M.Sc., BIOTECHNOLOGY

CHOICE BASED CREDIT SYSTEM

Curriculum and Syllabus
(2024-2025)

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)
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Coimbatore - 641 021, Tamil Nadu, India

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

REGULAR MODE
CHOICE BASED CREDIT SYSTEM (CBCS)

REGULATIONS - 2024

The following regulations are effective from the academic year 2024 -2025 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.	Programmes 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	M.A. English

1.2. MODE OF STUDY

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. ADMISSION 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.	Programme	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 /Industrial Biotechnology/ Molecular Biology / Genetic Engineering / Biochemistry / Agriculture / Forestry / Medical Lab Technology / Life Sciences

3	M.Sc. Biotechnology	B.Sc. Degree with Biotechnology/ Industrial Biotechnology/ 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 Sciences
5	M.Sc. Chemistry	B.Sc. Chemistry, Industrial Chemistry, Polymer Chemistry, B.Sc. Applied Sciences
6	M.Sc. Mathematics	B.Sc. Mathematics / B.Sc. Mathematics with Computer Applications, B.Sc. Applied Sciences
7	M.Sc. Computer Science	B.Sc. Computer Science / B.Sc Computer Science (Cognitive Systems)/ B.Sc Computer Science (AI&DS)/ B.Sc Computer Science (Cyber Security)/ Computer Technology / Information Technology / Electronics / Software Systems / BCA/ B.Sc. Applied Sciences
8	M.Com	B.Com. / B.Com.(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 semesters.

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. End Semester Examination shall be conducted at the end of every semester for the respective courses.

3. CHOICE BASED CREDIT SYSTEM

Credits means the weightage given to each course of study by the experts of the Board of Studies concerned. All PG programmes are offered under Choice Based Credit System and students can earn a total of 92 credits.

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. Major courses

Major courses consist of theory and practical and the examinations shall be conducted at the end of each semester.

b. Elective courses

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.

If the candidate undertakes the Research Project work outside the Department, the faculty concerned within the Department shall be the Supervisor and the teacher/scientist of the host institute will be the Co-supervisor. The candidate shall bring the attendance certificate from the host institute.

The Head of the Department shall assign a project supervisor who shall monitor the student's project work(s). A Project Assessing Committee (PAC) shall be constituted with HoD and two senior faculty members of the Department. The PAC shall announce the dates for the reviews and

demonstration. The student shall make a presentation on the progress and demonstration of their project before the PAC in the presence of their supervisor on the scheduled dates.

d. Internship

The student shall undergo 15 days internship at 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. The Internship will be assessed internally and marks will be awarded out of 100.

e. 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 2 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	24EGPOE301	English for Competitive Examinations
2	Commerce	24CMPOE301	Personal Finance and Planning
3	Management	24MBAPOE301	Organizational Behaviour
4	Computer Applications	24CAPOE301	Robotics Process Automation
5	Computer Science	24CSPOE301	Cyber Forensics
6	Mathematics	24MMPOE301	Coding theory
7	Physics	24PHPOE301	Electrical Appliances and Servicing
8	Chemistry	24CHPOE301	Industrial Chemistry
9	Microbiology	24MBPOE301	Fermentation Technology
10	Biotechnology	24BTPOE301	Nutrition and Dietetics

5. CREDIT TRANSFER THROUGH ONLINE PLATFORM / INTERNATIONAL STUDIES

Students are encouraged to enroll in courses offered by MOOC platforms and international institutions of higher learning, either virtually or in person. The equivalent credits for these courses will be determined by a committee named Subject Equivalency Committee comprising the Dean, Head of Department (HoD), and one faculty member nominated by the Vice Chancellor. The committee's decision will be submitted for ratification/approval by the Board of Studies (BoS) and the Academic Council. Additionally, the equivalent grade points for marks/grades/grade

points awarded by various MOOC platforms and international institutions of higher learning will be determined by a committee named Grade Equivalency Committee duly constituted by the Vice-Chancellor. The decisions of this committee will also be submitted for ratification/approval by the Academic Council. This shall be approved to be implemented from the even semester of the academic year 2024-25.

6. MEDIUM OF INSTRUCTION

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

7. 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 are for End Semester Examinations (ESE).

(ii) Maximum Marks for Project work

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

8. 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 students' periodically (once in 2 weeks) on the Notice Board to enable the students to know their attendance status and satisfy the **clause 8** of this regulation.

9. 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 HoD / senior faculty concerned as a Chairperson. The objective of the class committee Meeting is all about the teaching – learning process. The Class Committee shall be convened at least once in a month. The constitution and 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.
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.

10. REQUIREMENTS TO APPEAR FOR THE END SEMESTER EXAMINATION

a. 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.

c. However, a student who has secured less than 65% in any of the semesters due to any reasons, shall not be permitted to appear for the End Semester Examinations. But he/she will be permitted to appear for his/her arrear examinations. In order to redo the semester with lack of attendance he/she has to attend the corresponding semester of the subsequent year(s) with approval of the Dean of the Faculty, Dean - Students Affairs and the 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, the CIA and Seminar marks and the record of class work completed (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 every fortnight to respective Dean. 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. 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 (2 ½ units)	10
3	Test – II (2 ½ units)	10
4	Journal Paper Analysis & Presentation*	15
	Total	40

*****Evaluated by two faculty members of the department concerned. Distribution 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
	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 Portions for Test Question Paper

Portions for Internal Test – I : 2 ½ Units

Portions for Internal Test – II : 2 ½ Units

11.4 Pattern of Test Question Paper

Theory Courses:

Maximum Marks : 100 **Duration: 3 Hours**

Section	Marks
Part – A	Short Answer Answer ALL the Questions (10 x 2 = 20 Marks)
Part - B	Long Answer – 5 six mark questions 'either – or' type Answer ALL the Questions (5 x 6 = 30 Marks)
Part - C	Essay type Answer– 5 ten mark questions 'either – or 'type Answer ALL the Questions (5 x 10 = 50 Marks)

11.5 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

12.1 End Semester Examination (ESE): ESE will be held at the end of each semester for each course. The question paper is for a maximum of 100 marks.

Pattern of ESE Question Paper

Theory Courses:

Maximum Marks: 100 **Duration: 3 Hours**

Section	Marks
Part – A	Short Answer Answer ALL the Questions (10 x 2 = 20 Marks)
Part - B	Long Answer – 5 six mark questions 'either – or' type Answer ALL the Questions (5 x 6 = 30 Marks)
Part - C	Essay type Answer– 5 ten mark questions 'either – or 'type Answer ALL the Questions (5 x 10 = 50 Marks)

The 100 Marks is converted to 60 Marks.

12.2 Practical Courses: There shall be combined valuation by the Internal and External examiners. The pattern of distribution of marks shall be as given below.

S. No.	Category	Maximum Marks
1.	Experiments	40
2.	Record work	10
3.	*Viva – voce* [Comprehensive]	10
	Total	**60**

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 (vide 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: A candidate needs to secure a minimum of 20 marks out of 40 marks in CIA and 30 marks out of 60 marks in ESE. The overall passing minimum in each course is 50 marks 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 17.1, 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 receives 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 The CIA marks secured by the candidate in the first passed attempt 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

The 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 obtained.

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.

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

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

Sum of the product of the GPs by the corresponding credits of the courses offered for the entire programme

CGPA of the entire programme = $\dfrac{\text{Sum of the credits of the courses of the entire programme}}{}$

i.e. **CGPA** of the entire programme = $$\frac{\sum_{n}\sum_{i} CniGPni}{\sum_{n}\sum_{i} Cni}$$

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 retotaling 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 are allowed on representation (clause 18). 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.
- No pending disciplinary enquiry/ action 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 14) 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 14) 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 21.1 and 21.2) who qualify for the award of the degree (vide Clause 20) shall be declared to have passed the examination in **Second Class**.

21. 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.

22. 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.

23. DISCIPLINE

23.1. 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.

23.2. 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.

24. KAHE ENTRANCE EXAMINATION

At the end of Fourth Semester, the KAHE Entrance Examinations will be conducted who are aspiring for Higher Education (Ph.D).

25. 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.

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Annexure I

S.No.	Programme	Subject	Eligibility
1.	B. Sc.	Biotechnology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Biology or Botany or Zoology or chemistry as subjects at the Higher Secondary level.
2.	B. Sc.	Computer Science	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern. preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.
3.	B. Sc.	Microbiology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Biology or Botany Zoology or chemistry as subjects at the Higher Secondary level.
4.	B. Sc.	Information Technology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.
5.	B. Sc.	Computer Technology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.
6.	B.Sc.	Computer Science(Cognitive Systems)	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.

7.	B.Sc.	Computer Science (Artificial Intelligence and Data Science)	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.
8.	BCA	Computer Application	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.
9.	B. Com.	Commerce	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
10.	B.Com (CA)	Commerce with Computer Applications	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
11.	B. Com. (PA)	Commerce with Professional Accounting	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
12.	B. Com. (BPS)	Commerce with Business Process Services	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
13.	B.B.A.	Business Administration	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
14.	B. Com	Financial Analytics	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level

15.	B. Com	International Accounting and Finance	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
16.	B.Com	Information Technology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
17.	B. Sc.	Computer Science (Cyber Security)	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10^{th} or 10+2 pattern of education taking computer science/maths as one of the subject.
18.	B. Com	FinTech.	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level

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 PROGRAM (CBCS) – M.Sc., Biotechnology (FULL TIME)
(2024–2025 Batch and onwards)

Course Code	Name of the course	Category	Outcomes		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
SEMESTER I												
24BTP101	Biochemistry	CC	1, 5 ,6, 8, 11, 13, 15	I	4	0	0	4	40	60	100	6
24BTP102	Microbiology	CC	1, 5 ,6, 8, 9, 11, 13, 15	I	4	0	0	4	40	60	100	8
24BTP103	Cell Biology and Molecular Genetics	CC	1, 4, 5 ,6, 8, 13, 15	I	4	0	0	4	40	60	100	10
24BTP104	Bioinstrumentation and Biostatistics	CC	1, 4, 5 ,6, 8, 10, 11, 13, 15	I, II	4	0	0	4	40	60	100	12
24BTP105A	Biodiversity and conservation Biology	EC	1,4,5,6,8, 13,15	I	4	0	0	4	40	60	100	14
24BTP105B	Microbial Genetics											16
24BTP105C	Herbal Technology											18
24BTP111	Analytical Biochemistry Practical–I	CC	1,4,5,6,7,8,9, 11,13,15	II	0	0	4	2	40	60	100	20
24BTP112	Microbiology and Molecular Genetics Practical–II	CC	1,4,5,6,7,8,9, 11,13,15	II	0	0	4	2	40	60	100	22
Journal Paper Analysis & Presentation		CC	-	II	0	0	2	-	-	-	-	24
Semester total					**20**	**0**	**10**	**24**	**280**	**420**	**700**	
SEMESTER II												
24BTP201	Genetic Engineering	CC	1,3,4,5,6,8,9, 10,11,13,15	I, II	4	0	0	4	40	60	100	25
24BTP202	Bioprocess and Downstream Processing	CC	1,4,5,6,8,13, 15	I, II	4	0	0	4	40	60	100	27
24BTP203	Immunology and Immunotechnology	CC	1,4,5,6,8, 13,15	I, II	4	0	0	4	40	60	100	29
24BTP204	Systems Biology	CC	1,4,5,6,8,10, 13,15	I, II	4	0	0	4	40	60	100	32
24BTP205A	Microbial Biotechnology	EC	1,4,5,6,8,10, 13,15	I, II	3	0	0	3	40	60	100	34
24BTP205B	Stem Cell Biology		1,4,5,6,8,10, 13,15									36

24BTP205C	Bio-entrepreneurship		1,4,5,6,7,8,9, 10,11,13,14, 15									38
24BTP211	Recombinant DNA, fermentation and bioprocess technology practical –III	CC	1,4,5,6,7,8,9, 13,15	II	0	0	4	2	40	60	100	40
24BTP212	Immunology and Immunotechnology Practical –IV	CC	1,4,5,6,7,8, 9,13,15	II	0	0	4	2	40	60	100	42
24BTP206	Community Engagement and Social Responsibility	CC	6,11,12,13	II	2	-	-	2	40	60	100	43
Journal Paper Analysis & Presentation		CC	-	II	0	0	1	-	-	-	-	45
Semester total					**21**	**0**	9	**25**	**320**	**480**	**800**	
SEMESTER- III												
24BTP301	Plant Biotechnology	CC	1,4,5,6,7,8, 9, 13, 15	I, II	4	0	0	4	40	60	100	46
24BTP302	Animal Biotechnology	CC	1,4,5,6,7,8, 9, 13, 15	I, II	4	0	0	4	40	60	100	48
24BTP303	Genomics, Proteomics and Bioinformatics	CC	1,4,5,6,8,9, 10, 11, 13,15	I, II	4	0	0	4	40	60	100	50
24BTP304	Molecular and Developmental Biology	CC	1,4,5,6,7,8, 9, 13,15	I, II	4	0	0	4	40	60	100	52
24BTP305A	Food and Agricultural Biotechnology	EC	1,4,5,6,7,8, 9, 13,15	I, II	4	0	0	4	40	60	100	54
24BTP305B	Environmental Biotechnology											56
24BTP305C	Pharmaceutical Biotechnology											58
24BTP311	Plant and Animal Biotechnology Practical– V	CC	1,4,5,6,8,9,1 0,11,13,15	II	0	0	4	2	40	60	100	60
24BTP312	Genomics, Proteomics and Bioinformatics Practical–VI	CC	1,4,5,6,8,9,1 0, 11,13,15	II	0	0	3	**2**	40	60	100	62
24BTPOE301	Open elective	OE	1,4,5,6,8,9,1 0, 11,13,15	I	3	0	0	2	40	60	100	64
24BTP391	Internship Programme	-	3,4,5,6,8,11,14	II	-	-	-	2	100	0	100	84
Semester total					**23**	**0**	**7**	**28**	**420**	**480**	**900**	
SEMESTER- IV												
24BTP491	Project	CC	1,2,3,4,5,6,7, 8,9,10,13,14, 15	II	-	-	**30**	15	80	120	200	85
Semester total					**-**	**-**	**30**	**15**	**80**	**120**	**200**	
Overall Total					**64**	**-**	**56**	**92**	**1100**	**1500**	**2600**	

Elective courses*

Elective –1 (24BTP105)		Elective –2 (24BTP205)		Elective –3 (24BTP305)	
Course code	**Name of the course (Theory)**	**Course Code**	**Name of the course (Theory)**	**Course Code**	**Name of the course (Theory)**
24BTP105A	Biodiversity and conservation Biology	24BTP205A	Microbial Biotechnology	24BTP305A	Food and Agricultural Biotechnology
24BTP105B	Microbial Genetics	24BTP205B	Stem Cell Biology	24BTP305B	Environment Biotechnology
24BTP105C	Herbal Technology	24BTP205C	Bio-entrepreneurship	24BTP305C	Pharmaceutical Biotechnology

Open Elective Course		
Semester	**Subject code**	**Subject**
III	24MBAPOE301	Organizational Behavior
III	24PHPOE301	Electrical Appliances and Servicing
III	24CAPOE301	Robotics Process Automation
III	24BTPOE301	Nutrition and Dietetics
III	24CSPOE301	Cyber Forensics
III	24CMPOE301	Personal Finance and Planning
III	24CHPOE301	Industrial Chemistry
III	24MBPOE301	Fermentation Technology
III	24EGPOE301	English for Competitive Examinations
III	24MMPOE301	Coding Theory

*Electives are Transborder/cross disciplinary / Discipline centric elective nature.

