selectivity - Organization Error of perception – Linkage between perception and Decision making.

**UNIT IV Group and Stress Management** **6 hours**

Foundation of Group Behavior - Types of Groups - Stages of Group Development - Group Norms - Group Cohesiveness – Stress – Causes of stress – Effects of Occupational Stress- Coping Strategies for Stress.

**UNIT V Organization Culture and Change** **8 hours**

Organizational culture- Characteristics of Culture- Types of Culture – Creating and Maintaining an Organizational Culture. Organizational change – Meaning - Forces for Change - Factors in Organizational Change - Resistance to change- Overcoming resistance to change.

**SUGGESTED READINGS:**


1. Fred Luthans. (2017). *Organizational Behavior: An Evidence - Based Approach*, 12th edition, Mcgraw Hill Education, NewDelhi.
2. Steven Mcshane and Mary Ann VonGlinow (2017)*, Organizational Behavior,* 6th edition, McGraw Hill Education, NewDelhi
3. Robbins, S. P., and Judge, T.A. (2016). *Organizational Behaviour*.(16th edition).New Delhi: Prentice Hall of India.
4. Laurie J. Mullins (2016), *Management and Organisationalbehaviour*, 10th edition, Pearson Education, NewDelhi
5. Robbins, S. P., and Judge, T.A. (2016). *Essentials of Organizational Behavior*.13th edition, Pearson Education.
6. https://nptel.ac.in/courses/110/105/110105033/

**23PHPOE301** **MATERIALS CHARACTERIZTION** **3H – 2C**

**Instruction Hours/week: L: 3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**
**End Semester Exam:** 3Hours

**Course Objectives**

- To Study materials is always important, for any application, including fabrication of satellites.
- To introduce various methods available for characterizing the materials. The characterization of materials specifically addresses that portfolio with which researchers and educators must have working familiarity.
- To provide an introduction to materials characterization and its importance
- To discuss different types of characterization techniques and their uses.
- To introduce the students to the principles of optical and electron microscopy, X-ray diffraction and various spectroscopic techniques Introduction:
- To understand the materials characterization and available techniques

**Course Outcomes (COs)**

After completing the course the students will / can able to

1. Handle with X-ray, thermal, microscopic, and electrical methods of characterization.
2. Understand and describe the fundamental principles behind the methods of characterization which are included in the curriculum
3. Analyze, interpret and present observations from the different methods.
4. Evaluate the uncertainty of observations and results from the different methods.
5. Understand the history of materials science with basic understanding of metals, binary alloys, magnetic materials, dielectric materials and polymers
6. Understand nucleation, growth and phase transformation kinetics

**UNIT -1** **8 hours**

X-ray techniques for materials characterization X-ray diffraction: Principle, measuring system and applications for characterization of powdered materials. X-ray diffraction profile and analysis: FWHM and line broadening, Crystallite size effect and Scherrer formula, Effect of strain (tensile vs compressive, uniform vs. non-uniform) Introduction to Extended X-ray absorption fine structure (EXAFS), Surface extended X-ray absorption (SEXAFS).

**UNIT - II** **6 hours**

Microscopic techniques Principles, instrumentations and applications of Optical microscope, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM) for characterization of different samples. Energy dispersive X-ray microanalysis (EDS) - Basic aspects of Atomic force microscopy (AFM).

**UNIT – III** **6 hours**

Spectroscopic methods Principle, instrumentation and applications of UV-Visible Diffuse Reflectance (UV-Vis DRS) spectroscopy, Ft-Ir, Raman and Fluorescence spectroscopy. Hand of experience on operation of UV-Vis-DRS, FT-IR, Raman and data analysis..

**UNIT -IV** **8 hours**

Thermoanalytical Methods Principle, instrumentation and applications of Thermogravimetric Analysis (TGA), Differential Temperature Analysis (DTA) and Differential Scanning Calorometry (DSC). Factors affecting the TGA/DTA/DSC results and their interpretations. Hand on on experience of operation of TG/DSC and data analysis.

**UNIT -V** **8 hours**

Electroanalytical Techniques Voltammetric principles, hydrodynamic voltammetry, stripping voltammetry, cyclic voltammetry, criteria of reversibility of electrochemical reactions, quasi-reversible and irreversible processes, qualitative and quantitative analysis current-potential relation applicable for Linear Sweep Voltammetry (LSV) and Cyclic Voltammetry (CV), interpretation of cyclic voltammograms and parameters obtainable from voltammograms. Hand on experience on operation of CV and data analysis.

