M.Sc., BIOTECHNOLOGY

CHOICE BASED CREDIT SYSTEM

Curriculum and Syllabus
(2022-2023)

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

DEPARTMENT OF BIOTECHNOLOGY

FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT

KARPAGAM ACADEMY OF HIGHER EDUCATION

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

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)
(Established under Section 3 of UGC Act, 1956)
Coimbatore - 641 021, INDIA

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

REGULAR MODE
CHOICE BASED CREDIT SYSTEM (CBCS)

REGULATIONS - 2022

The following Regulations are effective from the academic year 2022-2023 and are applicable to the candidates admitted in Post Graduate (PG) Degree programmes in the Faculty of Arts, Science, Commerce and Management, Karpagam Academy of Higher Education (KAHE).

1 PROGRAMMES OFFERED,

MODE OF STUDY AND ADMISSION REQUIREMENTS

1.1 P.G. PROGRAMMES OFFERED

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

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

1.2 MODE OF STUDY

Full-Time

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

1.3 ADMSSION REQUIREMENTS (ELIGIBILITY)

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

QUALIFICATIONS FOR ADMISSION

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

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

2 DURATION OF THE PROGRAMMES

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

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

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

3. CHOICE BASED CREDIT SYSTEM

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

3.2 Credits

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

4. STRUCTURE OF THE PROGRAMME

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

a. Core course

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

b. Elective course

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

c. Project Work

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

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

d. Value Added Courses

Courses of varying durations but not less than 30 hours which are optional and offered outside the curriculum that add value and help the students in for

getting placement. Students of all programmes are eligible to enroll for the Value Added Courses. The student shall choose one Value Added Course per semester from the list of Value Added Courses available in KAHE. The examinations shall be conducted at the end of the Value Added Course at the Department level and the student has to secure a minimum of 50% of marks to get a pass. The certificate for the Value Added Course for the passed out students shall be issued duly signed by the HOD and Dean of the Faculty concerned.

e. Internship

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

f. Open Elective

He / She may select one of the open elective courses from the list given below offered by the other department 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 Department	Course Code	Name of the Course
1	M.A English	22EGPOE301	English for Competitive Examinations
2	M.Com	22CMPOE301	Personal Finance and Planning
3	MBA	22MBAPOE301	Organizational behavior
4	MCA	22CAPOE301	Robotics
5	M.Sc Computer Science	22CSPOE301	Cyber forensics
6	M.Sc Mathematics	22MMPOE301	Coding theory
7	M.Sc Physics	22PHPOE301	Non-destructive techniques – an industrial approach
8	M.Sc Chemistry	22CHPOE301	Applying Chemistry to Society
9	M.Sc Microbiology	22MBPOE301	Fermentation technology
10	M.Sc Biochemistry	22BCPOE301	Nutrition and Dietetics
11	M.Sc Biotechnology	22BTPOE301	Plant tissue culture and its applications

Online Course

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

be considered as additional credit(s) over and above the credits minimum required to earn a particular Degree.

5. MEDIUM OF INSTRUCTION

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

6. MAXIMUM MARKS

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

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

(ii) Maximum marks for Project work

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

7. REQUIREMENTS TO APPEAR FOR THE END SEMESTER EXAMINATION

a. Ideally every student is expected to attend all classes and secure 100% attendance. However, in order to allow for certain unavoidable circumstances, the student is expected to attend at least 75% of the classes and the conduct of the candidate is 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 / 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. However, the candidate has to pay the prescribed condonation fee to the KAHE.

c. However, a candidate who has secured attendance less than 64% in the current semester due to any reason shall not be permitted to appear for the current semester examinations. But he/she will be permitted to appear for

his/her supplementary examinations, if any and he/she has to re do the same semester with the approval of the "Students' Affairs Committee" and Registrar.

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 ward students' periodically (once in 2 weeks) on the Notice Board to enable the students to know their attendance status and satisfy the **clause 7** of this regulation.

b. **ONLINE COURSE COORDINATOR**

To help students in planning their online courses and for general advice on online courses, the HOD shall nominate a coordinator for the online courses. The Online course coordinator shall identify the courses which the students can select for their programme from the available online courses offered by the different agencies periodically and inform the same to the students. Further, the coordinators shall advice the students regarding the online courses and monitor their course.

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

- Analyzing and Solving problems experienced by students in the class room and in the laboratories.
- Analyzing the performance of the students of the class after each test and finding the ways and means to improve the performance.
- 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 faculty Dean.

- The Class Committee shall be constituted during the first week of each semester.
- The HoD / Chairperson of the class committee are authorized to convene the meeting of the class committee.
- The respective faculty Dean has the right to participate in any class committee meeting.
- The Chairperson is required to prepare the minutes of every meeting, and submit the same to Dean 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.

10. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or group shall have a "Course Committee" comprising all the teachers handling the common course with one of them nominated as course coordinator. The nomination of the course coordinator shall be made by the Dean depending upon whether all the teachers handling the common course belong to a single department or to various other departments. The 'Course Committee' shall meet in order to arrive at a common scheme of evaluation for the tests to ensure a uniform evaluation of the tests. If feasible, the course committee shall prepare a common question paper for the Internal Assessment test(s).

11. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

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

Theory Courses

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

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

Practical Courses

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

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

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

11.3 **Pattern of Test Question Paper**

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

11.4 Attendance

Marks Distribution for Attendance

S. No.	**Attendance (%)**	**Maximum Marks**
1	91 and above	5.0
2	81 - 90	4.0
3	76 - 80	3.0
4	Less than 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 60 marks.

Pattern of ESE Question Paper

Instruction	**Remarks**
Maximum Marks	60 marks for ESE
Duration	3 hours (½ Hr for Part – A Online & 2 ½ Hours for Part – B and C)
Part – A	20 Questions of 1 mark each (20 x 1 = 20 Marks) Question No. 1 to 20 Online Multiple Choice Questions

Instruction	Remarks
Part- B	5 Questions of six marks each (5 x 6 = 30 Marks.) Question No. 21 to 25 will be 'either-or' type, covering all five units of the syllabus; i.e., Question No. 21: Unit - I, either 21 (a) or 21 (b), Question No. 22: Unit - II, either 22 (a) or 22 (b), Question No. 23: Unit - III, either 23 (a) or 23 (b), Question No. 24: Unit - IV, either 24 (a) or 24 (b), Question No. 25: Unit - V, either 25 (a) or 25 (b)
Part - C	Question No.26. One Ten marks Question (1 x 10 = 10 Marks)

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

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

Record Notebooks for Practical Examination

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

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

12.3. **Evaluation of Project Work**

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

12.3.2 The project report is 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 have failed in the project work and shall re-enroll for the same in a subsequent semester.