PROGRAMME OUTCOMES (POs)

PO1: Disciplinary knowledge: Post-graduates will be able to gain In-depth knowledge of advanced biotechnological concepts applicable to various diversified fields such as medical, industrial, environment, agriculture.

PO2: Communication Skills: The Post-graduates will be able to strengthen the communication skills by sharing the concepts of biotechnology through oral presentation and writing research manuscripts.

PO3: Critical thinking: The Post-graduates will understand and demonstrate key practical skills/ competencies in adapting suitable biotechnological techniques, resources and modern instrumentation.

PO4: Problem solving: The Post-graduates will gain knowledge on broader perspective of the discipline biotechnology enabling him/ her to identify challenging societal problems and plan his/her professional career to develop innovative solutions.

PO5: Analytical reasoning: The Post-graduates will be able to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.

PO6: Research-related skills: The Post-graduates will be able design, solve the application-oriented problem in biotechnological field through project-based learning.

PO7: Cooperation/Team work: The Post-graduates will be able to work independently as well as in teams and apply basic ethical principles in all their pursuits.

PO8: Scientific reasoning: The Post-graduates will be able to conduct investigations, analyze, interpret and draw solutions to mitigate the environmental problem using the biotechnological tools.

PO9: Reflective thinking: The Post-graduates will be able to understand the basis of molecular pathogenesis and its diagnosis; the graduate will be equipped to design custom medicine for the infectious/non infectious diseases

PO10: Information/digital literacy: The Post-graduates will be effectively able to manage resources and time using ICT and Computer enabled tools and accomplish ability to understand and communicate the ideas effectively.

PO 11 Self-directed learning: The Post-graduates will have the ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.

PO 12 Multicultural competence: The Post-graduates will possess knowledge of the values and beliefs of multiple cultures with a global perspective to effectively engage and interact respectfully with diverse groups.

PO 13: Moral and ethical awareness/reasoning: The Post-graduates will be capable of demonstrating their ability to identify ethical issues, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights.

PO 14: Leadership readiness/qualities: The Post-graduates will be capable for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.

PO 15: Lifelong learning: Post-graduates will carry on to learn and adapt in a world of constantly evolving technology.

PROGRAMME SPECIFIC OUTCOMEs (PSOs)

PSO1: Able to quench the advanced biotechnological knowledge on the central dogma of life processing and its consequences.

PSO2: The Graduates will be able to work independently by biotechnological concepts with modern tools and techniques towards product and process development for academic, industrial and research applications.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

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

PEO II: 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 involving any technological and professional issues independently in a global and societal context.

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

MAPPING OF PEOs AND POs

	Programme Outcome(s)															
PEOs	1	2	3	4	4	5	6	7	8	9	10	11	12	13	14	15
PEO I	x	x														
PEO II		x	x	x	x	x	x	x	x	x						
PEO III		x									x	x	x	x	x	x

SEMESTER I

24BTP101 **BIOCHEMISTRY** **4H –4C**

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

End Semester Exam:3 Hours

PREREQUISITE: The students should have knowledge about cell metabolism and Bioenergetics.

COURSE OBJECTIVES (CO)

- To understand the key concepts of biological chemistry.
- To understand the functions and importance of various biomolecules.
- To describe the various metabolic pathways involved in cells and metabolism.

COURSE OUTCOMES (COs)

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

COs	Course Outcomes	Blooms Level
CO1	Recall the key concepts of biological chemistry.	Remember
CO2	Understand fundamental properties and functions of carbohydrate, fatty acids, amino acids and proteins in living organisms.	Understand
CO3	Identify the classification, functions and role of enzymes in living system.	Apply
CO4	Analyze the metabolism pathway of carbohydrates, lipids, proteins and amino acids.	Analyze
CO5	Develop necessary knowledge on disorders associated metabolic pathways and biomolecules.	Create

UNIT –I INTRODUCTION: HISTORY OF BIOCHEMISTRY: 10 HOURS

Chemical basis of life; Composition of living matter; **Structure and Properties of water,** function relationships.

UNIT- II BIOMOLECULES: 10 HOURS

Classification**,** Structure and properties of carbohydrates, fatty acids amino acids, proteins. Structure and properties of purines, pyrimidines, nucleosides, nucleotides, polynucleotides, ribonucleic acids and deoxy ribonucleic acids, nucleoprotein complexes.

UNIT–III ENZYMOLOGY: **10 HOURS**

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

UNIT- IV METABOLISM: **10 HOURS**

Biosynthesis and degradation of fatty acids and cholesterol, biosynthesis and degradation of amino acids, peptides and proteins, biosynthesis and degradation of purines, pyrimidines and nucleic acids.

UNIT –V BIOENERGETICS: **8 HOURS**

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

TOTAL: 48 HOURS

TEXT BOOK:

1. Jain, J.L. (2002). *Fundamentals of Biochemistry* (5ed.). New Delhi: S. Chand & Co.
2. Zubay, G.L., Parson, W.W., & Vance D.E. (1995). *Principles of Biochemistry*. (1st ed.) Oxford: MC Brown Publishers.
3. Voet, G., & Voet, A. (2004). *Fundamentals of Biochemistry* (3rd ed.). New York: John Wiley and Sons, Inc.

REFERENCE BOOK:

1. Murray, R.K., Bender, D.A., Botham, K.M., & Kennelly, P.J., (2012). *Harper's Illustrated Biochemistry* (29th ed.). London: McGraw-Hill Medical.
2. Nelson, D.L., & Cox, M.M. (2013). Leininger: Principles of Biochemistry (6th ed.). New York: W.H. Freeman and Company

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	-	2	2	-	2	-	-	1	-	2	-	2	3	3
CO2	3	-	-	-	2	2	-	2	-	-	1	-	2	-	2	3	3
CO3	3	-	-	-	2	2	-	2	-	-	1	-	2	-	2	3	3
CO4	3	-	-	-	2	2	-	2	-	-	1	-	2	-	2	3	3
CO5	3	-	-	-	2	2	-	2	-	-	1	-	2	-	2	3	3
Average	3	-	-	-	2	2	-	2	-	-	1	-	2	-	2	3	3

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER I

24BTP102 **MICROBIOLOGY** **4H – 4C**

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

End Semester Exam:3 Hours

PREREQUISITE: The students should have knowledge about microorganism and its culture methods.

COURSE OBJECTIVES (CO)

- To understand fundamental concepts, classification and life cycle of microorganisms.
- To understand the conceptual knowledge on microbial diseases and control measures.
- To obtain information regarding application of microbes in industrial sectors.

COURSE OUTCOMES (COs)

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

COs	Course Outcomes	Blooms Level
CO1	Understand the basic concepts and classification of microorganisms.	Understand
CO2	Label the cultivation and maintenance of different types of microorganisms.	Remember
CO3	Acquire knowledge on significance and activities of eukaryotic microorganisms.	Apply
CO4	Discuss the control measures for microbial mediated diseases.	Analyze
CO5	Build the knowledge about beneficial microbes and its industrial applications.	Create

UNIT-I HISTORY AND DEVELOPMENT OF MICROBIOLOGY: **10 HOURS**

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 CULTIVATION AND MAINTENANCE OF MICROORGANISMS: **10 HOURS**

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 EUKARYOTIC MICROORGANISMS: **10 HOURS**

General characters, Structure and Reproduction of Slime molds. Mycorrhiza: 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 – viroid's and prions. **Viral Genetics:** M13 and lambda.

UNIT –IV MICROBIAL DISEASES AND CONTROL MEASURES: **10 HOURS**

Bacterial Infections – Typhoid Fever and Tuberculosis- causes, diagnosis, pathogenesis, prevention and treatment Viral diseases: COVID-19 and HIV- causes, diagnosis, pathogenesis, prevention and treatment. Protozoan Diseases – Malaria and Leishmaniasis causes, diagnosis, pathogenesis, prevention and treatment. Fungal Diseases – Candidiasis, ring worm - causes, diagnosis, pathogenesis, prevention and treatment. Nosocomial Infection. Opportunistic pathogens in diseases

UNIT- V APPLICATION OF MICROBES IN INDUSTRY: 8 HOURS

Beverages: wine, beer, whisky. Yoghurt production, 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.

TOTAL: 48 HOURS

TEXT BOOK:

1. Black, J.G. (2002). *Microbiology Principles and Explorations*. (9th ed.) New York: John Wiley and Sons Publishing.
2. Talaro, K.P., (2009). *Foundations in Microbiology*. (8th ed.) McGraw- Hill Publishing Company, New York.
3. Pascale,C. (2005). *Cellular Microbiology*.(2nd ed.) New York: American Society for Microbiology.
4. 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.
5. Pelczar, M.J., Chan, E.C.S., & Krieg, N.R. (1993). *Microbiology* (5th ed.). McGraw Hill Book Company.
6. Roland, V.G. (2005). *Applied Food Microbiology*. London: Star Publishing Co.

REFERENCE BOOK:

1. Atlas, R.M. (2015). *Principles of Microbiology Illinois*: (2nd ed.) USA, WCB McGraw Hill publishers.
2. Reed, G. (Ed.). (1982). *Prescott & Dunn's industrial microbiology* (4th ed).
3. Prescott, L.M., Harley, J.P. & Klien, D.A. (2005). *Microbiology*. (6th ed.) Boston: NY, McGraw-Hill Publishing Company.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	-	2	2	-	2	2	-	1	-	2	-	2	3	2
CO2	3	-	-	-	2	2	-	2	2	-	1	-	2	-	2	3	2
CO3	3	-	-	-	2	2	-	2	2	-	1	-	2	-	2	3	2
CO4	3	-	-	-	2	2	-	2	2	-	1	-	2	-	2	3	2
CO5	3	-	-	-	2	2	-	2	2	-	1	-	2	-	2	3	2
Average	3	-	-	-	2	2	-	2	2	-	1	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER I

24BTP103 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

PREREQUISITE: The students should have knowledge about Cell functions and Mendelian Principles.

COURSE OBJECTIVES (CO):

- 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 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)

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

COs	Course Outcomes	Blooms Level
CO1	Define the structures and basic components of prokaryotic and eukaryotic cells.	Remember
CO2	Impart knowledge about cellular components and activities.	Create
CO3	Demonstrate the pathways involved in various cellular events including cell cycle.	Understand
CO4	Analyze the inheritance of genes among plants and animals and the genetic makeover as well as the physical appearance of organisms.	Analyze
CO5	Apply the Mendelian inheritance and the inheritance of gene in human beings.	Apply

UNIT- I CELL ORGANIZATION: 10 HOURS

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.

UNIT- II CELL REGULATION: 10 HOURS

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 GENETICS: 10 HOURS

Mendelian and Non-Mendelian principles. Concept of gene: Allele, multiple alleles, pseudo allele, complementation tests. Genetic recombination, Linkage and Crossing over. Mutations-Types of Mutation, Genetic analysis of Mutations, DNA repair Mechanisms. **Ploidy and its genetic implications.**

UNIT- IV GENETIC TRANSFORMATION, GENOME MAPPING AND TRANSPOSABLE ELEMENTS: 10 HOURS

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 MICROBIAL AND HUMAN GENETICS: 8 HOURS

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, Quantitative genetics- Polygenetic inheritance, Heritability and its measurements, Quantitative Trait Locus (QTL) mapping.

TOTAL: 48 HOURS

TEXT BOOK:

1. Krishnaiya, G. R. (2019). *A Textbook of Microbial Genetics & Molecular Biology* (1st ed.). Blue Rose Publishers.

REFERENCE BOOK:

1. Alberts, B. (2017*). Molecular Biology of the Cell* (6th ed.). Garland Science Publication.
2. Cooper, G.M. (2018). *The Cell: A Molecular Approach* (Eighth ed.). Sinauer Associates (Oxford University Press).
3. Strachan, T., Read, A. (2018). *Human Molecular Genetics* (5th ed.). Garland Science Publication.
4. Ranzoni, A.M., Cvejic, A. (2018*). Single-cell biology: resolving biological complexity, one cell at a time*. Development. The Company of Biologists Publication.

WEBSITES:

1. MOOC: https://nptel.ac.in/courses/102103012/
2. MOOC: https://nptel.ac.in/courses/102104052/

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO2	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO3	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO4	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO5	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
Average	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER I

24BTP104 BIOINSTRUMENTATION AND BIOSTATISTICS 4H-4C

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

End Semester Exam:3Hours

PREREQUISITE: The students should have basic knowledge about microscopy, colorimetry, spectroscopy instrumentation and basic statistics.

COURSE OBJECTIVES (CO)

- To understand the fundamental principles of bioinstrumentation.
- To recognize the concepts on spectroscopy, centrifugation, chromatography and electrophoresis techniques.
- To understand key concepts on biostatistics and its various tools.

COURSE OUTCOMES (COs)

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

Cos	Course Outcomes	Blooms Level
CO1	Recall the basic knowledge about microscopy, colorimetry and spectroscopy instrumentation.	Remember
CO2	Compare colorimetric and spectroscopic methods to analyze biological samples.	Understand
CO3	Examine the principles of centrifugation and chromatography for compound separation.	Analyze
CO4	Impart knowledge on separation of nucleic acids and proteins using electrophoresis.	Create
CO5	Apply various statistical tools for analyzing the biological data.	Apply

UNIT–I MICROSCOPY, COLORIMETRY AND SPECTROSCOPY: 10 HOURS

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, Instrumentation and applications of UV Visible light spectroscopy, Spectro fluorimeter, FTIR, NMR spectroscopy–2D and 3D structure prediction.

UNIT–II CENTRIFUGATION AND CHROMATOGRAPHY: 10 HOURS

Principle, types of centrifuges, Applications of analytical and preparative centrifuge, density gradient and ultra-centrifuge. Chromatography: 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), 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, Immunoblotting, Chemidoc.

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 error and 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. Statistical software's (Microsoft excel, graph pad prism, epi graph, origin). Statistical Design-CRPD INNOVA (one-way, two-way analysis). 7QC tools (Histogram, Pareto chart, Control chart, Scatter, Diagram.

TOTAL:48 HOURS

TEXT BOOK:

1. Veerakumari, L. (2009). *Bioinstrumentation*. MJP Publishers, Chennai, India
2. Sawhney, S.K.& Singh, R. (2005). Introductory *Practical Biochemistry* (2nd ed.). Alpha Science International Ltd. Publishers, Oxford, United Kingdom.
3. Glover, T.& Mitchell, H. (2015). *An Introduction to Biostatistics* (3rd ed.). Wavel and Press, Illinois, United States.

REFERENCE BOOK:

1. Chatwal, G.R.& Anand, S.K. (2014). *Instrumental Methods of Chemical Analysis* (5th ed.). Himalaya Publishing House, Mumbai, India.
2. Hofmann, A. & Clokie, S. (2018). *Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology* (8th ed.). Cambridge University Press, Cambridge, United Kingdom.
3. Rosner, B. (2015). *Fundamentals of Biostatistics* (8th ed.). Cengage Learning Publishers, Massachusetts, United States.
4. Sawhney, S.K. & Singh, R. (2005). Introductory *Practical Biochemistry* (2nd ed.). Alpha Science International Ltd. Publishers, Oxford, United Kingdom.
5. Sharma, B. K. (2011). *Instrumental Methods of Chemical Analysis* (1st ed.). Krishna Prakashan Media Publishers, Meerut, India.

TOTAL: 48 HOURS

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	2	1	2	-	2	-	2	2	-	2	-	2	3	2
CO2	3	-	-	2	1	2	-	3	-	2	2	-	2	-	2	3	2
CO3	3	-	-	2	1	2	-	2	-	2	2	-	2	-	2	3	2
CO4	3	-	-	2	1	2	-	2	-	2	2	-	2	-	2	3	2
CO5	3	-	-	2	1	2	-	3	-	2	2	-	2	-	2	3	2
Average	3	-	-	2	1	2	-	2.4	-	2	2	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER I

24BTP105A BIODIVERSITY AND CONSERVATION BIOLOGY 4H-4C

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

End Semester Exam:3Hours

PREREQUISITE: The students should have basic knowledge about biodiversity of plants and animals and conservation methods.