**SUGGESTED READINGS:**

1) Theory and Applications of UV Spectroscopy, H.H.Jaffe and M.Orchin, IBH-Oxford.
2) Inorganic spectroscopic methods, A.K. Brisdon, Oxford Chem. Primers, 1997, New York.
3) Applied Electron Spectroscopy for Chemical Analysis Ed. H. Windawi and F.L.Ho, Wiley Inter science.
4) Introduction to Spectroscopy, Pavia, Brooks/Cole Cenage, 4th edition, 2009, Belmont.
5) Introduction to Photoelectron Spectroscopy, P.K.Ghosh, John Wiley.
6) Fundamental of Molecular Spectroscopy, C. N. Banwell and E. McCash, Tata McGraw Hill, 4th edition, 1994, New Delhi.

SEMESTER–III

**23CAPOE30 ROBOTICS AND AUTOMATION PROCESS 3H – 2C**

**InstructionHours/week:L:3 T:0 P:0** **Marks:**Internal:**40** External:**60** Total:**100**

**End Semester Exam:**3Hours

**Course objectives**

Enable the student

- Learn the concepts of RPA, its benefits, types and models
- Gain the knowledge in application of RPA in Business Scenarios
- Identify measures and skills required for RPA
- Adopt to the implementations of Automation
- Able to process information and draw inference
- Understand the concepts of robot skills

**Course Outcomes (COs)**

Upon completion of this course students will be able to:

1. Demonstrate the benefits and ethics of RPA K1, K2
2. Understand the Automation cycle and its techniques K2
3. Draw inferences and information processing of RPA K3, K4
4. Understand the Automation concepts
5. Implement & Apply RPA in Business Scenarios K5
6. Analyze on Robots & leveraging automation

**Unit I - Introduction 8 hours**

Introduction to RPA - Overview of RPA - Benefits of RPA in a business environment - Industries & domains fit for RPA - Identification of process for automation - Types of Robots - Ethics of RPA & Best Practices - Automation and RPA Concepts - Different business models for implementing RPA - Centre of Excellence – Types and their applications - Building an RPA team - Approach for implementing RPA initiatives.

**Unit II - Automation 6 hours**

Role of a Business Manager in Automation initiatives - Skills required by a Business Manager for successful automation - The importance of a Business Manager in automation - Analyzing different business processes - Process Mapping frameworks - Role of a Business Manager in successful implementation – Part 1 - Understanding the Automation cycle – First 3 automation stages and activities performed by different people

**Unit III - Automation Implementation 8 hours**

Evaluating the Automation Implementation Detailed description of last 3 stages and activities performed by different people - Role of a Business Manager in successful completion – Part 2 - Activities to be performed post-implementation - Guidelines for tracking the implementation success - Metrics/Parameters to be considered for gauging success - Choosing the right licensing option - Sending emails - Publishing and Running Workflows

**Unit IV – Robot** **8 hours**

Ability to process information through scopes/systems - Understand the skill of information processing and its use in business - Leveraging automation - Creating a Robot - New Processes. Establish causality by variable behavior - Understand the skill of drawing inference or establishing causality by tracking the behavior of a variable as it varies across time/referenced variable - Leveraging automation for this skill - Robot & new process creation.

**Unit V – Robot Skill** **8 hours**

Inference from snapshots of curated terms – Omni-source data curation - Multisource trend tracking - Understand the skill of drawing inference from the behavior of curated terms by taking snapshots across systems in reference to time/variable(s) - Leveraging automation for this skill – Robot creation and new process creation for this skill.

**Suggested Readings**


1. Tom Taulli, February 2020. "The Robotic Process Automation Handbook" Apress , Reference Books 1 Steve Kaelble" Robotic Process Automation" John Wiley & Sons, Ltd.
2. Alok Mani Tripathi, March 2018. "Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool", Packet Publishing Limited


**Websites**

1. https://www.tutorialspoint.com/uipath/uipath_robotic_process_automation_introduction.htm
2. https://www.javatpoint.com/rpa 3 https://onlinecourses.nptel.ac.in/noc19_me74/preview

SEMESTER–III

**23BCPOE301** **NUTRITION AND DIETETICS** **3H – 2C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal:**40** External:**60** Total:**100**

**End Semester Exam:** 3Hours

**Course Objectives**

To equip the students with

- Fundamentals of food, nutrients and their relationship to health
- Respect to deriving maximum benefit from available food resources
- Understanding of the consequences of vitamin and mineral deficiency/excess of vitamin
- Respect to the nutrition in adult age
- Nutrition deficiency diseases and their consequences
- Food adulteration and prevention of food adulteration

**Course Outcomes (CO's)**

After successful completion, the students will understand:

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | The fundamentals of nutrition and their relationship to health | Understand |
| **CO2** | To derive maximum benefits from available food resources | Understand |
| **CO3** | The consequences of vitamin and mineral deficiency/excess of vitamin | Understand |
| **CO4** | The nutrition in adult age | Remember |
| **CO5** | Nutrition deficiency diseases and their consequences | Remember |
| **CO6** | The sources of food adulteration and measures to prevent it | Create |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | L | L | L | L | L | L | L |
| **CO2** | L | L | L | L | L | L | L |
| **CO3** | L | L | L | L | L | L | L |
| **CO4** | L | L | L | L | L | L | L |
| **CO5** | L | L | L | L | L | L | L |
| **CO6** | L | L | L | L | L | L | L |

**S-Strong; M-Medium; L-Low**

**UNIT 1** **8 hours**

Basic concepts in food and nutrition- Understanding relationship between food, nutrition andhealth, Functions of food- Physiological, psychological and social. Dietary guidelines for Indians food pyramid. Junk foods and its causes.