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

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

13. PASSING REQUIREMENTS

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

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

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

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

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

14. IMPROVEMENT OF MARKS IN THE COURSE ALREADY PASSED

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

15. AWARD OF LETTER GRADES

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

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

16. GRADE SHEET

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

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

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

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

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

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

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

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

CGPA of the entire programme = ----------

Sum of the credits of the courses of the entire programme

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

where,

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

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

17. REVALUATION

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

18. TRANSPARENCY AND GRIEVANCE COMMITTEE

Revaluation and Re-totaling is allowed on representation (clause 17). Student may get the Xerox copy of the answer script on payment of prescribed fee, if he / she wish. The student may represent the grievance, if any, to the Grievance Committee, which consists of Dean of the Faculty, (if Dean is HoD, the Dean of another Faculty nominated by the KAHE), the HoD of Department concerned, the faculty of the course and Dean from other discipline nominated by the KAHE and the CoE. If the Committee feels that the grievance is genuine, the script may be sent for external valuation; the marks awarded by the External examiner will be final. The student has to pay the prescribed fee for the same.

19. ELIGIBILITY FOR THE AWARD OF THE DEGREE

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

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

20. CLASSIFICATION OF THE DEGREE AWARDED

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

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

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

21. PROVISION FOR WITHDRAWAL FROM END-SEMESTER EXAMINATION

21.1 A candidate due to valid reason on prior application may be granted permission to withdraw from appearing for the examination of any one

course or consecutive examinations of more than one course in a semester examination.

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

21.3 Withdrawal of application is valid only if it is made within 10 days prior to the commencement of the examination in that course or courses and recommended by the HoD / Dean concerned and approved by the Registrar.

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

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

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

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

22. PROVISION FOR AUTHORISED BREAK OF STUDY

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

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

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

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

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

23. RANKING

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

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

24. SUPPLEMENTARY EXAMINATION

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

25. DISCIPLINE

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

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

26. REVISION OF REGULATION AND CURRICULUM

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

DEPARTMENT OF BIOTECHNOLOGY

FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT

PG PROGRAMME (CBCS) – M.Sc. Biotechnology

(2022–2023 Batch and onwards)

Course code	Name of the course	Objectives and Outcomes		Instruction hours / Week			Credit (s)	Marks			Category	Page. No.
		PEOs	POs	L	T	P		CIA	ESE	Total		
SEMESTER – I												
22BTP101	Biochemistry	I	a	4	0	0	4	40	60	100	CC	6
22BTP102	Microbiology	I	a	4	0	0	4	40	60	100	CC	8
22BTP103	Cell Biology and Molecular genetics	I	a	4	0	0	4	40	60	100	CC	10
22BTP104	Bioinstrumentation and Biostatistics	I, II	a, b	3	1	0	4	40	60	100	CC	12
22BTP105A 22BTP105B 22BTP105C	Ecology, Biodiversity and Evolutionary Biology Microbial Genetics Enzyme Technology	I	a	4	0	0	4	40	60	100	EC	14-19
22BTP111	Analytical Biochemistry Practical – I	II	b, c	0	0	4	2	40	60	100	CC	20
22BTP112	Microbiology and Molecular Genetics Practical – II	II	b, c	0	0	4	2	40	60	100	CC	22
Journal Paper Analysis & Presentation		III IV	d	2	0	0	-	-	-	-	CC	24
Semester total				**21**	**1**	**8**	**24**	**280**	**420**	**700**		
SEMESTER – II												
22BTP201	Recombinant DNA technology	I, III	a, e, f	4	0	0	4	40	60	100	CC	25
22BTP202	Immunology and Immunotechnology	I, III	a, e, f	4	0	0	4	40	60	100	CC	27
22BTP203	Molecular and Developmental Biology	I, III	a, e, f	3	1	0	4	40	60	100	CC	29
22BTP204	Fermentation and Bioprocess Technology	I, III	a, e, f	4	0	0	4	40	60	100	CC	31
22BTP205A 22BTP205B 22BTP205C	Microbial Biotechnology Nano Biotechnology Biosafety and IPR	I, III	a, e, f	4	0	0	4	40	60	100	EC	33-39

22BTP211	Recombinant DNA,Bioprocess and Fermentation Technology Practical – III	II, III	b, c	0	0	4	2	40	60	100	CC	40
22BTP212	Immunology and Immuno technology Practical – IV	II, III	b, c	0	0	4	2	40	60	100	CC	42
Journal Paper Analysis & Presentation		III, IV	d	2	0	0	-	-	-	-	CC	43
Semester total				**21**	**1**	**8**	**24**	**280**	**420**	**700**		

Course code	Name of the course	Objectives and Outcomes		Instruction hours / Week			Credit (s)	Marks			Category	Page. No.
		PEO´s	PO´s	L	T	P		CIA	ESE	Total		
SEMESTER - III												
22BTP301	Plant Biotechnology	I, III	a, e, f	4	0	0	4	40	60	100	CC	44
22BTP302	Animal Biotechnology	I, III	a, e, f	4	0	0	4	40	60	100	CC	46
22BTP303	Environmental Biotechnology	I, III	a, e, f	4	0	0	4	40	60	100	CC	48
22BTP304	Genomics, Proteomics and Bioinformatics	I, III	a, e, f	3	1	0	4	40	60	100	CC	50
22BTP305A 22BTP305B 22BTP305C	Food Biotechnology Agricultural Biotechnology Pharmaceutical Biotechnology	I, III	a, e, f	3	0	0	3	40	60	100	EC	52-57
22BTP311	Plant and Animal Biotechnology Practical – V	II, III	b, c	0	0	4	2	40	60	100	CC	58
22BTP312	Genomics, Proteomics and Bioinformatics Practical – VI	II, III	b, c	0	0	3	2	40	60	100	CC	60
Journal Paper Analysis & Presentation		III, IV	d	1	0	0	-	-	-	-	CC	62
Open elective		I	a	3	0	0	2	40	60	100	OE	63
22BTP391	Internship Programme	III, IV	d,e,f,g	-	-	-	2	100	0	100		64
Semester total				**22**	**1**	**7**	**27**	**420**	**480**	**900**		
SEMESTER – IV												
22BTP491	Project and Viva Voce	III, IV	d,e,f,g	-	-	-	15	80	120	200	CC	65

Semester total	**-**	**-**	**-**	**15**	**80**	**120**	**200**		
	64	**3**	**23**	**90**	**1060**	**1440**	**2500**		

Elective courses*

Elective – 1 (20BTP105)		Elective – 2 (20BTP205)		Elective – 3 (20BTP305)	
Course code	**Name of the course (Theory)**	**Course Code**	**Name of the course (Theory)**	**Course Code**	**Name of the course (Theory)**
22BTP105A	Ecology, Biodiversity and Evolutionary Biology	22BTP205A	Microbial Biotechnology	22BTP305A	Food Biotechnology
22BTP105B	Microbial Genetics	22BTP205B	Nano Biotechnology	22BTP305B	Agricultural Biotechnology
22BTP105C	Enzyme Technology	22BTP205C	Biosafety and IPR	22BTP305C	Pharmaceutical Biotechnology

Open Elective Course		
Semester	**Subject code**	**Subject**
III	22BTPOE301	Plant tissue culture and its application

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

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

PROGRAMME OUTCOMES (POs)

a) Graduates will able to have knowledge on the basic and applied theories.

b) Ability to design and conduct experiments as well as to interpret the results.

c) Graduates will be able to visualize and work on multidisciplinary laboratory problems.

d) Making the graduates to demonstrate their communication effectively and scientifically as independent researcher.

e) Providing a broad educational, and analytical knowledge necessary to make the students for appearing in competitive examinations.

f) Generating the graduates with an ability to identify and formulate process/product with professional, societal and ethical responsibilities.

g) Graduates will be able to recognize the needs for lifelong learning.