COURSE OBJECTIVES (CO)

- To understand the fundamental concepts of biodiversity.
- To acquire knowledge on standards on biodiversity and ecosystem functioning.
- To apply the knowledge about various management strategies for conservation of ecosystem and restoration practices.

COURSE OUTCOMES (COs)

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

COs	Course Outcomes	Blooms Level
CO1	Define the fundamental principles and concepts of Biodiversity.	Remember
CO2	Outline knowledge about conservation of species various ecosystem.	Understand
CO3	Build the knowledge on developing relationships, distribution, abundance and interactions among other organisms in ecosystem.	Apply
CO4	Categorize the conservation methods for endangered species.	Analyze
CO5	Adapt basic management strategies for biodiversity conservation.	Apply

UNIT I INTRODUCTION: 10 HOURS

Definition, Genetic diversity, Species diversity, Ecosystem diversity: Structural and functional aspects. Bio-geographic classification of India. Basic concepts of conservation biology, history of conservation biology, the value of biodiversity and conservation, current practice in conservation, conservation of genetic diversity, conservation of species diversity, conservation of ecosystem diversity, relevance of ecosystem diversity as well as services in conservation

UNIT II VALUE OF BIODIVERSITY: 10 HOURS

Intrinsic, consumptive, productive use, social, ethical, aesthetic and option values. Utilitarian values of biodiversity- goods, services and information. Biodiversity and ecosystem functioning. Biodiversity and stability of ecosystem functioning. Biodiversity at global, national and local levels India as a Mega Diversity Nation. Hotspots of Biodiversity: Criteria for determining hot spots. Indo-Burma (Eastern Himalaya), Western Ghats and Sri Lanka.

UNIT III THREATS TO BIODIVERSITY: 10 HOURS

Habitat loss, pollution, species introduction, global climate change, overexploitation, poaching of wildlife. Rare species, genetic diversity of rare species, habitat loss and fragmentation. Extinction: mass extinction, extinction process, ecosystem degradation, over exploitation, invasive species. Human factors: social factors, economics, politics and action. Man wildlife conflicts. Endangered and endemic species of India, common plant species, common animal species.

UNIT IV CONSERVATION OF BIODIVERSITY: 10 HOURS

Strategies for conservation: In-situ and ex-situ conservation- environmental assessment, protected areas-biosphere reserves, national parks, sanctuaries, tiger reserves-project tiger. Ex situ conservation-Managed ecosystems, biological resources and gene banks, botanical gardens, bio-parks, simulated ex situ conservation strategies, valuing biological resources, ecotourism, Strategies for Conservation: Top-down and bottom- up protocols for conservation. In situ conservation-Protected areas, Wildlife sanctuaries, National parks, 8 Biosphere reserves. Strategies for ex situ conservation – Botanical Gardens, Seed banks, Field gene banks, Test tube gene banks, pollen banks, DNA bank, in vitro conservation.

UNIT V ECOSYSTEM RESTORATION AND MANAGEMENT PRACTICES: 8 HOURS

Global biodiversity and its importance, Different approaches of biodiversity conservation and management, registering biodiversity. Valuing biodiversity resources and their contribution to agriculture, community health and environment. Causes of biodiversity loss. Techniques of species reintroduction and restoration of the degraded habitat. Biodiversity policy and legislation. Wildlife conservation and management: Status of biodiversity conservation in India

TOTAL: 48 HOURS

TEXT BOOK:

1. Krishnamoorthy, K.V. (2017). *An advanced Text Book on Biodiversity: Principles and Practice* (1st ed.). Oxford & IBH Publishers, New Delhi, India.
2. Odum, E. P. & Barrett, G. W. (2004). *Fundamentals of Ecology* (5th ed.). Cengage Learning Publishers, Massachusetts, United States

REFERENCE BOOK:

1. Gilbert, S. F. & Barresi, M. J. F. (2016). *Developmental Biology* (11th ed.). Sinauer Associates (Oxford University Press), Sunderland, United Kingdom.
2. Minelli, A. (2018). *Plant Evolutionary Developmental Biology: The Evolvability of the Phenotype* (1sted.). Cambridge University Press, Cambridge, United Kingdom.
3. Pontarotti, P. (2016). *Evolutionary Biology: Convergent Evolution, Evolution of Complex Traits, Concepts and Methods* (1st ed.). Springer Publishers, New York, United States.
4. T. Pullaiah (2019). Global Biodiversity by Apple Academic Press.Vol;4 ISBN :9781771887519.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO2	3	-	-	2	1	2	-	3	-	-	-	-	2	-	2	3	2
CO3	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO4	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO5	3	-	-	2	1	2	-	3	-	-	-	-	2	-	2	3	2
Average	3	-	-	2	1	2	-	2.4	-	-	-	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER I

24BTP105B **MICROBIAL GENETICS** **4H-4C**

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

End Semester Exam:3 Hours

PREREQUISITE: The students should have basic knowledge about mendalian principles and central dogma of life.

COURSE OBJECTIVES (CO)

- To focus on the fundamental concepts behind microbial genetics.
- To understand the Transcription and Translation Process.
- To give a strong knowledge about genetics principle and genetic engineering.

COURSE OUTCOMES (COs)

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

COs	Course Outcomes	Blooms Level
CO1	Find basic awareness and outline of mendalian principles and its inheritance strategies.	Remember
CO2	Interpret the knowledge about the central dogma of life on earth.	Understand
CO3	Utilize the process of Mutation and mutagenesis.	Apply
CO4	Develop the knowledge on genetic analysis and recombination process in cells.	Create
CO5	Classify the concepts of DNA repair mechanisms.	Analyze

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 I: **10 HOURS**

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.

UNIT III TRANSLATION PROCESS: **10 HOURS**

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–IV GENETIC ANALYSIS AND RECOMBINATION IN BACTERIA: 10 HOURS

Gene transfer mechanisms in bacteria, Transformation: Introduction and History, Types of transformation in prokaryotes. 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. 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.

UNIT–V DNA 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

TOTAL: 48 HOURS

TEXT BOOK:

1. Klug, W.S., Cummings, M.R., Spencer, C., Palladino, M. (2011). Concepts of Genetics, 10th edition, Benjamin Cummings.
2. Gardner, E.J., Simmons, M.J., Snustad, D, P. (2008). Principles of Genetics. 8th edition, Wiley-India.
3. David P. Clark, Michelle R. Mc Gehee, and Nanette J. Pazdernik. (2018). Molecular genetics 3rd ed.
4. Molecular Cell biology 6th edition (2016) by Lodish, Berk, Kaiser, Krieger, Scott, Bretscher, Ploegh, Matsudaira.

REFERENCE BOOK:

1. Krebs, J., Goldstein, E., Kilpatrick, S. (2013). Lewin's Essential Genes, 3rd ed, Jones and Bartlett Learning.
2. Pierce, B. A. (2011) Genetics: A Conceptual Approach,4th edition, Macmillan Higher Education Learning.
3. Watson, J, D., Baker, T. A., Bell, S.P., (2008) Molecular Biology of the Gene, 6th edition, Benjamin Cummings.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO2	3	-	-	2	1	2	-	3	-	-	-	-	2	-	2	3	2
CO3	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO4	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO5	3	-	-	2	1	2	-	3	-	-	-	-	2	-	2	3	2
Average	3	-	-	2	1	2	-	2.4	-	-	-	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER I

24BTP105C **HERBAL TECHNOLOGY** **4H-4C**

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

End Semester Exam: 3 Hours

PREREQUISITE: The students should have basic knowledge about plant medicinal properties and plant extract preparation process.

COURSE OBJECTIVES (CO)

- To impart knowledge on ancient medicine.
- To comprehend plants and its medicinal properties and metabolites extraction methods.
- To gain knowledge on various applications of plants metabolites.

COURSE OUTCOMES (COs)

On completion of the course, students are able to

COs	Course Outcomes	Blooms Level
CO1	Find the ancient medicine and its treatment.	Remember
CO2	Classify the medicinal plants and its medicinal properties.	Understand
CO3	Extract the plant metabolites.	Apply
CO4	Analyze the plant metabolites functions.	Analyze
CO5	Formulate analysis of plant and plant-based drugs.	Create

UNIT I - HERBS AS RAW MATERIALS: **10 HOURS**

Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation Source of Herbs Selection, identification and authentication of herbal materials Processing of herbal raw material. Good agricultural practices in cultivation of medicinal plants including Organic farming. Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides.

UNIT II – NUTRACEUTICALS: **10 HOURS**

General aspects, Market, growth, scope and types of products available in the market. Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastro intestinal diseases. Herbal-Drug and Herb-Food Interactions: General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra.

UNIT III - HERBAL COSMETICS: **10 HOURS**

Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products. Herbal excipients: Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes. Herbal formulations: Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes

UNIT IV- EVALUATION OF DRUGS: 10 HOURS

WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs. Patenting and Regulatory requirements of natural products: Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem. Regulatory Issues – Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs – Schedule Z of Drugs & Cosmetics Act for ASU drugs.

UNIT V-GENERAL INTRODUCTION TO HERBAL INDUSTRY: 8 HOURS

Herbal drugs industry: Present scope and future prospects. A brief account of plant-based industries and institutions involved in work on medicinal and aromatic plants in India. Schedule T – Good Manufacturing Practice of Indian systems of medicine Components of GMP (Schedule – T) and its objectives Infrastructural requirements, working space, storage area, machinery and equipment, standard operating procedures, health and hygiene, documentation and records

TOTAL: 48 HOURS

TEXT BOOK:

1. Arber, Agnes. (1999). Herbal Plants and Drugs. Mangal Deep Publications, Jaipur.
2. Miller, L. and Miller, B. (2017). Ayurveda & Aromatherapy: The Earth Essential Guide to Ancient Wisdom and Modern Healing. 4th edition. Motilal Banarsidass;

REFERENCE BOOK:

1. Trease, E.C. and Evans, W.C. (2009) Pharmacognosy. 16th Edition, W.B. Saunders, Philadelphia, 365-650.
2. Kokate, C.K. (2003). Practical Pharmacognosy. Vallabh Prakashan, Pune.

WEBSITE:

1. AYUSH (www.indianmedicine.nic.in).

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO2	3	-	-	2	1	2	-	3	-	-	-	-	2	-	2	3	2
CO3	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO4	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO5	3	-	-	2	1	2	-	3	-	-	-	-	2	-	2	3	2
Average	3	-	-	2	1	2	-	2.4	-	-	-	-	2	-	2	3	2

1- Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER I

24BTP111 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:3 Hours

PREREQUISITE: The students should have basic knowledge about biochemical techniques in the laboratory.

COURSE OBJECTIVES (CO):

- To execute the laboratory experiments, independently using the standard methods and techniques.
- To train the students of the subject on handling various experimental methods and techniques in order to analyze the given biological samples from biochemical stand points.
- To provide knowledge about quantitative analysis of the macromolecules in the given sample and analyze the results.

COURSE OUTCOMES (COs)

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 about methods used in the analysis of various biological macromolecules.	Create
CO4	Apply the quantification methods to analysis the sugars, amino acids and lipids.	Understand
CO5	Analyze the effect of physio - chemical parameters of biomolecules.	Evaluate

BIOCHEMISTRY **48 HOURS**

1. Quantification of proteins–Lowry et al/ Bradford method
2. Quantification of carbohydrates by Phenol sulphuric acid method
3. Quantification of sugars–Enthronement
4. Estimation of Total free amino acids by Ninhydrin method
5. Quantification of lipids by Folch method
6. Quantification of Ascorbic acid
7. Membrane-based separation (e.g., Microfiltration/Ultrafiltration)
8. Separation of Amino acids /fatty acids/sugar/nucleic acid 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

TOTAL: 48 HOURS

TEXT BOOK:

1. Keith Wilson & John Walker. (2010). Principles and Techniques of Biochemistry and Molecular Biology. New York, NY: Cambridge University Press
2. Boyer, R.F. (2011). Biochemistry Laboratory: Modern Theory and Techniques (2nd ed.). Pearson Education Publishers, New Jersey, United States.
3. Sadasivam. S. & Manickam, A. (2008). Biochemical Methods. (3rd ed.) New Age International Private Limited Publishers, New Delhi, India.
4. Palanivelu, P. (2016). Analytical Biochemistry and Separation Techniques (5th ed.). Twenty first Century Publications, Coimbatore, India.

REFERENCE BOOK:

1. Hofmann, A. & Clokie, S. (2018). Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (8th ed.). Cambridge University Press, Cambridge, United Kingdom

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
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CO2	3	-	-	2	1	2	2	3	2	-	2	-	2	-	2	3	2
CO3	3	-	-	2	1	2	2	2	2	-	2	-	2	-	2	3	2
CO4	3	-	-	2	1	2	2	2	2	-	2	-	2	-	2	3	2
CO5	3	-	-	2	1	2	2	3	2	-	2	-	2	-	2	3	2
Average	3	-	-	2	1	2	2	2.4	2	-	2	-	2	-	2	3	2

1- Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER I

24BTP112 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:3 Hours

PREREQUISITE: The students should have basic knowledge about handling of microbes in the laboratory and basic genetics.

COURSE OBJECTIVES (CO)

- To gain knowledge on identifying prokaryotic and eukaryotic cell types.
- To understand various eukaryotic cellular components.
- To identify the different types of cell division.

COURSE OUTCOMES (COs)

On completion of the course, students are able to

COs	Course Outcomes	Blooms Level
CO1	Find the prokaryotic and eukaryotic cell types by morphological and intercellular organelles arrangement.	Remember
CO2	Gain knowledge about the various cellular components in eukaryotic cells and prokaryotic cells.	Create
CO3	Understand about the cell permeability in plant and animal cells.	Understand
CO4	Impart knowledge on mitotic and meiotic cell divisions.	Evaluate
CO5	Examine the structural variations in the nucleus using different staining methods.	Apply

MICROBIOLOGY **24 hours**

1. Pure culture technique–Pour plate, spread plate and streaking methods.
2. Staining technique– Gram's staining and Fungal staining
3. Motility test –Hanging drop method.
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 and MIC
6. Preparation of Yoghurt.

MOLECULAR GENETICS **24 hours**

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

TOTAL: 48 HOURS

TEXT BOOK:

1. Cappuccino, J.H. and Sherman, N. (2014). Microbiology–A lab Manual (10th ed), The Benjamin Publishing Company, Singapore.
2. Sundararaman, G. and Arumugam, A. (2017). Labin Cell Biology, Microbiology and Bioinstrumentation: Laboratory Manual. Independently Published.
3. Pierce, B.A. (2011) Genetics: A Conceptual Approach, 4th edition, Macmillan Higher Education Learning.
4. Worku Mhiret. (2019) Laboratory Manual for Principles of Genetics (1st ed.). LAMBERT Academic Publishing.

REFERENCE BOOK:

1. Goering R, Dockrell H, Zuckerman M, and Wakelin D. (2012). Mims'Medical Microbiology. 5th edition. Elsevier.
2. Willey J M, Sherwood L M, and Woolverton C J. (2013). Prescott, Harley and Klein's Microbiology.9th edition. McGraw Hill Higher Education

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	2	1	2	2	2	2	-	2	-	2	-	2	3	2
CO2	3	-	-	2	1	2	2	3	2	-	2	-	2	-	2	3	2
CO3	3	-	-	2	1	2	2	2	2	-	2	-	2	-	2	3	2
CO4	3	-	-	2	1	2	2	2	2	-	2	-	2	-	2	3	2
CO5	3	-	-	2	1	2	2	3	2	-	2	-	2	-	2	3	2
Average	3	-	-	2	1	2	2	2.4	2	-	2	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER I

JOURNAL PAPER ANALYSIS AND PRESENTATION **2H**

SEMESTER II

24BTP201 **GENETIC ENGINEERING** **4H-4C**

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

End Semester Exam:3Hours

PREREQUISITE: The students should have basic knowledge about mendalian genetics and functions of nucleic acid.