**UNIT II** **6 hours**

Nutrients - Functions, dietary sources and clinical manifestations of deficiency/ excess of the following nutrients: Carbohydrates, lipids and proteins, Fat soluble vitamins-A, D, E andK, Water soluble vitamins – thiamin, riboflavin, niacin, pyridoxine, folate, vitamin B12 and vitamin C, Minerals – calcium, iron and iodine

**UNIT III** **6 hours**

Adult nutrition

Physiological changes, RDA, nutritional guidelines, nutritional concerns and healthy food choices -Adult, Pregnant woman, Lactating mother, Elderly. Nutrition during childhood -Growth and development, nutritional guidelines, nutritional concerns and healthy food choices -Infants, Preschool children, School children, Adolescents. Nutritional needs of nursing mothers and infants, determinants of birth weight and consequences of low birth weight, Breastfeeding biology, Breastfeeding support and Counselling, Infant and young child feeding and care - Current feeding practices andnutritional concerns, guidelines for infant and young child feeding, Breast feeding, weaning and complementary feeding. Assessment and management of moderate and severe malnutrition among children, Micronutrient malnutrition among preschool children. Child health and morbidity, neonatal, infant and child mortality.

## UNIT IV **8 hours**

Introduction to Nutritional deficiency diseases -Causes, symptoms, treatment, prevention of the following: Protein Energy Malnutrition (PEM), Vitamin A Deficiency (VAD), Iron Deficiency Anaemia (IDA), Iodine Deficiency Disorders (IDD), Zinc Deficiency, Flurosis Nutritional needs during pregnancy, common disorders of pregnancy (Anaemia, HIV infection, Pregnancy induced hypertension), relationship between maternal diet and birth. Maternal health and nutritional status, maternal mortality and issues relating to maternal health.

## UNIT V **8 hours**

**Dietetics :** Diet for diabetes mellitus-Nutrition recommendations for patient with diabetes, Meal planning, Exchange list of different food groups, Glycemic index based formulation of diet for diabetic individual, Diabetic diets menu wise. Diet for Cardiovascular Diseases -Dietary management and general guidelines for coronary heart disease, Dietary recommendations of WHO. Diet for Acute cardiac diseases. Influence of diet on carcinogenesis, Dietary risk factors and cancers at various sites in the human body, diet therapy, diet for cancer patients, managing eating problems during treatment. Hormonal imbalance-Poly cystic ovarian syndrome, hypogonadism, cushing syndrome. Causes of hormonal imbalance. Treatment- Dietary and stress management protocols to be followed.

**SUGGESTED READING**

1.Gordon M, Wardlaw and Paul M. (2012). Perspectives in Nutrition: U.S.A. McGraw Hill Publishers. 9rd Edition. New Delhi

2.Srilakshmi.B. (2014) Nutrition Science: New Age International (P) Ltd. Publishers.4th Edition. New Delhi.

3.Srilakshmi.B. (2015) Food Science:. New Age International (P) Ltd. Publishers. 6nd Edition., New Delhi

4.Darshan Sohi (2012). A Comprehensive Textbook of Nutrition & Therapeutic Diets. Jaypee Brothers Medical Publishers Pvt. Ltd.

SEMESTER–III

**23CSPOE301 CYBER FORENSICS 3H – 2C**

**InstructionHours/week:L:3 T:0 P:0** **Marks:**Internal:**40** External:**60** Total:**100**

**End Semester Exam:**3Hours

**Course Objectives**

- To understand about computer forensics and investigations.
- To know about digital evidence and crime.
- To analyse and validate forensics data.
- To know about e-mail investigation.
- To understand about Mobile device forensics.