PROGRAMME SPECIFIC OUTCOMEs (PSOs)

To enable the student to emerge as:

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

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

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

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

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

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

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

MAPPING OF PEOs AND POs

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

Semester – I

BIOCHEMISTRY

22BTP101 **4H – 4C**

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

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Understand Biochemistry as discipline and milestone discoveries in life sciences that led to establishment of Biochemistry as separate discipline
2. Understand fundamental properties of elements, their role in formation of biomolecules and in chemical reactions within living organisms
3. Draw or describe the structure of amino acids, proteins, enzymes, chemical messengers, carbohydrates, lipids, and nucleic acid
4. Describe the metabolism of carbohydrates, lipids, proteins and amino acids, and write chemical reactions for the individual steps in each pathway
5. Write the chemical reactions involved in biochemical pathways that produce ATP, such as citric acid cycle and electron transport
6. Be familiar with the enzymes (biocatalysts), and their salient attributes including unique conformation and amazing catalytic properties

UNIT –I

Introduction: Chemical basis of life; Composition of living matter; Water – properties, pH, ionization and hydrophobicity; Emergent properties of biomolecules in water; Biomolecular hierarchy; Macromolecules; Molecular assemblies; Structure-function relationships.

UNIT -II

Biomolecules: 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: Enzymes classification and nomenclature; mechanism of action, regulation of enzymatic activity, enzyme kinetics – Michaelis Menton equation, Line weaver burk plot and Eadie Hoffstee and Haneswoll equation, enzyme inhibition.

UNIT- IV

Metabolism: 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: TCA Cycle, glycolysis, gluconeogenesis, pentose phosphate shunt, Embden-Meyerhof pathway, urea cycle, interconnection of pathways, metabolic regulation, bioenergetics: Respiratory chain, ATP cycle, energy-rich compounds.

SUGGESTED READINGS

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

Semester – I

MICROBIOLOGY

22BTP102 4H – 4C

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

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Demonstrate the principles and applications of microscopic techniques
2. Demonstrate microbial structure and similarities and differences among various groups of microorganisms such as bacteria and fungi
3. Illustrate microbial diversity using different methods and systematics of bacteria
4. Discuss the various methods for identification of isolated and unculturable microorganisms
5. Comprehend the various methods for identification of unknown microorganisms
6. Discuss the industrial applications of microorganisms

UNIT -I

Microbial diversity: Definition, history, scope, discovery and development of microorganisms. Diversity- Bacteria, fungi, algae - distribution, reproduction and characteristics divisions. Autotropic and heterotic nutrition.

UNIT –II

Microscopy techniques: Principles, types and applications of light, phase contrast, fluorescence, scanning and transmission electron microscopy, cytophotometry and flow cytometry, fixation and staining. Types of media preparation, methods of sterilization, Staining – types of stains and dyes, staining methods.

UNIT –III

Microbial metabolism: Common nutrient requirements, nutritional types, uptake of nutrients, culture media, isolation, maintenance and preservation of pure cultures. Microbial growth, growth curve, measurement of microbial growth, continuous culture, influence of environmental factors on growth, regulation of microorganisms by physical and chemical agents.

UNIT –IV

Biomass production: Production of carbohydrates - higher alkanes and methanol; Edible mushroom and its types. Oyster, paddy straw, button and medicinal mushroom production and their applications.

UNIT - V

Microbial diseases and control measures: Causative agent, pathology, diagnosis, control and treatment of Bacterial - TB, Cholera and Typhoid. Protozoan - Amoebiasis and Malaria. Viral – AIDS and Covid-19. Control of microorganisms - drugs, chemotherapy, antimicrobial agents.

SUGGESTED READINGS

1. Black, J.G. (2002). *Microbiology Principles and Explorations*. (9th ed.) NewYork: John Wiley and Sons Publishing.
2. Prescott, L.M., Harley, J.P. & Klien, D.A. (2005). *Microbiology*. (6th ed.) Boston: NY, McGraw - Hill Publishing Company.
3. Talaro, K.P., (2009). *Foundations in Microbiology*. (8th ed.) McGraw - Hill Publishing Company, New York.
4. Prescott, & Dunn's. (1984). *Industrial Microbiology* (4th ed.). Conneticut: Gerald Reed& AVI Publishing Company Inc.
5. Pascale, C. (2005). *Cellular Microbiology*. (2nd ed.) New York: American Society for Microbiology.
6. Hui, Y.H., Goddik, L.M., Hansen, A.S., Josephsen, J., Nip, W.K., Stanfield, P.S., & Toldra, F. (2004). *Handbook of Food and Beverage Fermentation Technology*. London: Taylor and Francis publishers.
7. Pelczar, M.J., Chan, E.C.S., & Krieg, N.R. (1993). *Microbiology* (5th ed.). McGraw Hill Book Company.
8. Roland, V.G. (2005). *Applied Food Microbiology*. London: Star Publishing Co.
9. Atlas, R.M. (2015). *Principles of Microbiology Illinois*: (2nd ed.) USA, WCB McGraw Hill publishers.

Semester – I

CELL BIOLOGY AND MOLECULAR GENETICS

22BTP103 4H – 4C

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

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Describe the structures and basic components of prokaryotic and eukaryotic cells
2. Illustrate how the cellular components are used for various cellular activities
3. Demonstrate the pathways involved in various cellular events including cell cycle
4. Understand the inheritance of genes among plants and animals and the genetic makeover as well as the physical appearance of organisms
5. Describe Mendelian inheritance and the inheritance of gene in human beings
6. Illustrate the effect of chromosomal abnormalities in human diseases

UNIT - I

Cell organization:

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

UNIT - II

Cell regulation:

Nucleic acid - 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:

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

UNIT - IV

Genetic transformation, Genome mapping and Transposable elements:

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

UNIT - V

Microbial and Human genetics:

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

SUGGESTED READINGS:

1. Alberts, B. (2017*). Molecular Biology of the Cell* (Sixth ed.). Garland Science Publication.
2. Cooper, G.M. (2018). *The Cell: A Molecular Approach* (Eighth ed.). Sinauer Associates (Oxford University Press).
3. Krishnaiya, G.R. (2019). *A Textbook of Microbial Genetics & Molecular Biology* (First ed.). Blue Rose Publishers.
4. Strachan, T., Read, A. (2018). *Human Molecular Genetics* (Fifth ed.). Garland Science Publication.
5. MOOC: https://nptel.ac.in/courses/102103012/
6. MOOC: https://nptel.ac.in/courses/102104052/
7. Ranzoni, A.M., Cvejic, A. (2018*). Single-cell biology: resolving biological complexity, one cell at a time*. Development. The Company of Biologists Publication.
8. E-content: http://172.16.25.76/course/view.php?id=1602

BIOINSTRUMENTATION AND BIOSTATISTICS

22BTP104 **4H-4C**

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

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Demonstrate the bioinstrumentation principles with respect to device design and applications
2. Perform colorimetric and spectroscopic methods to analyze biological samples
3. Apply the principles of centrifugation and chromatography for compound separation
4. Carryout the separation of nucleic acids and proteins using electrophoresis
5. Recognize the definition of biostatistics and its relation with other sciences
6. Apply the biostatistical knowledge in analyzing biological problems using relevant softwares

UNIT – I Microscopy, Colorimetry and Spectroscopy:

Microscopy: Tranmission and scanning electron microscope (TEM & SEM), Fluorescence microscope. **Colorimetry and Spectroscopy:** Calorimetry, basic principles**,** Color and absorption spectra, Beer's and Lambert's law., Instrumentation and applications of UV Visible light spectroscopy, Spectrofluorimeter, FTIR, atomic spectroscopy, NMR spectroscopy – 2D and 3D structure prediction, Peptide mass finger printing - MALDI –TOF, Mass Spectrometry - GC-MS, LC- MS.

UNIT – II Centrifugation and Chromatography:

Principle, types of centrifuges, Principles, g and RPM value, Applications of analytical and preparative centrifuge, density gradient and ultra-centrifuge. Chromatography: Principles, Type - Paper, thin layer, normal and reverse phase, ion-exchange, affinity, gel filtration, size exclusion, HPTLC, HPLC and FPLC.

UNIT – III Electrophoresis:

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

UNIT- IV Biostatistics:

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:

Randomized block design, ANOVA, Test of significance -F, t, DMRT and chi-square test. Statistical and graphical software – SPSS and other softwares. Case studies.

SUGGESTED READINGS:

1. Boyer, R.F. (2000). *Modern Experimental Biochemistry* (3rded.). Pearson Publishers, London, United Kingdom.
2. Chatwal, G.R.&Anand, S.K. (2014). *Instrumental Methods of Chemical Analysis* (5thed.). Himalaya Publishing House,Mumbai, India.
3. Glover,T. & Mitchell, H. (2015). *An Introduction to Biostatistics* (3rded.). Waveland Press, Illinois, United States.
4. Hofmann, A. &Clokie, S. (2018). *Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology* (8thed.). Cambridge University Press, Cambridge, United Kingdom.
5. Rosner, B. (2015). *Fundamentals of Biostatistics* (8thed.). Cengage Learning Publishers, Massachusetts, United States.
6. Sawhney, S.K.& Singh, R. (2005). Introductory *Practical Biochemistry* (2nded.). Alpha Science International Ltd. Publishers, Oxford, United Kingdom.
7. Sharma, B.K. (2011). *Instrumental Methods of Chemical Analysis* (1sted.). Krishna Prakashan Media Publishers, Meerut, India.
8. Veerakumari, L. (2009). *Bioinstrumentation*. MJP Publishers, Chennai, India.

ECOLOGY, BIODIVERSITY AND EVOLUTIONARY BIOLOGY

22BTP105A **4H-4C**

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

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Learn the fundamental principles and concepts of ecology
2. Use this knowledge to conserve ecosystem biodiversity
3. Describe relationships, distribution, abundance and interactions of organisms, their populations and environments
4. Demonstrate the ecological ethics issues and human genome project.
5. Learn the basics of darwinism and mendalism in evolutionary biology.
6. Analyze the concepts of molecular evolution using various tools.

UNIT-I Ecological Principles

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

UNIT – II Ecosystem, Applied and Conservation Ecology

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

UNIT –III Biodiversity

Introduction, types, concepts, values, uses, Measures of biodiversity. Vegetation types of India. Hotspot biodiversity areas in India, Red Listed plants and RED Data Book, Threatened plants and animals of India. Role of biotechnology; Conservation biodiversity - *In situ* and *ex situ* methods.

Molecular markers and their application in plant conservation. National Biodiversity Authority. Protection of environment and biodiversity

UNIT –IV Introduction to Evolutionary Biology

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

UNIT -V Evidences of Evolution

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

SUGGESTED READINGS:

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

MICROBIAL GENETICS

22BTP105B **4H-4C**

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

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Have basic awareness and outline of Molecular Biology with unique reference to microbial genome.
2. Describe the nature of molecular world and its application in modern Microbiological sectors.
3. Understand the process of Mutation and mutagenesis.
4. Aquire the knowledge about the central dogma of biology.
5. Understand the concepts of genetic recombination techniques.
6. gain the awareness about the transposons and its applications

UNIT – I History of Genetics:

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. DNA repair mechanisms..

UNIT – II: Plasmids:

Types of plasmids- replication, partitioning, host range, plasmid-incompatibility, amplification, pBR322 plasmid, pUC18 plasmids and its application as a vector. curing and application. Cosmid- types of cosmids with examples. Cloning vectors and expression vectors.

UNIT – III: Genetic code

Central dogma of biology-transcription, translation, RNA editing, t-RNA charging, m RNA splicing, peptidyl transferase. Aminoacyl t-RNA. Genetic code- Operon concept-Lactose, tryptophan. Genetic recombination in bacteria- Conjugation, Transformation-Transduction and its types. Gene mapping techniques-gene and chromosome walking.

UNIT – IV Mutation:

Mutations and mutagenesis, types of mutations and mutagens. Identification of mutants- Ames test, Luria Delbruck experiments.

UNIT – V Transposons:

Transposons-definition, types of transposons, mechanism of transposition and application. Mu transposon elements and eukaryotic transposable elements and applications

SUGGESTED READINGS:

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

Semester – I

ENZYME TECHNOLOGY

22BTP105C **4H-4C**

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

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To understand the basics of enzyme system
- To obtain knowledge on key properties of enzymes
- To comprehend the strategies for the discovery of novel enzymes
- To attain the principles involved in enzyme technology including methods for large scale production of enzymes
- To recognize the application of enzymes used in different industries
- To acquire the importance of enzyme-based biosensors

Course Outcomes

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

1. Demonstrate the classification of enzymes and enzyme activity
2. Discuss the structure and important functions of enzymes
3. Describe the isolation and purification of novel enzymes for industrial applications
4. Appreciate the underlying mechanisms of Immobilized and soluble enzymes in health and industry
5. Identify novel enzymes used for clinical diagnosis
6. Apply the acquired knowledge of this course in enzymology research

UNIT – I Nomenclature, classification of enzymes and enzyme activity

Nomenclature and classification of enzymes, Isozymes, characteristics of enzymes, enzyme cofactors, catalytic power, catalytic strategies, substrate specificity, lock and key model, induced fit hypothesis, active site- structure, substrate binding, role of catalytic amino acid residues, Catalytic mechanisms of enzymes with representative examples, types of enzyme inhibition, regulation, kinetics of enzyme- catalyzed reactions, effect of pH and temperature, thermodynamics, enzyme pathways and regulatory networks.