COURSE OBJECTIVES (CO)

- To acquaint fundamental knowledge on recombinant DNA technology for the production of genetically engineered organisms.
- To understand the knowledge about advance techniques and tools involved in the genetic engineering.
- To obtain the principles of cloning strategies for selection and screening of recombinant clones and its application in industrial sectors.

COURSE OUTCOMES (COs)

On completion of the course, students are able to

COs	Course Outcomes	Blooms Level
CO1	Understand the fundamental steps involved in genetic engineering.	Remember
CO2	Gain knowledge about various vectors used in cloning for biotechnological research.	Understand
CO3	Apply 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

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: **10 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: **10 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: 10 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: 10 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 (Covid vaccines). Gene Knockout technology.

TOTAL: 48 HOURS

TEXT BOOK:

1. Glick, B.R. & Patten, C.L. (2017). *Molecular Biotechnology*. (5th ed.) Taylor & Francis Publishers, Abingdon, United Kingdom.
2. Primrose, S.B. & Twyman, R. M. (2016). *Principles of Gene Manipulation and Genomics (*8th ed.). John Wiley and Sons Ltd. Publishers, Chicester, United Kingdom.

REFERENCE BOOK:

1. Brown, T.A. (2016). *Gene Cloning and DNA Analysis: An Introduction* (7th ed.). Wiley - Blackwell Publishers, New Jersey, United States.
2. 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.
3. Winnacker, E. L. (2013). *From Genes to Clones* (1st ed.). Panima Educational Book Agency, New Delhi.

WEBSITES:

1. https://nptel.ac.in/courses/102103013/

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	1	2	1	2	-	2	2	2	1	-	2	-	2	3	2
CO2	3	-	1	2	1	2	-	3	2	2	1	-	2	-	2	3	2
CO3	3	-	1	2	1	2	-	2	2	2	1	-	2	-	2	3	2
CO4	3	-	1	2	1	2	-	2	2	2	1	-	2	-	2	3	2
CO5	3	-	1	2	1	2	-	3	2	2	1	-	2	-	2	3	2
Average	3	-	1	2	1	2	-	2.4	2	2	1	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER II

24BTP202 BIOPROCESS AND DOWNSTREAM PROCESSING 4H- 4C

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

End Semester Exam:3Hours

PREREQUISITE: The students should have basic knowledge about fermentation process and industrially important microorganisms.

COURSE OBJECTIVES (CO)

- To understand the significance of bioprocess and industrially important microbes.
- To understand fundamental principles for cultivating microorganisms in fermenters.
- To attain key concepts in application of bioprocess and fermentation technology.

COURSE OUTCOMES (COs)

On completion of the course, students are able to

COs	Course Outcomes	Blooms Level
CO1	Recall the factors that contribute in enhancement of cell and product formation during fermentation process	Remember
CO2	Compare the kinetics of cell and product formation in batch, continuous and fed-batch cultures	Understand
CO3	Identify the rheological changes during fermentation process	Apply
CO4	Develop protocol for scale-up and harvesting from shake flask to bench top fermenter	Create
CO5	Analyze the bioprocess paradigms including scale-down, bioprocess simulation and economics in biological manufacturing	Analyze

UNIT –I INTRODUCTION TO BIOPROCESS TECHNOLOGY: 10 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, solid-state.

UNIT–II FERMENTER: DESIGN, CONTROL AND MONITOR: 10 HOURS

Design of fermenter, Types: Batch, Continuous, Fed Batch PFR. 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**.**

UNIT–III UPSTREAM PROCESSING: 10 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.

UNIT–V APPLICATION OF BIOPROCESS TECHNOLOGY: 10 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. Effluent treatment. Fermentation products available in market.

TOTAL: 48 HOURS

TEXT BOOK:

1. Bailey, J.S. & Ollis, D.F. (2017). *Biochemical Engineering Fundamentals* (2nd ed.) McGraw- Hill Education/ 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.

REFERENCE BOOK:

1. Dutta, R. (2008). *Fundamentals of Biochemical Engineering* (1st ed.). Springer Publishers, New York, United States.
2. Shuler, M.L.& Kargi, F. (2015). *Bioprocess Engineering Basic concepts* (2nd ed.). Pearson India Education Services Pvt. Ltd., Bengaluru, India
3. Stanbury, P.F., Whitaker, A., & Hall, S.J. (2016). *Principles of Fermentation Technology* (3rd ed.). Butterworth - Heinemann Publishers, Oxford, United Kingdom.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
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CO2	3	-	-	2	1	2	-	3	-	-	-	-	2	-	2	3	2
CO3	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO4	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO5	3	-	-	2	1	2	-	3	-	-	-	-	2	-	2	3	2
Average	3	-	-	2	1	2	-	2.4	-	-	-	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER II

24BTP203 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

PREREQUISITE: The students should have basic knowledge about immune system and vaccines.

COURSE OBJECTIVES (CO)

- To understand the immune system and 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 attain the principles involved in vaccine technology including recombinant vaccines.

COURSE OUTCOMES (COs)

On completion of the course, students are able to

COs	Course Outcomes	Blooms Level
CO1	Define various immunological process including innate and adaptive immunity, cells and organs of immune system, antigen and antibody interaction.	Remember
CO2	Infer the organization of genes, class switching in constant regions of genes and expression and regulation of genes.	Understand
CO3	Identify how animal cell culture is explored for monoclonal antibodies production using hybridoma technology.	Apply
CO4	Survey the role of cancer immunotherapy.	Analyze
CO5	Develop novel vaccines against infectious diseases.	Create

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: 10 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: 10 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 10 HOURS

Antigen- antibody interactions: Agglutination. Precipitation. Immuno-diffusion. Immuno-fluorescence. 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: 10 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.

TOTAL: 48 HOURS

TEXT BOOK:

1. Abbas, A.K., Lichtman, A.H., & Pillai, S. (2017). *Cellular and Molecular Immunology* (9th ed.). Elsevier Publishers, Amsterdam, Netherlands.
2. Punt, J., Stranford, S., Jones, P., & Owen, J.A. (2018). *Kuby Immunology* (8th ed.). W.H. Freeman and Company, New York, United States.
3. Tizard, I.R. (2017). *Veterinary Immunology* (10th ed.) Saunders Publishers, New York, United States.
4. Turgeon, M.L. (2017). *Turgeon: Immunology and Serology in Laboratory Medicine*. (6th ed.). Elsevier Publishers, Amsterdam, Netherlands.

REFERENCE BOOK:

1. Abbas, A.K., Lichtman, A.H., & Pillai, S. (2019). *Basic Immunology: Functions and Disorders of the Immune System* (Sixth ed.). Elsevier Publishers, Amsterdam, Netherlands.
2. 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.
3 Myrone M. Levine, Gordon Dougan, Michael F. Good, Gary J. Nabel, James P. Nataro, Rino Rappuoli (2017). *New Generation Vaccines* (4th ed.). CRC Press.

WEBSITES:

1. https://www.cell.com/cancer-cell/libraries/tumor-immunology-and-immunotherapy
2. MOOC: https://nptel.ac.in/courses/102103038/

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO2	3	-	-	2	1	2	-	3	-	-	-	-	2	-	2	3	2
CO3	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO4	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO5	3	-	-	2	1	2	-	3	-	-	-	-	2	-	2	3	2
Average	3	-	-	2	1	2	-	2.4	-	-	-	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER II

24BTP204 **SYSTEMS BIOLOGY** **4H-4C**

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

End Semester Exam: 3Hours

PREREQUISITE: The students should have basic knowledge about biological databases.

COURSE OBJECTIVES (CO)

- 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

COURSE OUTCOMES (COs)

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	Find the algorithms required to compare sequences and require to know the phylogenetic relationship between the gene sequences	Remember
CO3	Build knowledge on building 3D structures of genes	Analyze
CO4	Build the databases at the NCBI and EBI resources	Create
CO5	Know the difference between databases, tools, repositories and be able to use each one to extract specific information	Apply

UNIT - I INTRODUCTION TO SYSTEMS BIOLOGY: 10 HOURS

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.

UNIT – II METABOLIC NETWORKS AND MODELS IN SYSTEM BIOLOGY: 10 HOURS

Metabolomics, metagenomics. 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 SYSTEMS BIOLOGY DATABASES: 10 HOURS

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 TOOLS FOR SYSTEM BIOLOGY: 10 HOURS

Cell Designer. Ali Baba. Cell Profiler. J Designer. 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). Artificial Intelligence tool.

UNIT – V PREMISES & PROMISES OF SYSTEMS BIOLOGY: 8 HOURS

Premise of Systems Biology. Promise of Systems Biology. Challenges of Systems Biology. Applications of Systems Biology. Introduction to synthetic biology**.**

TOTAL: 48 HOURS

TEXT BOOK:

1. Lodhi, H.M. & Muggleton, S.H. (2010) *Elements of Computational Systems Biology.* Wiley-Blackwell Publishers, New Jersey, United States.
2. Cánovas, M., Iborra, J.L., & Manjón, A. (2006). *Understanding and Exploiting Systems Biology in Biomedicine and Bioprocesses.* Caja Murcia Foundation, Spain.
3. Sensen, C.W. (2002). *Essentials of Genomics and Bioinformatics*. Wiley-VCH Publishers, New Jersey, United States.
4. Voit, E. (2017). *A First Course in Systems Biology* (2nd ed.). Garland Science Publishers, United States.

REFERENCE BOOK:

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-Inter science Publishers, New Jersey, United States.
3. Pennington, S.R. & Dunn, M.J. (2002). *Proteomics.* Viva Books Pvt. Ltd., New Delhi, India.

WEBSITES:

1. http://www.systemsbiology.org
2. http://www.systems-biology.org

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO2	3	-	-	2	1	2	-	3	-	-	-	-	2	-	2	3	2
CO3	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO4	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO5	3	-	-	2	1	2	-	3	-	-	-	-	2	-	2	3	2
Average	3	-	-	2	1	2	-	2.4	-	-	-	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER II

24BTP205A **MICROBIAL BIOTECHNOLOGY** **3H-3C**

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

End Semester Exam: 3 Hours

PREREQUISITE: The students should have basic knowledge about microbes and its industrial importance.

COURSE OBJECTIVES (CO)

- To provide an in-depth knowledge on microbial metabolic production.
- To develop genetically engineered microbes for biomedical applications.
- To understand fundamentals of bioconversion and waste utilization.

COURSE OUTCOMES (COs)

On completion of the course, students are able to

COs	Course Outcomes	Blooms Level
CO1	Label the role of micro-organisms in specific biotechnological processes.	Remember
CO2	Explain the complex processes behind the development of genetically manipulated organisms**.**	Understand
CO3	Apply the knowledge of microalgae in pharmaceutical industries.	Apply
CO4	Discuss state-of-the-art technologies of genetics of antimicrobial metabolite production in biocontrol bacteria.	Create
CO5	Analyze the major groups of microorganisms used in microbial bioconversion.	Analyze

UNIT–I INTRODUCTION **7 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 **7 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 7 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 7 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.

TOTAL: 36 HOURS

TEXT BOOK:

1. Bernad. R. Glick and Jack J. Pasternak. (2002). Molecular Biotechnology Principles and Applications of Recombinant DNA.WCB.
2. Kun, Y.L (2013). Microbial Biotechnology: Principles and applications. 3rd ed. World Scientific Publishing Company;

REFERENCE BOOK:

1. Glazer, A.N. and Nikaido, H. (2007) Microbial Biotechnology. Cambridge, New York.
2. Harzevili, D.F. and Chen, H. (2015). Microbial Biotechnology: Progress and trends. Taylor and Francis group.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
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CO2	3	-	-	2	1	2	-	3	-	-	-	-	2	-	2	3	2
CO3	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO4	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO5	3	-	-	2	1	2	-	3	-	-	-	-	2	-	2	3	2
Average	3	-	-	2	1	2	-	2.4	-	-	-	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER II

24BTP205B **STEM CELL BIOLOGY** **3H-3C**

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

End Semester Exam:3Hours

PREREQUISITE: The students should have basic knowledge about stem cell biology.

COURSE OBJECTIVES (CO)

- The course aim to understand the stem cell and its research.
- To analyze the importance of embryonic stem cell and pluripotent stem cell.
- To understand the diverse of application of stem cells in regenerative medicine.

COURSE OUTCOMES (COs)

On completion of the course, students are able to

COs	Course Outcomes	Blooms Level
CO1	Define the core concepts of stem cells, and explain routine methods used in stem cell research.	Understand
CO2	Understand the embryonic and induced pluripotent stem cells and their potential for regenerative medicine.	Understand
CO3	Describe the developmental origin, identification, differentiation, self-renewal, and senescence of various tissue-specific stem cells and their function in tissue growth and maintenance.	Understand
CO4	Discuss the fundamentals of stem cell biology, and identify the genetic control of stem cells.	Understand
CO5	Illustrates the diverse applications in tissue regeneration, disease therapeutics, aging, cancer and equipped skills in stem cell culture.	Apply

UNIT I: INTRODUCTION TO STEM CELLS **7 HOURS**

Definition, properties, proliferation, culture of stem cells, medical applications of stem cells, ethical and legal issues in use of stem cells.

UNIT II: TYPES OF STEM CELLS **7 HOURS**

Stem Cell biology and therapy, types embryonic stem cell, Adult stem cell, Stem Cell Biology and Therapy, Embryonic Stem Cells, culture and the potential benefits of stem cell technology

UNIT III: THERAPEUTIC APPLICATIONS OF STEM CELLS **7 HOURS**

Gene Therapy: Introduction, History and evolution of Gene therapy, optimal disease targets, Failures and successes with gene therapy and future prospects, Genetic Perspectives for Gene Therapy, Gene Delivery methods: Viral vectors and Non-viral Vectors

UNIT IV: ETHICAL ISSUE **7 HOURS**

Ethical Issues associated with stem cell-based regenerative medicine field Regulatory and Ethical Considerations of stem cell and Gene Therapy, Assessing Human Stem Cell Safety, Use of Genetically Modified Stem Cells in Experimental Gene Therapies.

UNIT V: STEM CELL AND TUMORS/MALIGNANCY: **8 HOURS**

Source of stem cells from solid tumors- Breast cancer stem cells, Brain tumor stem cells, Prostate cancer stem cells. Hematopoietic stem cell transplantation for malignancies lymphoma, leukemia and myeloma.

TOTAL: 36 HOURS

TEXT BOOK:

1. Marshak, D. R., Gardner, R. L., & Gottlieb, D. I. (2001). *Stem cell biology*. CSHL Press.
2. Mohamed Al-Rubeai (Editor), Mariam Naciri, 2014, Stem Cells and Cell Therapy (Cell Engineering Book 8), Springer
3. Sell, S. (2013). Stem Cells Handbook. Springer Science & Business Media.
4. Stephen Sullivan, Chad A Cowan and Kevin Eggan, 2007, Human Embryonic Stem Cells: The Practical Handbook, John Wiley and Sons Ltd.