**Course Outcomes (COs)**

At the end of this course, students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Define, understand and explain various investigation procedures and summarize duplication of digital evidence. | Remember |
| CO2 | Apply the knowledge of digital evidences. | Understand |
| CO3 | Design and develop various forensics tools and analyse the network forensics. | Create |
| CO4 | Demonstrate the systematic study of high-tech forensics | Understand |
| CO5 | Understand the importance of reports. | Evaluate |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | L | L | M | L | M | M | M | M | L | L | M | M |
| **CO2** | S | M | M | M | L | L | M | M | S | S | L | M |
| **CO3** | S | M | L | L | S | S | L | M | S | S | S | L |
| **CO4** | L | S | S | S | M | M | S | L | L | L | M | S |
| **CO5** | L | M | S | M | L | L | S | S | L | L | L | S |

**S-Strong; M-Medium; L-Low**

**Unit I – Computer forensics and investigations (7 HOURS)**

Computer forensics and investigations as a profession – Preparing for computer investigations – Taking a systematic approach–Procedures for corporate high-tech investigations–Data recovery work stations and software– Conducting an investigation.

**Unit II – Data Acquisition (7 HOURS)**

Data acquisition – Storage formats for digital evidence – Validating data acquisitions – Processing crime and incident scenes–Identifying digital evidence–Collecting evidence in private sector incident scenes – Preparing for search-seizing digital evidence at the scene-storing digital evidence –Reviewing a case.

**Unit III – Computer Forensics Tools (7 HOURS)**

Current computer forensics tools–Software tools–Hardware tools–The Macintosh file structure and boot process – Computer forensics analysis and validation – Addressing data –Hiding techniques.

**Unit IV – Network Forensics** **(7 HOURS)**

Virtual machines – Network forensics – Developing standard procedures – Live acquisitions – email investigations – Investigating e-mail crimes and violations – Understanding e-mail servers – Cell phone and mobile device forensics.

**Unit V – Mobile Device Forensics** **(8 HOURS)**

Understanding mobile device forensics – Acquisition procedures –Report writing for high-tech investigations – Importance of reports – Guidelines for writing reports –Expert testimony in high-tech investigations.

**SUGGESTED READINGS**


1. Bill Nelson, Amelia Phillips and Christopher Steuart. (2018). Computer Forensics and Investigations, Cengage Learning, 5th Edition.
2. Eoghan Casey. (2017). "Handbook of Digital Forensics and Investigation", Academic Press, 1st Edition,
3. John R Vacca,.(2016)."Computer Forensics", Cengage Learning, 2nd Edition.


**WEB LINKS**

1. www.cps.brockport.edu/~shen/cps301/figures/figure1.pdf
2. www.forensicsguru.com/devicedataextractionsimcell.php
3. www.nptel.ac.in/courses/106101060
4. www.samsclass.info/121/ppt/ch11.ppt
5. www.garykessler.net/library/role_of_computer_forensics.html
6. www.ukessays.com/essays/information-technology/computer-forensics-and-crime investigations-information-technology-essay.php

SEMESTER–III

**23CMPOE301 PERSONAL FINANCE AND PLANNING 3H – 2C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3Hours

**COURSE OBJECTIVES:**

**To make the students**

1. To familiarize with regard to the concept of Investment Planning and its methods
2. To examine the scope and ways of Personal Tax Planning;
3. To analyze Insurance Planning and its relevance
4. To develop an insight in to retirement planning and its relevance.
5. To construct an optimal portfolio in real life situations

**COURSE OUTCOMES:**

**Learners should be able to**

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Familiarize with regard to the concept of Investment Planning and its methods | Understand |
| CO2 | Examine the scope and ways of Personal Tax Planning; | Analyze |
| CO3 | Analyze Insurance Planning and its relevance | Analyze |
| CO4 | Develop an insight in to retirement planning and its relevance. | Create |
| CO5 | Construct an optimal portfolio in real life situations | Create |

**UNIT I** **8 hours**

**Introduction to Financial Planning -** Financial goals, Time value of money, steps in financial planning, personal finance/loans, education loan, car loan & home loan schemes. Introduction to savings, benefits of savings, management of spending & financial discipline, Net banking and UPI, digital wallets, security and precautions against Ponzi schemes and online frauds such as phishing, credit card cloning, skimming.

**UNIT II** **6 hours**

**Investment Planning** - Process and objectives of investment, Concept and measurement of return & risk for various assets class, Measurement of portfolio risk and return,Diversification & Portfolio formation. Gold Bond; Real estate; Investment in Greenfield and brownfield Projects; Investment in fixed income instruments-financial derivatives& Commodity market in India. Mutual fund schemes including SIP; International investment avenues.

**UNIT III** **6 hours**

**Personal Tax Planning -** Tax Structure in India for personal taxation, Scope of Personal tax planning, Exemptions and deductions available to individuals under different heads ofincome and gross total income, Special provision u/s 115BAC vis-à-vis General provisions of the Income-tax Act, 1961. Tax avoidance versus tax evasion.

**UNIT IV** **8 hours**

**Insurance Planning -** Need for Protection planning. Risk of mortality, health, disability andproperty. Importance of Insurance: life and non-life insurance schemes. Deductions availableunder the Income-tax Act for premium paid for different policies.