UNIT – II Properties of enzymes:

Thermal stability and catalytic efficiency of enzyme, site directed mutagenesis and enzyme engineering– selected examples, structural motifs and enzyme evolution. Methods for analysis of secondary and tertiary structures of enzymes. Protein folding *in vitro* & *in vivo*. Delivery system for protein pharmaceuticals.

UNIT – III Strategies in production of novel enzymes:

Strategies for the discovery of improved and novel enzymes for industrial applications (homology and structure-based approaches, screening methods, use of mutants). Optimization of industrial enzymes by mutagenesis; Protein engineering strategies to improve enzyme stability, specificity and activity; Artificial enzymes; Isolation and purification of industrially important enzymes.

UNIT – IV Enzyme technology:

Methods for large scale production of enzymes. Immobilized enzyme and their comparison with soluble enzymes, Methods for immobilization of enzymes. Immobilized enzyme reactors. Application of Immobilized and soluble enzyme in health and industry.

UNIT – V Applications of enzymes:

Enzymes used in different industries, enzyme replacement therapy – definition, modes of administration, enzyme deficiency disorders and enzyme therapy; Application of enzymes: Cosmetic benefits, Application to fundamental studies of biochemistry. Enzyme electrodes. Enzyme-based biosensors; Enzymes in clinical diagnosis: primary and secondary serum enzymes, Intracellular distribution of diagnostic enzymes, Enzyme markers of Xenobiotic toxicity - Pharmacogenomics related to polymorphism of drug metabolizing enzymes, KEGG (Kyoto Encyclopedia of Genes and Genomes) pathway.

SUGGESTED READINGS:

1. Berg, J.M., Tymoczko, J.L., Gatto Jr, G.J., & Stryer, L. (2015). *Biochemistry* (8th ed.). W.H. Freeman and Company, New York, United States.
2. Campbell, M.K., Farrell, S.O., & McDougal, O.M. (2017). *Biochemistry* (9th ed.). Cengage Learning Publishers, Massachusetts, United States.
3. Price, N.C. & Stevens, L. (1999) *Fundamentals of Enzymology* (3rd ed.). Oxford University Press, Oxford, United Kingdom.
4. Rodwell, V.W., Bender, D.A., Botham, K.M., Kennelly, P.J., & Weil, P.A. (2018). *Harper's illustrated*
   Biochemistry (31st ed.). McGraw-Hill Education Publishers, Ohio, United States.
5. Voet, D, Voet, J.G., & Pratt, C.W. (2016). *Fundamentals of Biochemistry* (5th ed.). Wiley Publishers, New York, United States.

Semester – I

ANALYTICAL BIOCHEMISTRY PRACTICAL – I

22BTP111 **4H - 2C**

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

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To execute the laboratory experiments, independently using the standard methods and techniques in Biochemistry
- Offer knowledge to execute the experiments flawlessly
- 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 quantitative analysis of the macromolecules in the given sample and analyze the results
- Carry out the purification of a variety of enzymes
- Understand quantification of sugars, amino acids and lipids

Course Outcomes

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

1. Apply the knowledge of various biochemical techniques in the laboratory
2. Acquire skills to quantitatively estimate the range of biomolecules using appropriate biochemical techniques
3. Implement the knowledge of biochemistry in the analysis of various biological macromolecules
4. Describe the quantification methods of sugars, amino acids and lipids
5. Determine the quality and quantity of enzymes
6. Perform the purification of enzymes

Biochemistry

1. Quantification of proteins – Lowry et al/ Bradford method
2. Quantification of carbohydrates by Phenol sulphuric acid method
3. Quantification of sugars – Anthrone method
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

SUGGESTED READINGS:

1. Keith Wilson, & John Walker (Eds.). (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 (2nded.). Pearson Education Publishers, New Jersey, United States.
3. Sadasivam. S. &Manickam, A. (2008). Biochemical Methods. (3rded.). New Age International Private Limited Publishers, New Delhi, India.
4. Palanivelu, P. (2016). Analytical Biochemistry and Separation Techniques (5thed.). Twentyfirst Century Publications, Coimbatore, India.
5. Hofmann, A. & Clokie, S. (2018). Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (8thed.). Cambridge University Press, Cambridge, United Kingdom

.

MICROBIOLOGY AND MOLECULAR GENETICS PRACTICAL – II

22BTP112 **4H-2C**

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

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Identify and confirm the prokaryotic and eukaryotic cell types by morphological and intercellular organelles arrangement
2. Discuss the presence of various cellular components in eukaryotic cells
3. Demonstrate the cell permeability in plant and animal cells
4. Determine the mitotic and meiotic cell divisions
5. Examine the structural variations in the nucleus using different staining methods
6. Get practiced with the tools and techniques for analyzing conjugation and transduction

MICROBIOLOGY

1. Pure culture technique –Pour plate, spread plate and streaking methods.
2. Staining technique –Grams 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.

MOLECULAR GENETICS

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

SUGGESTED READINGS:

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

Semester – I

JOURNAL PAPER ANALYSIS AND PRESENTATION

2H-0C

Semester – II

RECOMBINANT DNA TECHNOLOGY

22BTP201 **4H-4C**

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

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Understand the fundamental steps in recombinant DNA technology
2. Demonstrate the mechanism of action and the use of restriction enzymes in biotechnology research and recombinant protein production
3. Explain the value of plasmid and vector preparations and how the concentration and purity of plasmid and vector samples can be determined
4. Confer cloning strategies and techniques used in DNA probing for specific genes of interest
5. Conceptualize hybridization and PCR techniques in clinical research
6. Recapitulate various applications of recombinant DNA technology in human health care and safety regulations.

UNIT – I Tools in genetic engineering:

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

UNIT –II Vectors:

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:

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:

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

UNIT –V Application:

Molecular diagnosis of diseases. Antisense technology, RNAi technology, terminator gene technology, CRISPR gene therapy- *in vivo* and *ex vivo*. DNA fingerprinting, genetically engineered biotherapeutics and vaccines (Covid vaccines).

SUGGESTED READINGS:

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

Semester – II

IMMUNOLOGY AND IMMUNOTECHNOLOGY

22BTP202 **4H-4C**

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

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Demonstrate various immunological process including innate and adaptive immunity, cells and organs of immune system, antigen and antibody interaction, immunogenicity and antigenicity, epitopes and antibody structure
2. Describe the organization of Ig genes, class switching in constant regions of genes and expression and regulation of Ig genes
3. Recognize how animal cell culture is explored for monoclonal antibodies production using hybridoma technology
4. Apply the knowledge of immunosuppressive therapy during organ transplantation
5. Illustrate the role of cancer immunotherapy
6. Develop novel vaccines against infectious diseases

UNIT –I Introduction to immune System:

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.