REFERENCE BOOK:

1. Alexander Battler, Jonathan Leo, 2006, Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine, Springer
2. Quesenberry PJ, Stein GS and Bernard G. Forget, 1998. Stem Cell Biology and Gene Therapy. Wiley.
3. Roger Bertolotti, Keiya Ozawa and H. Kirk Hammond, 2004, Progress in gene therapy, Volume 2, Pioneering stem cell/gene therapy trials, VSP International Science Publishers

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
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CO3	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO4	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO5	3	-	-	2	1	2	-	3	-	-	-	-	2	-	2	3	2
Average	3	-	-	2	1	2	-	2.4	-	-	-	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER II

24BTP205C **BIOENTREPRENEURSHIP** **3H –3C**

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

End Semester Exam: 3Hours

PREREQUISITE: The students should have basic knowledge on entrepreneurial skills.

COURSE OBJECTIVES (CO)

- To understanding basic concepts, role and importance in the area of entrepreneurship for economic development.
- To developing personal creativity and entrepreneurial initiative.
- To acquire the resources needed for the successful development of entrepreneurial ventures.

COURSE OUTCOMES (COs)

On completion of the course, students are able to

COs	Course Outcomes	Blooms Level
CO1	Choose the business environment in order to identify business opportunities.	Remember
CO2	Classify the elements of success of entrepreneurial ventures.	Understand
CO3	Identify the legal and financial conditions for starting a business venture.	Apply
CO4	Evaluate the effectiveness of different entrepreneurial strategies and interpret their own business plan.	Evaluate
CO5	Choose the basic performance indicators of entrepreneurial activity.	Create

UNIT-I: INTRODUCTION TO ENTREPRENEURSHIP: 10 HOURS

Meaning and concept of entrepreneurship, the history of entrepreneurship development, role of entrepreneurship in economic development, Myths about entrepreneurs, agencies in entrepreneurship management and future of entrepreneurship types of entrepreneurs.

UNIT-II: ENTREPRENEUR SKILLS 10 HOURS

The Entrepreneur Why to become entrepreneur, the skills/ traits required to be an entrepreneur, Creative and Design Thinking, the entrepreneurial decision process, skill gap analysis, and role models, mentors and support system, entrepreneurial success stories.

UNIT -III: E-CELL 10 HOURS

E-Cell Meaning and concept of E-cells, advantages to join E-cell, significance of E-cell, various activities conducted by E-cell

UNIT-IV: COMMUNICATION SKILLS 10 HOURS

Communication Importance of communication, barriers and gateways to communication, listening to people, the power of talk, personal selling, risk taking & resilience, negotiation.

UNIT-V: BUSINESS VENUES 8 HOURS

Introduction to various form of business organization (sole proprietorship, partnership, corporations, Limited Liability company), mission, vision and strategy formulation

TOTAL: 48 HOURS

TEXT BOOK:

1. Ajit Parulekar and Sarita D'Souza, 2006, Indian Patent Law: Legal and Business Implications, Macmillan India publication,
2. Ganguli P, (2001), Intellectual Property Rights, Tata Mcgraw Hill.
3. Ramesh Chandra, (2004), Issues of Intellectual Property Rights, Isha Books.
4. Shiv Sahai Singh, (2004), Law of Intellectual Property Rights, Deep & Deep Publications (p) Ltd.
5. Subbian A, Bhaskaran S, (2007), Intellectual Property Rights: Heritage, Science and Society Int. Treaties, Deep & Deep Publications.
6. Bioethics & Biosafety, 2008. Sateesh MK, IK International publications.

REFERENCE BOOK:

1. Erbisch F.H., Maredia K.M, (2000), Intellectual Property Rights In Agricultural Biotechnology, Universities Press.
2. Elad Harison (2008). Intellectual Property Rights, Innovation and Software Technologies. Edward Elgar Publishing Limited, UK.
3. Santaniello, V., Evenson, R.E., Zilberman, D. and Carlson, G.A. 2003, Agriculture and Intellectual Property Rights, University Press publication.

WEBSITE:

1. USPTO Web Patent Databases at: www.uspto.gov/patft
2. Government of India's Patents Website: patinfo.nic.in
3. Intellectual property India: www.ipindia.nic.in

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	2	2	2	2	2	2	2	2	-	2	3	2	3	2
CO2	3	-	-	2	2	2	2	3	2	3	2	-	2	3	2	3	2
CO3	3	-	-	2	3	2	2	3	2	3	2	-	2	3	2	3	2
CO4	3	-	-	2	3	2	2	3	2	3	2	-	2	3	2	3	2
CO5	3	-	-	2	3	2	2	2	2	2	2	-	2	3	2	3	2
Average	3	-	-	2	2.6	2	2	2.6	2	2.6	2	-	2	3	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER II

24BTP211 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

PREREQUISITE: The students should have basic knowledge about DNA extraction techniques.

COURSE OBJECTIVES (CO)

- 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 and microbial production.

COURSE OUTCOMES (COs)

On completion of the course, students are able to

COs	Course Outcomes	Blooms Level
CO1	Recall recombinant DNA techniques including restriction and digestion, transformation and PCR	Remember
CO2	Demonstrate DNA and RNA isolation from microbes, plants and animals	Understand
CO3	Utilize various blotting techniques	Apply
CO4	Classify the biosafety practices and guidelines in research	Analyze
CO5	Formulate the microbial enzymes mediated production of Wine and alcohol	Create

Recombinant DNA technology practical's **24 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 **24 HOURS**

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. Downstream processing by solvent extraction
6. Operation of fermenter (Demonstration)

TOTAL: 48 HOURS

TEXT BOOK:

1. Green, M. R. & Sambrook, J. (2012). *Molecular Cloning: A Laboratory Manual*. (4th ed.). Cold Spring Harbor Laboratory Press, New York, United States.
2. Kulandaivelu, S.& Janarthanan, S. (2012). *Practical Manual on Fermentation Technology*. IK International Publishers, New Delhi, India.

REFERENCE BOOK:

1. Greene, J.J.& Rao, V.B. (2001). *Recombinant DNA Principles and Methodologies.* (2nd ed.) CRC Press, Florida, United States.
2. Schuler, M.A. & Zielinski, R.E. (2012). *Methods in Plant Molecular Biology*. (1st ed.). Academic Press Publishers, New York, United States.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	3	2	3	3	3	3	-	-	-	3	-	-	3	2
CO2	3	-	-	3	2	3	3	3	3	-	-	-	3	-	-	3	2
CO3	2	-	-	2	2	2	2	2	2	-	-	-	2	-	-	3	2
CO4	3	-	-	3	2	3	3	3	3	-	-	-	3	-	-	3	2
CO5	3	-	-	3	2	3	3	3	3	-	-	-	3	-	-	3	2
Average	2.8	-	-	2.8	2	2.8	2.8	2.8	2.8	-	-	-	2.8	-	-	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER II

24BTP212 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

PREREQUISITE: The students should have basic knowledge about immune system and vaccines

COURSE OBJECTIVES (CO)

- To perform and understand basic immunological techniques.
- To acquire knowledge in immuno electrophoresis techniques for Diagnosis.
- To gain hands on experience on immunological experiments.

COURSE OUTCOMES (COs)

On completion of the course, students are able to

COs	Course Outcomes	Blooms Level
CO1	Define the basic immunological techniques and their principles.	Remember
CO2	Explain the preparation of samples for immuno technological analysis.	Understand
CO3	Experiment with antigen-antibody interactions using immuno diffusion methods.	Apply
CO4	Distinguish the antigen-antibody specificity in disease diagnostics.	Analyze
CO5	Test Western blotting techniques for analyzing the protein -protein interactions.	Create

Immuno-technology Practical's **48 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. Hemagglutination
7. WIDAL test
8. DOT-ELISA
9. ELISpot
10. Western blotting

TOTAL: 48 HOURS

TEXT BOOK:

1. Vashist, S. K. & Luong, J.H.T. (2018). *Handbook of Immuno assay Technologies: Approaches, Performances, and Applications* (First ed.). Academic Press.
2. Webley, W. (2017). Immunology Lab Manual (12th ed.). LAD Custom Publishing.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	3	2	3	3	3	3	-	-	-	3	-	-	3	2
CO2	3	-	-	3	2	3	3	3	3	-	-	-	3	-	-	3	2
CO3	2	-	-	2	2	2	2	2	2	-	-	-	2	-	-	3	2
CO4	3	-	-	3	2	3	3	3	3	-	-	-	3	-	-	3	2
CO5	3	-	-	3	2	3	3	3	3	-	-	-	3	-	-	3	2
Average	2.8	-	-	2.8	2	2.8	2.8	2.8	2.8	-	-	-	2.8	-	-	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

24BTP206 COMMUNITY ENGAGEMENT AND SOCIAL RESPONSIBILITY 2H-2C

Instruction Hours/week: L:2 T:0 P:0 **Marks:** Internal**:40** External**: 60 T**otal**:100**

PRE-REQUISITE: Not required **End Semester Exam:** 3 Hours

COURSE OBJECTIVES (CO):

- To gain insights into the structures, challenges, and opportunities within communities.
- To explore ethical frameworks and dilemmas related to community engagement and social responsibility.
- To develop skills in monitoring, evaluating, and reporting on the outcomes of community engagement efforts to ensure effectiveness and accountability.

COURSE OUTCOMES (COs):

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

COs	Course Outcomes	Blooms Level
CO1	Understand the concept, ethics, and spectrum of community engagement.	Understand
CO2	Recognize the significance in local community development and rural culture.	Understand
CO3	Know the rural development programs, institutions.	Understand
CO4	Analyze the role of local administration in fostering community involvement and social networking.	Analyze
CO5	Develop skills in conducting community engaged research with a focus on ethics, rural distress, poverty alleviation, and disaster mitigation.	Apply

UNIT I INTRODUCTION AND PRINCIPLES 7 HOURS

Concept, Ethics and Spectrum of Community engagement, Local community, Rural culture and Practice of community engagement - Stages, Components and Principles of community development, Utility of public resources. Contributions of self-help groups

UNIT II RURAL DEVELOPMENT 7 HOURS

Rural Development Programs and Rural institutions Local Administration and Community Involvement- Social contribution of community networking, Various government schemes. Programmes of community engagement and their evaluation.

UNIT III COMMUNITY AND RESEARCH 6 HOURS

Community Engaged Research and Ethics in Community Engaged Research Rural Distress, Rural Poverty, Impact of COVID-19 on Migrant Laborers, Mitigation of Disaster.

UNIT IV: AWARENESS PROGRAMME ON DISEASE MANAGEMENT 2 HOURS

Creation of awareness programme about disease management and Control.

UNIT V : PLANTATION 2 HOURS

Plantation and Conservation of tree species to create awareness about usage and plant conservation.

TOTAL: 24 HOURS

TEXT BOOK:

Hatcher, M. T. (2011). *Principles of Community Engagement*. 2nd Edition, NIH Publication No. 11-782.

WEBSITES:

1. https://youtu.be/-SQK9RGBt7o
2. https://www.uvm.edu/sites/default/files/community_engagement_handout.pdf (Community Engagement)
3. https://www.atsdr.cdc.gov/communityengagement/pce_concepts.html (Perspectives of Community)
4. https://egyankosh.ac.in/bitstream/123456789/59002/1/Unit1.pdf (community concepts)
5. https://sustainingcommunity.wordpress.com/2013/07/09/ethics-and-community-engagement/(Ethics of community engagement)
6. https://www.preservearticles.com/sociology/what-are-the-essential-elements-of-community/4558 (Elements of Community)
7. https://www.yourarticlelibrary.com/sociology/rural-sociology/rural-community-top-10-characteristics-of-the-rural-community-explained/34968 (features of rural community)
8. https://www.mapsofindia.com/my-india/government/schemes-for-rural-development-launched-by-government-of-india (Government programmes for rural development)
9. https://www.yourarticlelibrary.com/sociology/rural-sociology/rural-community-top-10-characteristics-of-the-rural-community-explained/34968 (rural lifestyle)
10. https://www.insightsonindia.com/social-justice/issues-related-to-rural-development/government-schemes-for-rural-development-in-india/ (schemes for rural development)
11. https://www.mpgkpdf.com/2021/09/community-development-plan-in-hindi.html?m=1
12. https://images.app.goo.gl/sNF2HMWCuCfkqYz56
13. https://images.app.goo.gl/VaMNNMEs77XyPMrP7

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	-	-	-	-	-	3	-	-	-	-	2	3	3	-	-	-	2
CO2	-	-	-	-	-	3	-	-	-	-	2	3	3	-	-	-	2
CO3	-	-	-	-	-	3	-	-	-	-	2	3	3	-	-	-	2
CO4	-	-	-	-	-	3	-	-	-	-	2	3	3	-	-	-	2
CO5	-	-	-	-	-	3	-	-	-	-	2	3	3	-	-	-	2
Average	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**2**	**3**	**3**	**-**	**-**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER II

JOURNAL PAPER ANALYSIS AND PRESENTATION 1H

SEMESTER III

24BTP301 **PLANT BIOTECHNOLOGY** **4H – 4C**

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

End Semester Exam: 3 Hours

PREREQUISITE: The students should have basic knowledge on plant tissue culture techniques.

COURSE OBJECTIVES (CO)

- To understand the fundamental knowledge on plant tissue culture techniques.
- To gain knowledge on production of haploid plants.
- To analyze the various methods of gene transfer and gene expression in plants for the production of transgenic plants.

COURSE OUTCOMES (COs)

On completion of the course, students are able to

COs	Course Outcomes	Blooms Level
CO1	Understand the fundamental knowledge on plant tissue culture techniques.	Understand
CO2	Observe the production of homozygous lines through haploidy.	Create
CO3	Implement gene transfer methods to develop transgenic plants.	Create
CO4	Inculcate the deep information of genetic engineering of transgenic plants.	Understand
CO5	Apply knowledge for the development of plant-based edible vaccines through enzyme engineering.	Apply

UNIT- I PLANT TISSUE CULTURE: **10 HOURS**

Tissue culture media–composition and preparation, Callus and suspension culture, soma clonal variation, micropropagation, organogenesis, somatic embryogenesis, Embryo culture and 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-II PLANT TRANSFORMATION TECHNIQUES: **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-III GENE CONSTRUCT FOR TRANSGENIC PLANTS: **10 HOURS**

Factors influencing transgene expression. Designing gene constructs - Promoters and polyA signals, Protein targeting signals, Plant selectable markers, Reporter genes. Positive selection, Selectable marker elimination, Transgene silencing, Strategies to avoid transgene silencing, Analysis of transgenic plants. Advanced technologies - cis genesis and intragenesis, RNAi technology, genome editing technology, CRISPR/Cas.

UNIT-IV PLANT SECONDARY METABOLITES PRODUCTION 10 HOURS

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. Product recovery.

UNIT- V APPLICATION OF GENETIC TRANSFORMATION: 8 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.

TOTAL: 48 HOURS

TEXT BOOK:

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 Biotechnology and biodiversity conservation.* Jodhpur: Agrobios.
5. Stewart, N.C. (2016). *Plant Biotechnology and Genetics.*2nd ed. New Jersey: John Wiley & Sons, Inc.

REFERENCE BOOK:

1. Halford, N., & Halford, N. G. (2007). *Plant Biotechnology: Current and Future Applications of Genetically Modified Crops*. New Jersey: John Wiley & Sons.
2. Nirmala, C.B., Rajalakshmi, G., & Karthik, C. (2009). *Plant Biotechnology*. Chennai: MJP Publication

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO2	3	-	-	2	1	2	-	3	-	-	-	-	2	-	2	3	2
CO3	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO4	3	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO5	3	-	-	2	1	2	-	3	-	-	-	-	2	-	2	3	2
Average	3	-	-	2	1	2	-	2.4	-	-	-	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER–III

24BTP302 **ANIMAL BIOTECHNOLOGY** **4H – 4C**

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

End Semester Exam:3Hours

PREREQUISITE: The students should have basic knowledge on animal cell culture techniques.