**UNIT V** **8 hours**

**Retirement Benefits Planning -** Retirement Planning Goals, Process of retirement planning, Pension plans available in India, Reverse mortgage, New Pension Scheme. Exemption availableunder the Income-tax Act, 1961 for retirement benefits.

**SUGGESTED READINGS**


1. Indian Institute of Banking & Finance. (2017). Introduction to Financial Planning. New Delhi: Taxmann Publication.
2. Pandit, A. (2014). The Only Financial Planning Book that You Will Ever Need. Mumbai: Network Publications Ltd.
3. Sinha, M. (2008). Financial Planning: A Ready Reckoner. New York: McGraw Hill Education.
4. Halan, M. (2018). Let's Talk Money: You've Worked Hard for It, Now Make It Work for You. New York: HarperCollins Publishers.
5. Tripathi, V. (2017). Fundamentals of Investment. New Delhi: Taxmann Publication

SEMESTER–III

**23CHEOE301** **CHEMISTRY IN EVERYDAY LIFE** **3H – 2C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3Hours

**Course Objectives**

This course enables the students to

- Gain knowledge in the importance of chemistry in food industry.
- Understand the chemistry of medicines and cosmetics.
- Evaluate the solar energy utilization and its storage.
- Knowledge about the production of electricity by a nuclear reactor.
- Know about the chemistry of soaps, detergents and textiles.
- Know about the chemistry behind the polymers, fuel and agriculture.

**Course Outcomes (CO's)**

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

1. Know the importance of chemistry in food industry.
2. Understood the chemistry of medicines and cosmetics.
3. Evaluate the solar energy utilization and its storage.
4. Understood the production process of electricity by a nuclear reactor.
5. Know about the chemistry of soaps, detergents and textiles.
6. Know the chemistry behind the polymers, fuel and agriculture.

**UNIT - I Importance of Chemistry in food** **8 hours**

Chemicals in food, colouring agents, artificial preservatives, flow stabilizers, binding substance, flavours and sweeteners, antioxidants, minerals, vitamins. Chemistry at the breakfast table, raising agents- gluten, the taste maker- glutamic acid, stimulants-Caffeine, chemistry of onion, garlic and curcumin.

**UNIT - II Chemistry in medicines and cosmetics** **6 hours**

Elements in the human body, drugs and their classification, drug-target interaction, action of different classes of drugs, antiseptics and disinfectants.

Cosmetics: Chemistry behind the lotions, fragrances, talcum powder, sunblock and sunscreen, toothpaste, lipsticks, nail polishes.

**UNIT - III Chemistry in energy** **6 hours**

Solar energy - fuel from sun light - splitting of water - hydrogen from sunlight - hydrogen economy - fuel cells - batteries - photovoltaics - stealing the sun - nuclear energy - nuclear fission and fusion - production of electricity by a nuclear reactor - radioactivity and the hazards of radioactivity - living with nuclear power.

**UNIT - IV Importance of chemistry in soaps, detergents and textiles** **8 hours**

Detergents and soaps, types of soaps and detergents, saponification, cleansing action of soaps and detergents, perfumes used in soaps.

Textiles: Chemistry behind wool, silk, jute, cotton, glass fibre, polyester, acrylic, nylon, and other raw materials.

**UNIT - V Chemistry of polymers, fuel and agriculture 8 hours**

Polymers, types, polyethylene, plastics, disposal of plastics, degradation of polymers and plastics using nano materials. Petrochemistry, petrol, diesel, LPG, CNG, kerosene, oils, and other fuels. Agriculture: fertilizers, herbicides, insecticides, and fungicides.

**SUGGESTED READINGS**


1. Tripathy, S. N., & Sunakar Panda (2004). *Fundamentals of Environmental Studies* (II Edition). New Delhi: Vrianda Publications Private Ltd.
2. Arvind Kumar (2004). *A Textbook of Environmental Science*. New Delhi: APH Publishing Corporation.
3. Anubha Kaushik, C. P., & Kaushik (2004). *Perspectives in Environmental Studies*. New Delhi: New Age International Pvt. Ltd. Publications.
4. Seymour R. B., & Charles, E. (2003). *Seymour's Polymer Chemistry: An Introduction.* Marcel Dekker, Inc.
5. Stocchi. E, (1990). *Industrial Chemistry* (Vol–I). UK: Ellis Horwood Ltd.
6. Jain, P. C., & Jain, M. (2004). *Engineering Chemistry*. Delhi: Dhanpat Rai & Sons.
7. Sharma, B. K., & Gaur, H. (1996). *Industrial Chemistry.* Meerut : Goel Publishing House.