UNIT –II Generation and regulation of immune responses:

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.

UNIT-III Disorders of human immune system:

Primary and secondary immunodeficiency. Autoimmunity: Mechanism and autoimmune 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: Iimmunosuppressive therapy.

UNIT –IV : Immunological techniques

Antigen- antibody interactions: Agglutination. Precipitation. Immunodiffusion. Immunoflourescence. Complement fixation. Radioimmuno assay. ELISA. ELISpot. Immunoprecipitation. Immunoelectrophoresis. Western blotting. Immunohistochemistry. Immune cell isolation. Chimeric antigen receptor (CAR) and T cell receptor (TCR) T cell therapeutic techniques.

UNIT –V Monoclonal antibodies and vaccines production:

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, Immuno modulatory effect of Covaxin and Covishield. Recent trends in vaccine development.

SUGGESTED READINGS:

1. Abbas,A.K., Lichtman, A. H., & Pillai, S. (2017). *Cellular and Molecular Immunology* (Ninth ed.). Elsevier Publishers, Amsterdam,Netherlands.
2. Abbas,A.K., Lichtman, A. H., & Pillai, S. (2019). *Basic Immunology: Functions and Disorders of the Immune System* (Sixth ed.). Elsevier Publishers, Amsterdam,Netherlands.
3. Delves, P.J., Martin, S.J., Burton, D.R., & Roitt, I.M. (2017). *Roitt's Essential Immunology.* (Thirteenth ed.). Wiley-Blackwell, New Jersey, United States.
4. E-content:http://172.16.25.76/course/view.php?id=2099
5. https://www.cell.com/cancer-cell/libraries/tumor-immunology-and-immunotherapy
6. Levine, M.M. et al. (2017). New Generation Vaccines (Fourth ed.). CRCPress.
7. MOOC:https://nptel.ac.in/courses/102103038/
8. Punt, J., Stranford, S., Jones, P., & Owen, J.A. (2018). *Kuby Immunology* (Eighth ed.). W.H. Freeman and Company, New York, UnitedStates.
9. Tizard, I.R. (2017). *Veterinary Immunology* (Tenth ed.). Saunders Publishers, New York, United States.
10. Turgeon, M. L. (2017). *Turgeon: Immunology and Serology in Laboratory Medicine*. (Sixth ed.). Elsevier Publishers, Amsterdam, Netherlands.

MOLECULAR AND DEVELOPMENTAL BIOLOGY

22BTP203 **4H-4C**

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

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Achieve knowledge about the functions of nucleic acids and proteins
2. Acquire an in-depth knowledge of chemical and molecular processes that occur within and between the cells
3. Gain an insight into the mechanisms behind gene regulations
4. Gain knowledge about mechanism behind translation and transcription
5. Acquire an in-depth knowledge about developmental biology
6. Understand the concept of Metamorphosis

UNIT –I Nucleic acid organization

DNA as genetic material, Types of DNA: A-DNA, BDNA 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:

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, rRNA and tRNA splicing.

UNIT –III Regulation of gene expression and translation:

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 tRNA, aminoacyl tRNA synthetases, mechanism of initiation, elongation and

termination of polypeptides, fidelity of translation, Inhibitors of translation, Posttranslational modifications of proteins.

UNIT –IV Introduction to developmental biology:

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:

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 Megasporangium, Pollination, Embryo -Embryo sac development and double fertilization in plants, seed formation and germination. Out line of experimental embryology. Organization of shoot and root apical meristem, and development. Leaf development and phyllotaxy.

SUGGESTED READINGS:

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

FERMENTATION AND BIOPROCESS TECHNOLOGY

22BTP204 **4H-4C**

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

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Evaluate factors that contribute in enhancement of cell and product formation during fermentation process
2. Analyze kinetics of cell and product formation in batch, continuous and fed-batch cultures
3. Differentiate the rheological changes during fermentation process
4. Develop protocol for scale-up and harvesting from shake flask to bench top fermentor
5. Analyze the bioprocess paradigms including scale-down, bioprocess simulation and economics in biological manufacturing
6. Examine considerations in bioprocess simulation, sterilization and fermentation in bioproduct manufacturing

UNIT –I Introduction to bioprocess technology:

History and milestones of bioprocess technology, scope of bioprocess 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

Design of fermenter, Types – CSTR, Tower, jet loop, air lift fermenter, bubble column, packed bed. Fundamentals of process control and monitoring – on line and off line 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:

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:

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

UNIT – V Application of bioprocess and fermentation technology :

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

SUGGESTED READINGS:

1. Bailey, J.S. & Ollis, D.F. (2017). *Biochemical Engineering Fundamentals* (2nded.). McGraw - Hill Education/ Medical, London, United Kingdom.
2. Crueger, W.&Crueger, A. (2017). Cruegers Biotechnology: A *Textbook of Industrial Microbiology*.Medtech Publishers, New Delhi, India.
3. Doran, P.M. (2013). *Studyguide forBioprocess Engineering Principles*. New York, United States.
4. Dutta, R. (2008). *Fundamentals of Biochemical Engineering*(1sted.). Springer Publishers, New York, United States.
5. Shuler, M.L.&Kargi, F. (2015). *Bioprocess Engineering Basic concepts* (2nded.). Pearson India Education Services Pvt. Ltd., Bengaluru, India
6. Stanbury, P.F., Whitaker, A., & Hall, S.J. (2016). *Principles of Fermentation Technology* (3rded.). Butterworth-Heinemann Publishers, Oxford, United Kingdom.

Semester – II

MICROBIAL BIOTECHNOLOGY

22BTP205A **4H-4C**

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

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Critically evaluate the role of micro-organisms in specific biotechnological processes.
2. Explain the complex processes behind the development of genetically manipulated organisms**.**
3. Apply the knowledge of microalgae in pharmaceutical industries
4. Discuss state-of-the-art technologies of genetics of antimicrobial metabolite production in biocontrol bacteria.
5. Define the major groups of microorganisms used in microbial bioconversion
6. Collect the proficient knowledge on the utilization of waste to commercially important compounds

UNIT– I Introduction

History and scope of microbial biotechnology, General concepts of microbial biotechnology. Microorganisms as factories for the production of novel compounds. 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

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*. Industrial Applications of microalgae. Microalgae as live feed.

UNIT – III Agricultural microbiology

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. 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

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

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

SUGGESTED READINGS:

1. Bernad. R. Glick and Jack J. Pasternak. (2002). Molecular Biotechnology Principles and Applications of Recombinant DNA. WCB.
2. Glazer, A.N. and Nikaido, H. (2007) Microbial Biotechnology. Cambridge, New York.
3. Harzevili, D.F. and Chen, H. (2015). Microbial Biotechonology: Progress and trends. Taylor and Francis group.
4. Kun, Y.L (2013). Microbial Biotechnology: Principles and applications. World Scientific Publishing Company; 3rd revised ed. Edition.