COURSE OBJECTIVES (CO)

The main objectives of the course are

- To understand the fundamental knowledge on animal tissue culture.
- To gain knowledge about various methods of gene transfer in animals cells for various industrial applications.
- To understand the processes involved in gene transfer for the production of transgenic animals.

COURSE OUTCOMES (COs)

On completion of the course, students are able to

COs	Course Outcomes	Blooms Level
CO1	List the media and growth conditions required for animal cell culture	Remember
CO2	Interpret the deep information about various methods of gene transfer in animal cell culture for various industrial applications.	Understand
CO3	Build strong knowledge on transgenic animal production for various applications.	Apply
CO4	Analyze the quality parameters for the production of antibody through transgenic animals.	Analyze
CO5	Construct the various steps involved in the development of transgenic animals.	Create

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. FISH Hybridization, Blotting techniques. Molecular markers in transgene identification.

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

TOTAL: 48 HOURS

TEXT BOOK:

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 (3rd ed.).UK: Black well Science.
4. Gordon, I. (2003). Laboratory Production of Cattle Embryos (2nd ed.). New Delhi: CAB International.

REFERENCE BOOK:

1. Yagasaki, K., Miura, Y., Hatori, M.& Nomura, Y. (2008). Animal Cell Technology: Basic and Applied Aspects (Vols13). New York: Springer- Verlag.
2. Primrose, S.B., Twyman, R.M., & Old, R.W. (2001). Principles of Gene Manipulation (6th ed.). Germany: Blackwell Science Publishing Company.
3. Portner, R. (2014). Animal Cell Biotechnology: Methods and Protocols. 3rd edition. New York: Springer-Verlag.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	3	1	2	-	2	-	-	-	-	2	-	2	3	2
CO2	3	-	-	3	1	2	-	3	-	-	-	-	2	-	2	3	2
CO3	2	-	-	2	1	2	-	2	-	-	-	-	2	-	2	3	2
CO4	3	-	-	3	1	2	-	2	-	-	-	-	2	-	2	3	2
CO5	3	-	-	3	1	2	-	3	-	-	-	-	2	-	2	3	2
Average	2.8	-	-	2.8	1	2	-	2.8	-	-	-	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER III

24BTP303 GENOMICS, PROTEOMICS AND BIOINFORMATICS 4H – 4C

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

End Semester Exam: 3Hours

PREREQUISITE: The students should have basic knowledge on fundamentals of genomics, proteomics and bioinformatics

COURSE OBJECTIVES (CO)

- To import the basic and recent developments in the field of genome sequencing and genome mapping.
- To describe the sequence and structural alignments of proteins.
- To use bioinformatics techniques to construct phylogenetic tree for species identifications.

COURSE OUTCOMES (COs)

On completion of the course, students are able to

COs	Course Outcomes	Blooms Level
CO1	Label the applications of genome sequencing and genome mapping.	Remember
CO2	Develop the knowledge on proteomic data analysis.	Apply
CO3	Illustrate the omics data bases for genomic and proteomic data analysis	Understand
CO4	Develop sequence and structural alignments using bioinformatics tools.	Create
CO5	Analyze the phylogenetic tree construction for species identification.	Analyze

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).

TOTAL: 48 HOURS

TEXT BOOK:

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*(2nded.).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-A Student's Companion. Springer Publishers, New York, United States.
5. Lesk, A. M. (2014). *Introduction to Bioinformatics* (4th ed.). Oxford University Press, Oxford, United Kingdom.

REFERENCE BOOK:

1. Mount, D.W. (2005). *Bioinformatics –Sequence and Genome Analysis* (2nd ed.). CBS Publishers, CSHL Press, New York, United States.
2. Palzkill, T. (2007). *Proteomics*. Springer Publishers, New York, United States.
3. Primrose, SB & Twyman, R. (2006). *Principles of genome analysis and Genomics*. Wiley-Blackwell Publishers, New Jersey, United States.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	3	1	2	-	2	2	2	2	-	2	-	2	3	2
CO2	3	-	-	3	1	2	-	3	3	3	3	-	2	-	2	3	2
CO3	3	-	-	3	1	2	-	2	2	2	2	-	2	-	2	3	2
CO4	3	-	-	3	1	2	-	2	2	2	2	-	2	-	2	3	2
CO5	3	-	-	2	1	2	-	3	3	3	3	-	2	-	2	3	2
Average	3	-	-	2.8	1	2	-	2.8	2.8	2.8	2.8	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER III

24BTP304 MOLECULAR AND DEVELOPMENTAL BIOLOGY 4H-4C

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

End Semester Exam: 3Hours

PREREQUISITE: The students should have basic knowledge about fundamental process of cell and its developments.

COURSE OBJECTIVES (CO)

- To emphasize the basic knowledge about the structure and functions of nucleic acids and proteins.
- To gain the knowledge on transcription factors involved in RNA processing.
- To know about the regulation of gene expression and translation process for protein production.

COURSE OUTCOMES (COs)

On completion of the course, students are able to

COs	Course Outcomes	Blooms Level
CO1	List the functions of nucleic acids and proteins.	Remember
CO2	Acquire an in-depth knowledge of chemical and molecular processes that occur within and between the cells.	Understand
CO3	Build an insight into the mechanisms behind gene regulations.	Apply
CO4	Compare about mechanism behind translation and transcription.	Analyze
CO5	Develop knowledge about developmental biology and metamorphosis.	Create

UNIT –I NUCLEIC ACID ORGANIZATION 10 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: 10 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: 10 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: 10 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.

TOTAL: 48 HOURS

TEXT BOOK:

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.

REFERENCE BOOK:

1. Gilbert, Scott's. 10th edition (2014). Developmental biology. Sinauer Association, Inc., Publishers.2.
2. 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.
3. De Robertis, E.D.P., & De Robertis, E.M.F. (2006). Cell and Molecular Biology (8th ed.). Lippin cott Williams and Wilkins, Philadelphia

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	3	1	2	2	2	2	-	-	-	2	-	2	3	2
CO2	3	-	-	3	1	2	2	3	3	-	-	-	2	-	2	3	2
CO3	3	-	-	3	1	2	2	2	2	-	-	-	2	-	2	3	2
CO4	3	-	-	3	1	2	2	2	2	-	-	-	2	-	2	3	2
CO5	3	-	-	2	1	2	2	3	3	-	-	-	2	-	2	3	2
Average	3	-	-	2.8	1	2	2	2.8	2.8	-	-	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER III

24BTP305A FOOD AND AGRICULTURAL BIOTECHNOLOGY 4H – 4C

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

End Semester Exam:3Hours

PREREQUISITE: The students should have basic knowledge on food and agricultural process.

COURSE OBJECTIVES (CO)

- To understand the concepts of food biotechnology along with role of microbes in fermentation
- To understand the role of insects in crop management
- To obtain strong knowledge on Biotechnology approach in crop production

COURSE OUTCOMES (COs)

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	Acquire knowledge about activities of microorganisms in food and role of intrinsic and extrinsic factors on growth and survival of microorganisms in foods, food spoilage and preservation	Analyze
CO3	Learn the various technological aspects of fermented products such as beer and wine in larger scale production	Understand
CO4	Know the interactions of insects in crop development as well damage.	Understand
CO5	Identify ways to improve productivity of crop plants	Apply

Unit –I FOOD MICROBIOLOGY **10 HOURS**

Development and formulation of probiotic foods. Fermented foods–Types, changes during fermentation, nutritive value of fermented foods. 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 – II : FOOD BORNE DISEASES: **10 HOURS**

Definition, Classification (Food borne intoxications & Food borne infections), neurolathyrism, aflatoxins, Ergotism, Epidemic dropsy, Typhoid fever, Salmonellosis, Staphylococcal intoxication, Botulism, Bacillus cereus food poisoning, E.coli diarrhea, Cholera, Shigellosis, Brucellosis, Food poisoning: Types of food poisoning, method of investigation of food poisoning, prevention and control- food sanitation, refrigeration, surveillance. Food handlers: medical examination of food handlers, infections transmitted by food handlers, education of food handlers. Adulteration of foods: Health hazards

Unit –III FERMENTED FOODS: 10 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 BASICS OF CROP PROTECTION: 10 HOURS

Basics of Crop Protection Importance of insects in agriculture; Insects diversity; General symptoms of insects attack; Principles and methods of insect-pests management; Integrated Pest Management concept (IPM); Concept of disease in plants; Nature and classification of plant diseases.

Unit V CROP PRODUCTION TECHNOLOGY FOR MAJOR CROPS: 8 HOURS

Rice, wheat, cotton, rapeseed and mustard; Management of important insect-pests of major crops: Rice, wheat, cotton, rapeseed and mustard; Management of key diseases of major crops: Rice, wheat, cotton, rapeseed and mustard.

TOTAL: 48 HOURS

TEXT BOOK:

1. Adam, M.R.& Moss, M.O. (2018). *Food Microbiology*. New Age International Publishers, New Delhi, India.
2. Bhatia, S.C. (2017). *Food Biotechnology*. WPI Publishers, New Delhi, India.
3. Frazier, W.C., Westhoff, D.C., & Vanitha, N.M. (2017). *Food Microbiology* (5th ed.).Mc Graw- Hill Education/Medical, London, United Kingdom.
4. T. Jha and B. Ghosh. (2006) Plant Tissue culture: Basic and applied, Wiley Publishers.
5. R. Keshavachandra and K.V. Peter. (2006). Plant Biotechnology: Methods in tissue culture and gene transfer. New Age International Publishers, New Delhi, India.

REFERENCE BOOK:

1. Harrigan, W.F. (2013). *Laboratory methods in Food Microbiology* (3rd ed.). Elsevier Publishers, Amsterdam, Netherlands.
2. Jain, K.S. & Jain, A.V. (2017). *Foreign Trade - Theory, Procedures, Practices and Documentation*(7thed.). Himalaya Publishing House, Mumbai, India.
3. Jay, J.M., Loessner, J.M., & Golden, A.D. (2008). *Modern Food Microbiology* (7th ed.). Springer Publishers, New York, United States.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	3	1	2	2	2	2	-	-	-	2	-	2	3	2
CO2	3	-	-	3	1	2	2	3	3	-	-	-	2	-	2	3	2
CO3	3	-	-	3	1	2	2	2	2	-	-	-	2	-	2	3	2
CO4	3	-	-	3	1	2	2	2	2	-	-	-	2	-	2	3	2
CO5	3	-	-	2	1	2	2	3	3	-	-	-	2	-	2	3	2
Average	3	-	-	2.8	1	2	2	2.8	2.8	-	-	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER III

24BTP305B ENVIRONMENTAL BIOTECHNOLOGY 4H– 4C

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

End Semester Exam: 3Hours

PREREQUISITE: The students should have basic knowledge on fundamentals of environment and ecosystem

COURSE OBJECTIVES (CO)

- To understand the various components and fundamentals of ecosystem.
- To obtain knowledge on the sources for pollution and its bio remedial measures.
- To attain key concepts on sewage and waste water treatment.

COURSE OUTCOMES (COs)

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.	Apply
CO3	Appreciate recent approaches to biological waste water treatment.	Analyze
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

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.

Toral Hours: 48

TEXT BOOK:

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, New Delhi
3. Evans, G.M., & Furlong, J.C., (2003). *Environmental Biotechnology: Theory and Applications*. (2nd ed.) England: John Wiley & Sons Ltd.
4. Jordening, H.J., & Winter, J. (2005). *Environmental Biotechnology*. Germany: Wiley-VCH Verlag GmbH& Co.

REFERENCE BOOK:

1. Mara, D. (2003). *The Hand book of Water and Wastewater Microbiology*. (1st ed.) London: Academic Press.
2. Wang, L.K. (2010), Environmental Biotechnology, (1st ed.), A Product of Human a Press.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	3	1	2	2	2	2	-	-	-	2	-	2	3	2
CO2	3	-	-	3	1	2	2	3	3	-	-	-	2	-	2	3	2
CO3	3	-	-	3	1	2	2	2	2	-	-	-	2	-	2	3	2
CO4	3	-	-	3	1	2	2	2	2	-	-	-	2	-	2	3	2
CO5	3	-	-	2	1	2	2	3	3	-	-	-	2	-	2	3	2
Average	3	-	-	2.8	1	2	2	2.8	2.8	-	-	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER III

24BTP305C PHARMACEUTICAL BIOTECHNOLOGY 4H – 4C

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

End Semester Exam: 3 Hours

PREREQUISITE: The students should have basic knowledge on fundamentals of pharmaceutical products

COURSE OBJECTIVES (CO)

- To understand the various components and fundamentals pharmaceutical products.
- To understand novel formulation approaches for better delivery of biotechnology-derived drugs.
- To attain knowledge on drug safety and effectiveness.

COURSE OUTCOMES (COs)

On completion of the course, students are able to

COs	Course Outcomes	Blooms Level
CO1	Define different parameters used pharmaceutical products development.	Remember
CO2	Determine parameters related to stability and formulation of biotechnology-derived drugs.	Evaluate
CO3	Discuss quality control procedures related to pharmaceutical products in pharmaceutical industries.	Create
CO4	Apply the knowledge of physicochemical properties novel drug designing and development.	Understand
CO5	Demonstrate novel formulation methods for better delivery of biotechnology derived drugs.	Apply

UNIT –I INTRODUCTION: 10 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: 10 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: 10 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: 10 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.

TOTAL: 48 HOURS

TEXT BOOK:

1. Abraham, D.J. & Rotella, D.P. (2010). *Burger's Medicinal Chemistry, Drug Discovery and Development*(7th ed.). Wiley Publishers, New York, United States.
2. Banga, A.K. (2015). *Therapeutic Peptides and Proteins: Formulation, Processing, and Delivery Systems* (3rd ed.). CRC Press, Florida, United States.
3. Bhagavan, N.V. & Ha, C-E. (2015). *Essential of Medical Biochemistry* (2nd ed.). Academic Press Publishers, New York, United States.
4. Crommelin, D.J.A., Sindelar, R.D. & Meibohm, B. (2019). *Pharmaceutical Biotechnology: Fundamentals and Applications* (5th ed.). Springer Publishers, New York, United States.