SEMESTER–III

**23MBPOE301** **FERMENTATION TECHNOLOGY** **3H – 2C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3Hours

**COURSE OBJECTIVE**

- To encompass the use of microorganisms in the manufacture of food or industrial products on the basis of employment.
- Get equipped with a theoretical and practical understanding of industrial microbiology
- Appreciate how microbiology is applied in the manufacture of industrial products
- Know how to source microorganisms of industrial importance from the environment
- Know about the design of bioreactors, factors affecting growth and production, heat transfer, oxygen transfer
- Understand the rationale in medium formulation & design for microbial fermentation, and sterilization of medium and air.

**COURSE OUTCOME**

Students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Provides knowledge in the large scale production of industrial product, and teaches the modern employment trends to cater the needs of industry. | Understand |
| **CO2** | Students will differentiate the types of fermentation processes | Apply |
| **CO3** | Understand the biochemistry of various fermentations | Understand |
| **CO4** | Identify techniques applicable for Improvement of microorganisms based on known biochemical pathways and regulatory mechanisms | Analyze |
| **CO5** | Comprehend the techniques and the underlying principles in downstream processing | Apply |
| **CO6** | Students can able to explore the practical skills in research activities. | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | M | M | M | S | L | M | M | M | M | M | M |
| **CO2** | M | M | S | S | L | L | M | M | M | M | M |
| **CO3** | M | S | M | M | M | M | M | M | M | M | M |
| **CO4** | M | S | M | M | M | S | S | M | M | M | M |
| **CO5** | L | S | M | M | M | M | M | S | L | S | L |
| **CO6** | S | S | S | L | M | M | M | M | L | M | M |

**S-Strong; M-Medium; L-Low**

**Unit I - Basics of fermentation processes** **8 hours**

Definition, scope, history, and chronological development of the fermentation industry. Component parts of the fermentation process. y. Component parts of fermentation process. Microbial growth kinetics, batch and continuous, direct, dual or multiple fermentations; scaleup of fermentation, comparison of batch and continuous culture as investigative tools, examples of the use of fed batch culture.

**Unit II Isolation and Preservation** **6 hours**

Isolation, preservation, and strain improvement of industrially important microorganisms. Use of recombination system (Parasexual cycle, protoplast fusion techniques), application of recombinant strains, and the development of new fermentation products.

**Unit III –Screening and Inoculum development** **6 hours**

Screening (primary and secondary screening); detection and assay of fermentation products (Physico-chemical assay, biological assays). Inoculum development, criteria for transfer of inoculum, development of inoculum: Bacteria, Fungi and Yeast.

**Unit IV–Microbial Production** **8 hours**

Fermentation type reactions (Alcoholic, bacterial, mixed acid, propionic acid, butanediol and acetone-butanol). Microbial production of enzymes (amylases, Proteases, cellulases, pectinases and lipases) primary screening for producers, large scale production. Immobilization methods.

**Unit V – Alcohols and Beverages** **8 hours**

Fermentative production of industrial alcohol, production of beverages. Production of organic acids: citric acid, aminoacids: glutamic acid, production of vitamins. fungal enzymes and Single cell protein.

**SUGGESTED READING**


1. Casida, L.E.2007. Industrial microbiology, New age international (P) Ltd., New Delhi.
2. Clark, D.P and Pazdernik, N.J.2009. Biotechnology applying the genetic revolution, Elsevier Academic Press, UK.
3. Glazer, A and Nikaido.1995. Microbial biotechnology fundamentals of applied microbiology, W.H.Freemn and company, USA.
4. Glick, B.R and Pasternak, J.J.2003. Molecular Biotechnology Principles and Applications of Recombinant DNA, 3rd edition, ASM Press, USA.
5. Harider, S.I. and Ashok, A. 2009. Biotechnology, A Comprehensive Training Guide for the Biotechnology Industry, CRC Press, New York.
6. Sridhar, S.2010. Industrial Microbiology, Dominant Publishers, New Delhi.
7. Tanuja.S and Purohit, S.S. 2008. Fermentation Technology, Agrobios Publication, Jodhpur, India.

SEMESTER–III

**23EGPOE301 ENGLISH FOR COMPETITIVE EXAMINATION 3H – 2C**

**Instruction Hours/week: L: 3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3Hours

**Course Objectives**

•To train learners to crack competitive exams
•To know of various tools that is essential for Competitive Exams
•To enhance their ability to speak in English and face an interview.
•To make the student apply, prepare and clear the competitive exams.
•To prepare the student to concentrate, stay positive and confident.
•To take even failure at ease and continue the target of clearing competitive exams.