Semester – II

NANO BIOTECHNOLOGY

22BTP205B **4H-4C**

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

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To obtain sufficient knowledge on the fundamental concepts of Nano biotechnology
- To offer a strong information in the interface between chemistry and physics on the nano-structural level with a focus on biotechnological usage
- To provide basic concepts of synthesis and characterization of nanomaterials
- To understand the interaction of nanomaterials with biological molecules in living cells
- To learn nanomaterials and their use in agriculture
- To acquire information on nanoparticles in wastewater treatment

Course Outcomes

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

1. Recognize the role of bio nanotechnology as an interdisciplinary tool and to understand how to use these new tools in solving biological problems
2. Demonstrate the interactions and relationship between molecular dynamics, nanoscale physics and macroscopic system behavior
3. Explain basic principles of characterization tools in nanobiotechnology
4. Establish the mechanism of action of nanomaterials in living cells
5. Develop nanocarriers for crop improvement
6. Implement eco-friendly nanoparticles in wastewater treatment

UNIT – I Nanotechnology:

Definition, the fundamental Science behind nanotechnology- electrons, atoms and ions, molecules, metals, biosystems. Nanobiotechnology – concepts, definitions, prospects; nanoparticles – size, shape, properties. Types - nanoparticles, quantum dots, nanotubes and nanowires.

UNIT – II: Synthesis and characterization:

Methods – Physical, Chemical and Biological synthesis – Principle, applications; Nanoanalysis – optical (UV-Vis/Fluorescence); X-ray diffraction; Imaging and size (Electron microscopy, light scattering, zeta potential); Raman Spectroscopy, Surface and composition (ECSA, EDAX, AFM/STM etc); Vibrational (FT-IR and RAMAN), magnetic, electrical and electrochemical analysis.

UNIT – III Nano biotechnology in biomedical applications:

Nanoparticles in biomedical and clinical applications. Cytotoxicity, geno-toxicity, *In vivo* tests/assays. Biosensors. Biomedical applications: drugs, drug delivery, molecular motors, photodynamic therapy. neuro electronic interfaces, nanoluminescent tags, imaging and mapping. Microfluidics and lab-on-a-chip - Materials of microfluidic components - Silicon, glass, polymers, fluid structure, fabrication methods. Surface modifications, spotting, detection mechanics. Cancer therapeutics through nanomedicine.

UNIT – IV Nano biotechnology in agriculture:

Nanoparticles – Phytotoxicity tests/assays; Nano-materials to improve crop productivity, seed pretreatment, growth promotion, nano- fertilizers, nano- pesticides, nano-nutrient.

UNIT – V Nanotechnology and environment:

Nanoparticles in bio- degradation, nano-material-based adsorbents for water treatment, possible mutagenic properties of nanoparticles, nanoparticle bioaccumulation. Merits and demerits of applying nanotechnology on environment.

SUGGESTED READINGS:

1. Muralidharan, V.S. & Subramania, A. (2008). *Nanoscience and technology* (1st ed.). CRC Press, Florida, United States.
2. Niemeyer, C.M. & Mirkin, C. A. (2004). *Nanobiotechnology Concepts, Application and Perspectives* (1st ed.). Wiley – VCH Publishers, New York, United States.
3. Rao, C.N.R. (2006). *The Chemistry of Nanomaterial: Synthesis, Properties and Applications* (Vols 1 &3). Springer Publishers, New York, United States.
4. Ratner, M., & Ratner, D. (2002). *Nanotechnology- a Gentle Introduction to the Next Big idea*. Pearson Education, London, United Kingdom.
5. Vo-Dinh, T. (2017). Nanotechnology in Biology and Medicine: Methods, Devices and Applications. (2nd ed.). CRC Press, Florida, United States.

Semester – II

BIOSAFETY AND IPR

22BTP205C **4H – 4C**

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

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Gain the basic concepts of biodiversity and conservation
2. Obtain the perceptions on conservation of endangered species
3. Interpret basics of biosafety and its impact on all the biological sciences and the quality of human life
4. Recognize importance of biosafety practices and guidelines in research
5. Apply intellectual property law principles including copyright, patents, designs and trademarks in the production and marketing of biotech products
6. Describe various agreements and treaties related to the protection of intellectual property in biotechnology

UNIT –I Biosafety-Introduction:

Primary Containment for biohazards; Biosafety Levels; Biological Safety Cabinets;, Good laboratory practices (GLP) and Good manufacturing practices (GMP). Guidelines for research in transgenic plants. Cartagena protocol on biosafety.

UNIT –II Biological risk assessment:

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

UNIT –III Bioethics:

Introduction. Animal Rights. Ethical conflicts in biological sciences - interference with nature, general issues related to environmental release of transgenic plants, animals and microorganisms. Ethical issues related to research in embryonic stem cell cloning. Ethical, legal and social Implications (ELSI) of Human Genome Project.

UNIT –IV Intellectual property rights:

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

UNIT – V Patent application:

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

SUGGESTED READINGS:

1. Balasubramanian, S. (2017). India: Traditional Knowledge and Patent Issues: An Overview of Turmeric, Basmati, Neem Cases.
2. Biodiversity and Conservation. http://ncert.nic.in/ncerts/l/lebo115.pdf
3. Gaston, K.J. &Spicer, J.I. (2013) *Biodiversity: An Introduction* (2nd ed.). Wiley-Blackwell Publishers, New Jersey, United States.
4. GEAC India. http://geacindia.gov.in/resource-documents/biosafety-regulations/guidelines-and- protocols/GuidelinesfortheERAofGEplants.pdf
5. Goel, D. & Parashar, S. (2013). *IPR, Biosafety and Bioethics* (1st ed.). Pearson Publishers, London, United Kingdom.
6. http://www.mondaq.com/india/x/586384/Patent/Traditional+Knowledge+And+Patent+Issues+An+Overview+Of+Turmeric+Basmati+Neem+Cases
7. Intellectual Propertry India. The Patents Act, 1970. http://www.ipindia.nic.in/writereaddata/Portal/IPOAct/1311_patent-act-1970-11march2015. pdf
8. IPR in UK. https://www.wilsongunn.com/guide-to-ip/
9. Kankanala, C. (2007). *Genetic Patent Law and Strategy* (1st ed.). Manupatra Information Solution Pvt. Ltd. India.
10. Legal and Public Aspects of Biotechnology. http://www.actahort.org/members/showpdf?booknrarnr=447_125.
11. Llewelyn, D. & Aplin, T. (2019). Intellectual Property: Patents, Copyrights, Trademarks & Allied Rights (9th ed.). Sweet & Maxwell Publishers, London, United Kingdom.
12. Ministry of Environment, Forest and Climate Change, India. http://moef.gov.in/environment/biodiversity/