REFERENCE BOOK:

1. Golan, D. E., Armstrong, E.J., & Armstrong, A.W. (2016). *Principles of Pharmacology: The Pathophysiologic Basis of Drug Therapy* (4th ed.). LWW Publishers, Pennsylvania, United States.
2. Rho, J.P. & Louie, S.G. (2003). *Handbook of Pharmaceutical Biotechnology*(1sted.). CRC Press, Florida, United States.
3. Satoskar, R.S., Rage, N.N., Tripathi, R.K., & Bhandarkar, S.D. (2017). *Pharmacology and Pharmacotherapeutics* (25th ed.). Elsevier India Publishers, Chennai, India.
4. Sethi, P.D. (2008). *Quantitative Analysis of Drugs in Pharmaceutical Formulations* (3rd ed.). CBS Publishers and Distributers, New Delhi, India.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	3	1	2	2	2	2	-	-	-	2	-	2	3	2
CO2	3	-	-	3	1	2	2	3	3	-	-	-	2	-	2	3	2
CO3	3	-	-	3	1	2	2	2	2	-	-	-	2	-	2	3	2
CO4	3	-	-	3	1	2	2	2	2	-	-	-	2	-	2	3	2
CO5	3	-	-	2	1	2	2	3	3	-	-	-	2	-	2	3	2
Average	3	-	-	2.8	1	2	2	2.8	2.8	-	-	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER III

24BTP311 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

PREREQUISITE: The students should have basic knowledge on fundamentals of plant and animal biotechnology experiments

COURSE OBJECTIVES (CO)

- To gain hands-on experience and to learn the methods and principles of plant and animal biotechnology experiments
- To perform invitro seed germination, synthetic seed production and micropropagation from plant parts
- To analyze agrobacterium-mediated gene transformation for production of value added products

COURSE OUTCOMES (COs)

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	Remember
CO2	To support methodologies in plant and animal tissue/cell culture	Evaluate
CO3	Describe basic gene transfer technologies in plants	Create
CO4	Designate problems associated with plant and animal tissue culture	Understand
CO5	Join as lab manager or key scientist in plant and animal biotechnological research institute and industries.	Apply

Plant Tissue Culture Practical's **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 practical's **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

TOTAL : 48 HOURS

TEXT BOOK:

1. Bhojwani, S.S.& Dantu, P.K. (2013). *Plant Tissue Culture: An Introductory Text and Practice.* Springer Publishers, New York, United States.
2. Butler, M. (2003). *Animal cell culture and technology: The basics* (2nd ed.). Taylor & Francis Publishers, Abingdon, United Kingdom.
3. Slater, A., Scott, N.W. &Fowler, M.R. (2008). *Plant Biotechnology: The Genetic Manipulation of plants* (2nd ed.). Oxford University Press, Oxford, United Kingdom.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	3	1	2	2	2	2	-	-	-	2	-	2	3	2
CO2	3	-	-	3	1	2	2	3	3	-	-	-	2	-	2	3	2
CO3	3	-	-	3	1	2	2	2	2	-	-	-	2	-	2	3	2
CO4	3	-	-	3	1	2	2	2	2	-	-	-	2	-	2	3	2
CO5	3	-	-	2	1	2	2	3	3	-	-	-	2	-	2	3	2
Average	3	-	-	2.8	1	2	2	2.8	2.8	-	-	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER III

24BTP312 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

PREREQUISITE: The students should have basic knowledge about BIOEDIT, MEGA, PHYLIP, ITOL.

COURSE OBJECTIVES (CO)

- To give knowledge on genomics, proteomics and bioinformatics and their application
- To understand and analyze protein/nucleotide sequences and to predict its3D structure
- To comprehend the various online databases for submitting and retrieving data

COURSE OUTCOMES (COs)

On completion of the course, students are able to

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

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

TOTAL: 36HOURS

TEXT BOOK:

1. Baxevanis, A.D.& Ouellette, B.F. (2001). *Bioinformatics–A practical guide to the analyze of genes and proteins*(2nded.). Wiley-Blackwell Publishers, New York, United States.
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). *An Introduction to Chemoinformatics*. Springer Publishers, New York, United States.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	3	1	2	2	2	2	-	-	-	2	-	2	3	2
CO2	3	-	-	3	1	2	2	3	3	-	-	-	2	-	2	3	2
CO3	3	-	-	3	1	2	2	2	2	-	-	-	2	-	2	3	2
CO4	3	-	-	3	1	2	2	2	2	-	-	-	2	-	2	3	2
CO5	3	-	-	2	1	2	2	3	3	-	-	-	2	-	2	3	2
Average	3	-	-	2.8	1	2	2	2.8	2.8	-	-	-	2	-	2	3	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

SEMESTER III

24BTPOE301 **NUTRITION AND DIETETICS** **3H–2C**

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

End Semester Exam: 3 Hours

PREREQUISITE: Student should know about basics of food, its nutrients and their relationship to health

COURSE OBJECTIVES (CO)

- To understand the fundamentals of food, nutrients and their relationship to health
- To respect to deriving maximum benefit from available food resources
- To understand of the consequences of vitamin and mineral deficiency/excess of vitamin

COURSE OUTCOMES (COs)

On completion of the course, students are able to

COs	Course Outcomes	Blooms Level
CO1	Name the fundamentals of nutrition and their relationship to health	Remember
CO2	Learn to derive maximum benefits from available food resources	Understand
CO3	Identify the consequences of vitamin and mineral deficiency/excess of vitamin	Apply
CO4	Analyze the importance of nutrition in adult age	Analyze
CO5	Assess about nutrition deficiency diseases and their consequences	Evaluate

UNIT I BASIC CONCEPTS IN FOOD AND NUTRITION: **5 HOURS**

Understanding relationship between food, nutrition and health, Functions of food-Physiological, psychological and social. Dietary guidelines for Indians and food pyramid

UNIT II NUTRIENTS: **5 HOURS**

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

UNIT III NUTRITION DURING THE ADULT YEARS: **10 HOURS**

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, Breast feeding, Assessment and management of moderate and severe malnutrition among children, Child health and morbidity, neonatal, infant and child mortality

UNIT IV INTRODUCTION TO NUTRITIONAL DEFICIENCY DISEASES: **6 HOURS**

Causes, symptoms, treatment, prevention of the following: Protein Energy Malnutrition (PEM), Vitamin A Deficiency (VAD), Iron Deficiency Anemia (IDA), Iodine Deficiency Disorders (IDD), Zinc Deficiency, Flurosis Nutritional needs during pregnancy, common disorders of pregnancy (Anemia, 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 DIETETICS: **10 HOURS**

Dietary and stress management. Dietary recommendations of WHO. Diet for diabetes mellitus-Nutrition recommendations for patient with diabetes, Meal planning, Diet for Cardiovascular Diseases -Dietary management and general guidelines for coronary heart disease, Diet for cancers at various sites in the human body, diet therapy, managing eating problems during treatment. Hormonal imbalance - Poly cystic ovarian syndrome, causes of hormonal imbalance. Diet management.

Total Hours : 36 Hours

TEXT BOOK:

1. Srilakshmi. B. (2015) Food Science: New Age International (P) Ltd. Publishers. 6nd Edition., New Delhi
2. Swaminathan. M. (2008). Essential of Food and Nutrition Vol II The Bangalore Printing and Publishing Co. Ltd., Bangalore.

REFERENCE BOOK

1. Garrow, J.S., and James, W.P.T., (2000). Human Nutrition & Dietetics, Longman Group, UK.
2. Gordon M, Wardlaw and Paul M. (2012). Perspectives in Nutrition: U.S.A. McGraw Hill Publishers. 9th Edition. New Delhi
3. Sharma, R (2004). Diet Management,3rd ed, Reed Elsevier India Private Limited, Chennai.
4. Srilakshmi. B. (2014) Nutrition Science: New Age International(P)Ltd. Publishers. 4th ed. New Delhi.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	-	-	-	-	2	2	-	2	2	2	-	2	2	2
CO2	3	-	-	-	-	-	-	2	2	-	2	2	2	-	2	2	2
CO3	3	-	-	-	-	-	-	2	2	-	2	2	2	-	2	2	2
CO4	3	-	-	-	-	-	-	2	2	-	2	2	2	-	2	2	2
CO5	3	-	-	-	-	-	-	2	2	-	2	2	2	-	2	2	2
Avg	3	-	-	-	-	-	-	2	2	-	2	2	2	-	2	2	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

Semester III

24MBAPOE301 ORGANIZATIONAL BEHAVIOUR 3H-2C

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

End Semester Exam: 3 Hours

PREREQUISITE: Not Required

COURSE OBJECTIVES (CO):

- 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 evaluate how to perform in group and team and how to manage the power, politics and conflict.
- To recognize the importance of organizational culture and organizational change, group and team work to managing the conflict between members of the organization

COURSE OUTCOMES (COs):

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

COs	Course Outcomes	Blooms Level
CO1	Connect organizational behavior issues in the context of the organizational behavior theories and concepts.	Understand
CO2	Assess the behavior of the individuals and groups in oorganization and manage the stress.	Apply
CO3	Categorize team, power, politics and conflict arising between the members.	Analyze
CO4	Explain how organizational change and culture affect the working relationship within organizations.	Evaluate
CO5	Plan and exhibit the communications kills to convey the thoughts and ideas of case analysis to the individuals and group.	Analyze

UNIT I ORGANIZATION BEHAVIOR: INTRODUCTION 7 HOURS

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

UNIT II BEHAVIOUR AND PERSONALITY 7 HOURS

Attitudes – Sources - Types - Functions of Attitudes – Attitude and Job satisfaction, Emotions and Moods – Emotional Intelligence – Organization Behavior Applications of Emotions and Moods, Learning – Theories of Learning. Personality – Determinants of personality- Theories of Personality - psycho-analytical, social learning, job-fit, and trait theories.

UNIT III PERCEPTION 7 HOURS

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

UNIT IV GROUP AND STRESS MANAGEMENT 7 HOURS

Foundation of Group Behavior - Concept of Group - 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 AND STRESS MANAGEMENT 8 HOURS

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

TOTAL: 36 HOURS

TEXT BOOKS:

1. Fred Luthans. (2017). *Organizational Behavior: An Evidence - Based Approach*, 12th ed, Mcgraw Hill Education, New Delhi.
2. Steven Mcshane and Mary Ann Von Glinow (2017), *Organizational Behavior*, 6th ed, McGraw Hill Education, New Delhi
3. Robbins, S. P, and Judge, T. A. (2016). *Organizational Behaviour*, 16th edition, Prentice Hall of India, New Delhi

REFERENCE BOOKS:

1.Laurie J. Mullins (2016). *Management and Organizational behavior*, 10th Edition, Pearson Education, New Delhi
2.Robbins, S. P, and Judge, T. A. (2016). *Essentials of Organizational Behavior*,13th Edition, Pearson Education

WEB SITES:

https://nptel.ac.in/courses/110/105/110105033/

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	
CO3	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	2	-
Average	**-**	**-**	**2**	**3**	**2**		**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.5**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester III

24PHPOE301 ELECTRICAL APPLIANCES AND SERVICING 3H – 2C

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

End Semester Exam: 3 Hours

PREREQUISITE: Not Required

COURSE OBJECTIVES (CO):

- To create awareness about types and handling of domestic appliances
- To acquire knowledge about principle of operation, working and application of various domestic appliances.
- To gain the skills in assembly, repair, installation, testing and maintenance of domestic appliances.
- To acquire skills in entrepreneurship

COURSE OUTCOMES (COs):

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

COs	Course Outcomes	Blooms Level
CO1	Repair maintenance of the basic electrical and electronics appliances	Apply
CO2	Identification to protective devices	Understand
CO3	Repair and maintenance of the split Vacuum Cleaner and washing machine	Analysis
CO4	Repair and maintenance of the electric fan & hair drier	Apply
CO5	Acquire knowledge about tools, equipment and Instruments	Understand

UNIT I INSTRUMENTS AND TESTING 8 HOURS

Introduction – voltage tester screwdriver – continuing test – insulation test – measurement of power for dc & ac circuits. Electrical Cooking Appliances introduction – types – construction – electric toaster – types – automatic and non-automatic. Electric Iron Box types – non-automatic – automatic – construction and working – comparison – trouble shooting – Steam iron box.

UNIT II WATER HEATERS & COFFEE MAKERS 7 HOURS

Water heater – function – types – electric kettle – immersion water heater – construction and working – storage water heaters – non pressure type – pressure type – construction and working – repairs & remedies – coffee maker – types – construction and working of percolator type.

UNIT III ELECTRIC MIXER & EGG BEATERS 7 HOURS

Electric maker – function and its construction – general operating instruction – caution – cleaning – repairs and remedies – egg beaters – hand operated crank type – electric type and its construction.

UNIT IV VACUUM CLEANER AND WASHING MACHINE 7 HOURS

Vacuum cleaner – function – principle – main components – features – types - working – accessories - filters – repairing. washing machine – function – types – semi and fully automatic – top and front loading – washing technique – working

cycle – construction and working of washing machine – comparison of top and front-loading machines – problems and remedies.

UNIT V ELECTRIC FAN & HAIR DRIER **7 HOURS**

Fan – function – terminology – construction and working of ceiling & table fans –exhaust fan – general fault and remedy. hair drier – function – types – construction and working – safety features – repairs & remedies.

TOTAL:36 HOURS

TEXT BOOKS:

1. *Electrical Practical, Directorate General of employment & training (DGET),*(2018) .Arihant Publisher.
2. *Handbook of Repair and Maintenance of Domestic Electronics Appliances handbook* By Shashi Bhushan Sinha, BPB Publications.

REFERENCE BOOKS:

1. Dixon and Graham, *Electrical Appliance Manual–Hardcover,* ISBN 13: 9781859608005.
2. Graham and Dixon, (1995). *Electrical Appliances: The Complete Guide to the Maintenance and Repair of Domestic Electrical Appliances* (Haynes for Home DIY S.).
3. Shashi Bhushan Sinha, *Handbook of Repair and Maintenance of Domestic Electronics Appliances.*

WEBSITES:

1. https://alison.com/courses?query=Electrical%20Appliance%20and%20Servicings#.
2. https://www.scribd.com/document/269725441/Electrical-Appliances-PDF.
3. https://www.unitec.ac.nz/career-and-study-options/electrical-and-electronics-engineering/electrical-appliance-serviceperson-eas.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	-	-	3	-	-	-	-	-	1	-	2	-	2	-	-	2	-
CO2	-	-	3	-	1	-	-	-	1	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-		2	-	-	-	-	-	2	-	-	-	2
CO5	3	-	3	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Average	**3**	**-**	**3**	**-**	**1**	**1**	**2**	**-**	**1**	**-**	**2**	**-**	**2**	**-**	**-**	**2**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24CAPOE301 ROBOTICS PROCESS AUTOMATION 3H - 2C

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

PREREQUISITE: Not Required

COURSE OBJECTIVES (CO):

- To enable the understanding of RPA and the types of variables.
- To create expertism in handling the User Events and various types of Exceptions and strategies.
- To demonstrate the Deployment of the Robot and to maintain the connection.

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Explain the RPA and the ability to differentiate it from other types of automation.	Understand
CO2	Analyze the different types of variables, Control Flow and data manipulation techniques.	Analyze
CO3	Summarize Image, Text and Data Tables Automation.	Understand
CO4	Evaluate the User Events and its types of Exceptions and strategies.	Evaluate
CO5	Illustrate the deployment of the robot and to maintain the connection.	Apply

UNIT I INTRODUCTION TO ROBOTIC PROCESS AUTOMATION 8 HOURS

Scope and techniques of automation, Robotic process automation - What can RPA do?, Benefits of RPA, Components of RPA, RPA platforms, The future of automation. RPA Basics: History of Automation - What is RPA - RPA vs Automation - Processes & Flowcharts - Programming Constructs in RPA - What Processes can be Automated - Types of Bots - Workloads which can be automated - RPA Advanced Concepts - Standardization of processes - RPA Development methodologies - Difference from SDLC - Robotic control flow architecture - RPA business case - RPA Team - Process Design Document/Solution Design Document – Industries best suited for RPA - Risks & Challenges with RPA - RPA and emerging ecosystem.

UNIT II RPA TOOL INTRODUCTION AND BASICS 7 HOURS

Introduction -The User Interface - Variables - Managing Variables - Naming Best Practices - The Variables Panel - Generic Value Variables - Text Variables True or False Variables - Number Variables - Array Variables - Date and Time Variables Data Table Variables - Managing Arguments - Naming Best Practices - The Arguments Panel - Using Arguments - About Imported Namespaces - Importing New Namespaces- Control Flow - Control Flow Introduction - If Else Statements - Loops - Advanced Control Flow - Sequences - Flowcharts - About Control Flow - Control Flow Activities - The Assign Activity - The Delay Activity - The Do While Activity - The If Activity - The Switch Activity - The While Activity - The For Each Activity - The Break Activity - Data Manipulation- Data Manipulation Introduction - Scalar variables, collections and Tables -Text Manipulation - Data Manipulation - Gathering and Assembling Data

UNIT III ADVANCED AUTOMATION CONCEPTS & TECHNIQUES 7 HOURS

Recording Introduction - Basic and Desktop Recording - Web Recording - Input/Output Methods - Screen Scraping - Data Scraping - Scraping advanced techniques - Selectors - Defining and Assessing Selectors - Customization - Debugging - Dynamic Selectors - Partial Selectors - RPA Challenge - Image, Text & Advanced Citrix Automation - Introduction to Image & Text Automation - Image based automation - Keyboard based automation - Information Retrieval - Advanced Citrix Automation challenges - Best Practices - Using tab for Images - Starting Apps - Excel DataTables & PDF - Data Tables in RPA - Excel and Data Table basics

- Data Manipulation in excel – Extracting Data from PDF - Extracting a single piece of data - Anchors - Using anchors in PDF.