**Course Outcomes**

At the end of this course, students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | The student may settle in life with a government job. | Apply |
| **CO2** | The student may develop various skills | Understand |
| **CO3** | The successful student may guide other students to success. | Understand |
| **CO4** | Analyse logical reasoning questions, error analysis, and correct usage of words. | Analyse |
| **CO5** | Develop the knowledge of grammatical system of English language. | Apply |
| **CO6** | Elaborate on the correct structure of sentence | Understand |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | M | S | M | M | S | L | M | M | L |
| CO2 | L | M | M | M | M | L | M | S | M | L |
| CO3 | L | M | L | M | M | L | L | M | M | L |
| CO4 | M | M | M | S | S | M | M | S | M | L |
| CO5 | M | S | M | M | M | M | L | M | M | L |

**S-Strong; M-Medium; L-Low**

**UNIT I Grammar** **8 hours**

Number-Subject, Verb and Agreement-Articles-Sequences of Tenses-Common Errors

**UNIT II Word Power** **6 hours**

Idioms and Phrases-One word substitution-Synonyms-Antonyms-Words often confused

**UNIT III Paragraph** **6 hours**

Expansion of an idea

**UNIT IV Writing** **8 hours**

Essay- Letters-Memos-Agenda-Resume writing

**UNIT V Speaking** **8 hours**

Public Speaking-Group discussion-Interview-Spoken English

**SUGGESTED BOOKS**

V. Saraswathi, Maya K. Mudbhatkal (2014). English for Competitive Examinations. Emerald: Chennai.

SEMESTER–III

**23BTPOE301** **SERICULTURE** **3H – 2C**

**Instruction Hours/week: L: 3 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3Hours

**Course Objectives**

The main objectives of the course are

- To apply knowledge and skills of seribiotechnology for development new mulberry variety and silkworm breeds suitable for varied agro-climatic zones.
- To apply tools and techniques of biostatics for critical analysis and interpretation of data accrueded.
- To use bioinformatics tools and techniques for the analysis and interpretation of bimolecular data for better understating mulberry and silkworm.
- To demonstrate communication skills, scientific writing, data collection and interpretation abilities in all the fields of seribiotechnology.
- Thorough knowledge and application of good laboratory and good manufacturing practices in sericulture and biotech industries.
- To demonstrate entrepreneurship abilities, innovative thinking, planning, and setting up small-scale enterprises.

**Course Outcomes**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Know the different components and chain link of sericulture industry. | Understand |
| CO2 | Understand concepts of sericulture industry and demonstrate interdisciplinary skills acquired in mulberry plant cultivation and silkworm rearing. | Understand |
| CO3 | Demonstrating the Laboratory and field skills in mulberry cultivation and silkworm rearing with an emphasis on technological aspects. | Create |
| CO4 | To transfer the knowledge and technical skills to the Seri-farmers. | Understand |
| CO5 | To analyze the environmental issues and apply in management of mulberry garden and silkworm rearing at field. | Analyze |
| CO6 | Demonstrate comprehensive innovations and skills in improvement of mulberry and silkworm varieties for betterment of sericulture industry and human welfare. | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | L | S | S |
| **CO2** | S | S | S | S | L | S | S |
| **CO3** | S | S | S | S | L | S | S |
| **CO4** | M | M | M | M | L | M | M |
| **CO5** | M | M | M | M | L | M | M |
| **CO6** | M | M | M | M | L | M | M |

**S-Strong; M-Medium; L-Low**

**UNIT I** **6 hours**

Introduction to Sericulture - History of Sericulture – Sericulture organization in India, By products of silk industry. Mulberry and Non – mulberry silkworm types–Morphology and Life cycle of Bombyxmori,

**UNIT II** **8 hours**

Mulberry Cultivation: Mulberry Varieties – Methods of Irrigation –Nutrient Management and Weed control. Pruning and Harvesting – Crop improvement – Me chanism in Moriculture – Pest and Disease, deficiencies and symptoms in Mulberry.

**UNIT III** **8 hours**

Rearing of silkworm – Rearing Appliances – rearing operation. Harvesting and marketing of cocoons. Cocoon processing and reeling - Appliances used for reeling. Pre reeling process – Cocoon boiling. Reeling technology – re-reeling technology.

**UNIT IV** **8 hours**

Non – Mulberry Sericulture Scope of Non-mulberry Sericulture - Non-mulberry silk varieties and fauna, tasar, muga, eri – Silk Production and Marketing – Tropical tasar / muga – Morphology, anatomy grainage

**UNIT V** **6 hours**

Diseases of silkworm –Pebrine Protozoan, Flacheriebacterial,Nuclear Polyhedrosisviral and Muscardine fungal diseases. Pests of Silkworm.

**REFERENCES:**


1. Krisnamoorthy S., Improved Method of Rearing Young Age Silk Worms: Reprinted by CSB, Bangalore, 1986.
2. Tanaka Y., Sericology, CSB, Pub., Bangalore, 1964.
3. Ullal S.R., and Narasimhan M.N., Hand Book of Practical Sericulture, CSB, Bangalore, 1987.
4. HisaoAruga, Principles of sericulture, Oxford and IBH Publishing Company, 1994.
5. Hrccrama Reddy, G. 1998. Silkworm Breeding, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
6. Otsuki el.al. 1987. Silkworm Egg Production (Translated from Japanese Language), Oxford wild IBH Publishing Co. Pvt. Ltd., New Delhi.
7. Yasuji Hamamura, 2001 Silkworm Rearing on Artificial Diet (Translated from Japanese Language), Oxford wild IBH Publishing Co. Pvt. Ltd., New Delhi.
8. Mahadevappa, D. Halliyal, V.G., Sankar, D.G and Bhandiwad, R. 2000. Mulberry Silk Reeling Technology, Oxford wild IBH Publishing Co. Pvt. Ltd., New Delhi.
9. Dandin, S.B et.al. 2003. Advances in Tropical Sericulture, National Academy of Sericulture Sciences India, Central Silk Board, Bangalore, India.
10. Ganga G., Sulochanachetty. J. An Introduction of Sericulture. Oxford, New Delhi – 1977.
11. Johnson M., and Kesary M., Sericulture, CSI Press, Marthandam, 2008.
12. Text Book of Tropical Sericulture, Pub., Japan Overseas Volunteers, 1975

SEMESTER–III

**23MMPOE301** **CODING THEORY** **3H – 2C**

**Instruction Hours/week: L:3 T:0 P:0** **Marks:** Internal: **40** External: **60** Total: **100**

**End Semester Exam:** 3Hours

**Course Objectives**

This course enables the students to learn

- Elements of coding theory and its applications.
- Understand the concept of bounds in coding theory.
- About the encoding and decoding.
- Analyze the concept of cyclic coding
- Acquiring the knowledge special cyclic codes.

**Course Outcomes**

At the end of this course, students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| CO1 | Recognize the basic concepts of coding theory. | Apply |
| CO2 | Understand the importance of finite fields in the design of codes. | Understand |
| CO3 | Detect and correct the errors occur in communication channels with the help of methods of coding theory. | Apply |
| CO4 | Apply the tools of linear algebra to construct special type of codes. | Apply |
| CO5 | Use algebraic techniques in designing efficient and reliable data transmission methods. | Understand |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | | **S** | | | |
| CO2 | | | | | | | **S** | | | |
| CO3 | | | | | | | **S** | | | |
| CO4 | | | | | | | **S** | | | |
| CO5 | | | | | | | **S** | | | |

**S-Strong; M-Medium; L-Low**

## UNIT I - ERROR DETECTION, CORRECTION AND DECODING **8 hours**

Communication channels – Maximum likelihood decoding – Hamming distance – Nearest neighbourhood minimum distance decoding – Distance of a code.

## UNIT II - LINEAR CODES **6 hours**

Linear codes – Self orthogonal codes – Self dual codes – Bases for linear codes – Generator matrix and parity check matrix – Enconding with a linear code – Decoding of linear codes – Syndrome decoding.

## UNIT III - BOUNDS IN CODING THEORY: 6 hours

The main coding theory problem – lower bounds - Sphere covering bound – Gilbert Varshamov bound – Binary Hamming codes – q-ary Hamming codes – Golay codes – Singleton bound and MDS codes – Plotkin bound.

## UNIT IV - CYCLIC CODES: 8 hours

Definitions – Generator polynomials – Generator matrix and parity check matrix – Decoding of Cyclic codes.

## UNIT V - SPECIAL CYCLIC CODES: 8 hours

BCH codes – Parameters of BCH codes – Decoding of BCH codes – Reed Solomon codes.

### SUGGESTED BOOKS


1. San Ling and Chaoping Xing (2004). Coding Theory: A first course, Cambridge University Press.
2. Lin. S & Costello. D. J. (1983). Jr., Error Control Coding: Fundamentals and Applications, Prentice-Hall, Inc., New Jersey.
3. Vera Pless (1982). Introduction to the Theory of Error Correcting Codes, Wiley, New York.
4. Berlekamp E.R. (1968). Algebriac Coding Theory, Mc Graw-Hill.
5. H. Hill (1986). A First Course in Coding Theory, OUP.


### WEB LINKS

1. https://www.youtube.com/watch?v=XepXtl9YKwc
2. https://www.youtube.com/watch?v=oeQWxhlnCHM
3. https://www.youtube.com/watch?v=Z-QGtxlQWak

**SEMESTER–III**

**23BTP391** **INTERNSHIP PROGRAMME** **2C**

**Instruction Hours/week: L: 0 T: 0 P: 0** **Marks:** Internal: **100** External: **00** Total: **100**

**SEMESTER–IV**

**23BTP491** **PROJECT –VIVA VOCE** **15C**

**Instruction Hours/week: L:0 T:0 P:0** **Marks:** Internal:**80** External:**120** Total:**200**