UNIT IV HANDLING USER EVENTS & ASSISTANT BOTS, EXCEPTION HANDLING 7 HOURS

What are assistant bots? - Monitoring system event triggers - Hotkey trigger - Mouse trigger - System trigger - Monitoring image and element triggers - An example of monitoring email - Example of monitoring a copying event and blocking it - Launching an assistant bot on a keyboard event. Exception Handling -Debugging and Exception Handling - Debugging Tools - Strategies for solving issues - Catching errors.

UNIT V - DEPLOYING AND MAINTAINING THE BOT 7 HOURS

Publishing using publish utility - Creation of Server - Using Server to control the bots - Creating a provision Robotfrom the Server - Connecting a Robot to Server - Deploy the Robot to Server - Publishing and managing updates - Managing packages - Uploading packages - Deleting packages.

TOTAL: 36 HOURS

TEXT BOOKS:

1. Alok Mani Tripathi. (2018). *Learning Robotic Process Automation*, Packt Publishing.
2. Frank Casale , Rebecca Dilla, Heidi Jaynes , Lauren Livingston.(2015). *Introduction to Robotic Process Automation:a Primer*, Institute of Robotic Process Automation,1st Edition.
3. Richard Murdoch. (2018). *Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant*, Independently Published, 1st Edition.

REFERENCE BOOKS:

1. Srikanth Merinda. (2018). *Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation*, Consulting Opportunity Holdings LLC, 1st Edition.
2. Lim Mei Ying. (2018). *Robotic Process Automation with Blue Prism Quick Start Guide: Create software robots and automate business processes*, Packt Publishing, 1st Edition.

WEBSITE LINKS:

1. https://www.uipath.com/rpa/robotic-process-automation
2. https://www.academy.uipath.com

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	3	-	-	-		2	-	-	2	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	3	-	-	3	-	-	-	-	-	-	-	-
CO3	-	-	-	3	-	-	2	-	3	-	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	2	1	2	-	-	-	-	-	-	-	-
CO5	-	2	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	**2.5**	**2**	**1**	**2.5**	**-**	**2.5**	**2**	**1**	**2.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester III

24CSPOE301 **CYBER FORENSICS** **3H – 2C**

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

End Semester Exam: 3 Hours

PREREQUISITE:

- Basics of Cyber Security.

COURSE OBJECTIVES (CO):

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

COURSE OUTCOMES (COs):

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

COs	Course Outcomes	Blooms Level
CO1	Explain various investigation procedures and summarize duplication of digital evidence.	Evaluate
CO2	Apply the knowledge of digital evidences.	Apply
CO3	Design and develop various forensics tools and analyse the network forensics.	Analyze
CO4	Determine the systematic study of high-tech forensics	Evaluate
CO5	Analyze and validate digital evidence data	Analyze

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.

TOTAL:36 HOURS

TEXT BOOKS:

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*, 1st Edition, Academic Press.
3. John R Vacca, (2016). *Computer Forensics*, 2nd Edition, Cengage Learning.

REFERENCE BOOKS:

1. John R. Vacca, (2005), *Computer Forensics: Computer Crime Scene Investigation*, 2nd Edition Cengage Learning.
2. Marjie T Britz, (2008), *Computer Forensics and Cyber Crime: An Introduction*, 2nd Edition, Pearson Education.
3. Mari E-Helen Maras, (2014). *Computer Forensics: Cybercriminals, Laws, and Evidence*, 2nd Edition Jones & Bartlett Learning.

WEBSITES:

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.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	-	-	3	-	-	-	-	-	-	-	2	-	-	-	-	2	-
CO2	-	-	3	-	1	-	-	-	-	-	-	-	-	-	-	-	2
CO3	3	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-		2	-	-	-	-	-	-	-	-	-	-
CO5	3	-	3	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Average	**3**	**-**	**3**	**-**	**1**	**1**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**2**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

M.Com. **2024-2025**

Semester III

24CMPOE301 **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

PREREQUISITE: Basic understanding of financial management principles.

COURSE OBJECTIVES(CO):

- To familiarize students with the concept of Investment Planning and its methods.
- To examine the scope and methods of Personal Tax Planning.
- To analyze Insurance Planning and its relevance.

COURSE OUTCOMES(COs):

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 INTRODUCTION TO FINANCIAL PLANNING 7 HOURS

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 INVESTMENT PLANNING 7 HOURS

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 PERSONAL TAX PLANNING 7 HOURS

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 INSURANCE PLANNING 7 HOURS

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

UNIT V RETIREMENT BENEFITS PLANNING 8 HOURS

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

TOTAL: 36 HOURS

TEXT BOOKS:

1. Indian Institute of Banking & Finance. (2017). *Introduction to Financial Planning*, Taxmann Publication., New Delhi.
2. Pandit, A. (2014). *The Only Financial Planning Book that You Will Ever Need*, Network Publications Ltd., Mumbai.

REFERENCE BOOKS:

1. Sinha, M. (2008). *Financial Planning: A Ready Reckoner*, McGraw HillEducation, New York.
2. Halan, M. (2018). *Let's Talk Money: You've Worked Hard for It, Now Make It Workfor You*, Harper Collins Publishers, New York.
3. Tripathi, V. (2017). *Fundamentals of Investment*, Taxmann Publication, New Delhi.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011	P012	P013	P014	P015	PSO1	PSO2
CO1	3	-	-	-	3	-	-	-	-	-	3	-	-	-	3	3	3
CO2	3	-	-	-	3	-	-	-	-	-	3	-	-	-	3	-	-
CO3	3	-	-	-	3	-	-	-	2	-	3	-	-	-	3	3	3
CO4	3	-	-	-	3	-	-	-	2	-	3	-	-	-	3	3	3
CO5	3	-	1	-		-	-	-	2	-	3	-	-	-	3	-	-
Average	3	-	1	-	3	-	-	-	2	-	3	-	-	-	3	3	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester III

24CHPOE301 INDUSTRIAL CHEMISTRY 3H-2C

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

External Semester Exam: 3 Hours

PREREQUISITE: Not Required

COURSE OBJECTIVES:

- To gain the comprehensive process of cane sugar and paint production.
- To understand the physical and chemical properties, characteristics, and the manufacturing processes of glass and cement.
- To acquire the knowledge of rubber fabrication.

COURSE OUTCOMES (CO's):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Illustrate comprehensive process of cane sugar production.	Understand
CO2	Apply the knowledge of paint classification, constituents and diverse applications.	Apply
CO3	Examine the physical and chemical properties of glass.	Analyze
CO4	Analyze the manufacturing processes of cement, including the wet and dry processes,	Analyze
CO5	Explain the rubber fabrication, including refining processes, fabrication methods, and vulcanization techniques.	Evaluate

UNIT I SUGAR **8 HOURS**

Introduction, Manufacture of Cane Sugar - Extraction of juice, Purification of Juice, Defecation, Sulphitation, Carbonation, Concentration or Evaporation. Crystallization -Separation of crystals, drying, refining, recovery of sugar from Molasses, Bagasse. Manufacture of sucrose from beet root. Estimation of sugar, double sulphitation process, double carbonation.

UNIT II PAINTS **8 HOURS**

Classification, constituents, setting of paints, requirements of a good paint. Emulsion, Latex, Luminescent, Fire retardant and Heat resistant paints. Methods of applying paints. Special applications and failures of paint. Varnishes - Introduction – Raw materials – Manufacture of varnishes.

UNIT III GLASS **8 HOURS**

Introduction, Physical/Chemical properties, Characteristics of glass. Raw materials, methods of manufacture - formation of batch material, melting, shaping, annealing and finishing of glass.

UNIT IV CEMENT **6 HOURS**

Introduction, raw materials, manufacture – Wet process, Dry process, reactions in kiln, setting of cement, properties and uses of cement. Plaster of Paris, Gypsum, Lime.

UNIT V RUBBER **6 HOURS**

Introduction, Importance, types and properties of rubber. Refining of crude rubber, drawbacks of raw rubber. Rubber fabrication, vulcanization techniques**.**

TOTAL: 36 HOURS

TEXT BOOKS:

1. Sharma, B.K. (2014). *Industrial Chemistry* ,14th Edition, Meerut: Goel Publishing House.

2. Vermani, O.P and Narula, A.K. (2016*). Industrial Chemistry*. Delhi:Galgotia Publications Pvt Ltd.

REFERENCE BOOK:

1. Jain, P.C. and Monika Jain. (2016). *Engineering Chemistry* ,16th Edition, New Delhi: Dhanpat Rai Publishing Co. (Pvt) Ltd.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	2	**-**	**1**	**-**	**-**	**2**	**-**	**2**	**-**
CO2	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	2	**-**	**1**	**-**	**-**	**-**	**-**	**2**	**-**
CO3	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	-	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**
CO4	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	2	**-**	**1**	**-**	**-**	**1**	**-**	**3**	**-**
CO5	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	2	**-**	**1**	**-**	**-**	**1**	**-**	**2**	**-**
Average	**2.5**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**2**	**-**	**1**	**-**	**-**	**1.3**	**-**	**2.4**	**-**

1-Low, 2-Medium, 3-High, '-' - No Correlation

Semester III

24MBPOE301 FERMENTATION TECHNOLOGY 3H–2C

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

End Semester Exam: 3 Hours

PREREQUISITE: Not required

COURSE OBJECTIVES (CO):

- To study the use of microorganisms in the manufacture of food or industrial productson the basis of employment.
- To gain knowledge on design of bioreactors, factors affecting growth and production, heat transfer and oxygen transfer
- To understand the rationale in medium formulation; design for microbial fermentation,and sterilization of medium and air.

COURSE OUTCOMES (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Acquire knowledge in the production of industrial product, and gain knowledge in fermentation components and types	Understand
CO2	Isolate, preserve the microbes for fermentation upstream processes	Apply
CO3	Apply techniques for microbial production of various enzymes	Apply
CO4	Experiment with production of organic acids and beverages	Apply
CO5	Practice the techniques for the production of amino acids, vitamins and single cell proteins	Apply

UNIT I BASICS OF FERMENTATION PROCESSES 7 HOURS

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

UNIT II ISOLATION AND PRESERVATION 7 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 7 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 7 HOURS

Fermentation type reactions (Alcoholic, bacterial, mixed acid, propionic acid, butanediol and acetone-butanol). Microbial production of enzymes (amylases, Proteases, cellulases) 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, amino acids: glutamic acid, production of vitamins. fungal enzymes and Single cell protein.

TOTAL: 36 HOURS

TEXT BOOKS:

1. Sridhar, S. (2010). *Industrial Microbiology*, Dominant Publishers, New Delhi.
2. Tanuja. S and Purohit, S.S. (2008). *Fermentation Technology*, Agrobios Publication, Jodhpur, India.
3. Harider, S.I. and Ashok, A. (2009). *Biotechnology, A Comprehensive Training Guide for theBiotechnology Industry*, CRC Press, New York.

REFERENCE BOOKS:

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*, ElsevierAcademic Press, UK.
3. Glazer, A and Nikaido. (1995). *Microbial biotechnology fundamentals of applied microbiology*,W. H. Freeman 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.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	POS2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO3	2	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	3
CO4	-	-	-	2	-	2	-	3	-	-	2	-	-	-	-	-	3
CO5	-	-	-	2	-	2	-	3	-	-	2	-	-	-	2	-	3
Average	**2.7**	**-**	**-**	**2**	**-**	**2**	**-**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**-**	**3**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Semester III

24EGPOE301 ENGLISH FOR COMPETITIVE EXAMINATIONS 3H-2C

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

End Semester Exam:3Hours

PREREQUISITE: Not required

Course Objectives (CO):

•To train learners to crack 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 (COs):

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

COs	Course Outcomes	Blooms Level
CO1	execute the grammatical elements in competitive exams	Apply
CO2	identify the various skills to build a strong outer relationship	Understand
CO3	analyse logical reasoning questions	Analyse
CO4	execute the process of sharing the general knowledge with use of proper communication	Apply
CO5	translate the correct structure of sentence from one language to other	Understand

UNIT I Grammar **8 HOURS**

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

UNIT II Word Power **7 HOURS**

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

UNIT III Paragraph **7 HOURS**

Expansion of an idea

UNIT IV Writing **7 HOURS**

Essay- Letters-Memos-Agenda-Resume writing

UNIT V Speaking **7 HOURS**

Public Speaking-Group Discussion-Interview-Spoken English

TOTAL:36 HOURS

TEXT BOOK

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

WEBSITES

1.https://www.ef.com/wwen/english-resources/english-idioms/

2. https://www.talkenglish.com/speaking/listbasics.aspx

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	-	-	3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-
CO3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	3	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Average		**2.5**	**3**	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

3-Strong; 2-Medium; 1-Low '-' – No Corrections

Semester III

24MMPOE301 **CODING THEORY** **3H - 2C**

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

End Semester Exam: 3 Hours

PREREQUISITE:

- Algebra, Probability and Statistics, Digital Communication, Programming Skills.

COURSE OBJECTIVES (CO):

- To understand the communication channels and the importance of error correction.
- To explore the linear codes, self-orthogonal codes, and self-dual codes.
- To learn about the cyclic codes, their properties, and decoding methods.

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Understand the fundamental concepts of error detection, correction, and decoding in communication channels.	Understand
CO2	Apply the concepts of generator matrix and parity check matrix in encoding and decoding linear codes.	Apply
CO3	Analyze different types of codes, including Binary and q-ary Hamming codes, Golay codes, and MDS codes, for their error-correcting capabilities.	Analyze
CO4	Understand the definitions and properties of cyclic codes.	Understand
CO5	Apply BCH codes and Reed Solomon codes to various coding problems.	Apply

UNIT I ERROR DETECTION, CORRECTION AND DECODING **7 HOURS**

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

UNIT II LINEAR CODES **7 HOURS**

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

UNIT III BOUNDS IN CODING THEORY **8 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 **7 HOURS**

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

UNIT V SPECIAL CYCLIC CODES **7 HOURS**

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

TOTAL: 36 HOURS

TEXT BOOKS:

1. Hill, H. (1986). *A first course in Coding theory*, OUP.
2. San Ling and Chaping Xing, (2004). *Coding Theory: A first course*, Cambridge University Press.

REFERENCE BOOKS:

1. Berlekamp, E.R. (1968). *Algebraic Coding Theory*, Mc Graw – Hill.
2. Lin, S. and Costello, D. J. (1983). *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.

WEBSITES:

1. https://nptel.ac.in/courses/108104092
2. https://nptel.ac.in/courses/117106031

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
CO2	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO3	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
CO4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO5	3	2	1	-	-	-	1	-	-	-	-	-	-	-	-	-	1
Average	**2.4**	**1.4**	**1**	-	-	-	**1**	-	-	-	-	-	-	-	-	-	**1**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER–III

24BTP391	**INTERNSHIP PROGRAMME**	**2C**

Instruction Hours/week: L:0 T:0 P:0 **Marks:** Internal:1**00** External:**00** Total:**100**

SEMESTER IV

24BTP491	**PROJECT –VIVA VOCE**	**15C**

Instruction Hours/week: L:0 T:0 P:30 **Marks:** Internal:**80** External:**120** Total:**200**