13. National Biodiversity Authority of India. http://nbaindia.org/.
14. Office ofthe Controller General of Patents, Designs & Trade Marks, India. http://www.ipindia.nic.in/
15. Transgenic Crops-Biosafety Concerns and Regulations in India. http://vikaspedia.in/agriculture/crop-production/advanced-technologies/transgenic-crops-biosafety-concerns-and-regulations-in-india
16. U.S. Department of Health and Human Services. (2016). Biosafety in Microbiological and Biomedical Laboratories. Lulu Publishers, North Carolina, United States.
17. World Intellectual Property Organization. http://www.wipo.int/portal/index.html.en

RECOMBINANT DNA, FERMENTATION AND BIOPROCESS TECHNOLOGY PRACTICAL – III

22BTP211 **4H-2C**

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

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Perform recombinant DNA techniques including restriction and digestion, ligation, transformation and PCR
2. Carry out DNA and RNA isolation from microbes, plants and animals
3. Demonstrate various blotting techniques
4. Extract amylase or protease enzyme from microbial sources
5. Perform the enzyme immobilization assays
6. Explain the methods of wine production and alcohol determination

Recombinant DNA technology practical's

1. Isolation and analysis of total genomic DNA from Microbes (*E. coli*) and plant.
2. Isolation and analysis of plasmid DNA.
3. Isolation and analysis of total RNA.
4. Restriction digestion, ligation of DNA and vector.
5. Transformation of plasmid DNA using calcium chloride.
6. DNA Amplification by PCR.
7. Southern blotting (Demonstration).
8. Northern blotting (Demonstration).
9. Western blotting (Demonstration)

Fermentation and bioprocess technology practical's

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

SUGGESTED READINGS:

1. Green, M.R. &Sambrook, J. (2012). *Molecular Cloning: A Laboratory Manual*. (4thed.). Cold Spring Harbor Laboratory Press, New York, United States.
2. Greene, J.J.&Rao, V.B. (2001). *Recombinant DNA Principles and Methodologies.* (2nded.) CRC Press, Florida, United States.
3. Kulandaivelu, S. &Janarthanan, S. (2012). *Practical Manual on Fermentation Technology*. IK International Publishers, New Delhi, India.
4. Schuler, M.A. & Zielinski, R.E. (2012). *Methods in Plant Molecular Biology.* (1sted.).Academic Press Publishers, New York, United States.

IMMUNOLOGY AND IMMUNOTECHNOLOGY PRACTICAL – IV

22BTP212 **4H-2C**

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

Course Objectives

The main objectives of the course are

- To perform and understand basic immuno techniques
- To acquaint versatile tools and techniques employed in immuno technology such as ABO blood grouping
- To gain knowledge in immunoelectrophoresis
- To understand different types of immunodiffusion methods
- To gain hands on experience in immunological tools such as immunoelectrophoresis and WIDAL test
- To understand the concepts of ELISA and ELISpot

Course Outcomes

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

1. Carry out the laboratory immuno techniques
2. Explain the preparation of samples for immuno technological analyses
3. Describe antigen-antibody interactions using immunodiffusion methods
4. Utilize the immune techniques in diagnostic laboratories
5. Demonstrate antigen-antibody specificity
6. Perform Western blotting experiment to quantify the protein

Immuno-technology Practical's

1. ABO blood grouping, preparation of serum from blood
2. Methods of immunization, methods of bleeding, Hemolysis
3. Single and double radial immunodiffusion
4. Immunoelectrophoresis
5. Rocket immunoelectrophoresis
6. Haemagglutination
7. WIDAL test
8. DOT-ELISA
9. ELISpot
10. Western blotting

SUGGESTED READINGS:

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

Semester – II

JOURNAL PAPER ANALYSIS AND PRESENTATION

2H-0C

Semester – III

PLANT BIOTECHNOLOGY

22BTP301 **4H – 4C**

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

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Understand the growth conditions required to culture the plants in *in vitro* conditions
2. Inculcate the deep information of genetic engineering of plants
3. Acquire strong knowledge on transgenic plant production
4. Implement gene transfer methods to develop transgenic plants
5. Develop plant-based enzyme engineered edible vaccines
6. Recognize various progresses involved in plant tissue culture

UNIT – I Introduction:

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

UNIT - II Micropropagation:

Tissue culture media – composition and preparation, Callus and suspension culture, somaclonal 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 -III Plant genome organization:

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

UNIT-IV Plant genetic engineering:

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

UNIT - V Application of genetic transformation:

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

SUGGESTED READINGS:

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

Semester – III

ANIMAL BIOTECHNOLOGY

22BTP302 **4H – 4C**

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

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Understand the growth conditions required to culture the animal in *in vitro* conditions
2. Inculcate the deep information of genetic engineering of animal
3. Acquire strong knowledge on transgenic animal
4. Implement gene transfer methods to develop transgenic animal
5. Develop animal-based growth hormone
6. Recognize various progresses involved in development of transgenic animal

UNIT I Animal cells:

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:

Types, disaggregation of tissue, primary culture, established culture; Suspension culture, organ culture, three dimensional culture and tissue engineering, feeder layers; Cell synchronization; cryopreservation. 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:

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

UNIT IV Embryology:

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:

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

SUGGESTED READINGS:

1. Ranga, M. M. (2007). Animal Biotechnology. (3rd ed.). Jodhpur: Agrobios.
2. Freshney, R.I. (2000). Animal Cell Culture: A Practical Approach (4th ed.). New York: John Wiley Publications.
3. Glick, B.R., & Pasternack, J.J. (2003). Molecular Biotechnology (3rd ed.). UK: Blackwell Science.
4. Gordon, I. (2003). Laboratory Production of Cattle Embryos (2nd ed.). New Delhi: CAB International.
5. Yagasaki, K., Miura, Y., Hatori, M. & Nomura, Y. (2008). Animal Cell Technology: Basic and Applied Aspects (Vols 13). New York: Springer-Verlag.
6. Primrose, S.B., Twyman, R.M., & Old, R.W. (2001). Principles of Gene Manipulation (6th ed.). Germany: Blackwell Science Publishing Company.
7. Portner, R. (2014). Animal Cell Biotechnology: Methods and Protocols. 3rd edition. New York: Springer-Verlag.

Semester – III

ENVIRONMENTAL BIOTECHNOLOGY

22BTP303 **4H – 4C**

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

End Semester Exam: 3 Hours

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Demonstrate various types of ecosystems, environmental threats and management
2. Discuss the different methods of bioremediation and its impact on environmental pollution
3. Appreciate recent approaches to biological wastewater treatment
4. Recognize the importance of bioaugmentation for the degradation of xenobiotics
5. Implement different types of biofuels such as biogas, bioethanol and biohydrogen for betterment of green environment
6. To understand the importance of biological techniques in controlling air pollution

UNIT – I Environment

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, land degradation.

UNIT – II Bioremediation

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 disadvantages; *In-situ* and *ex-situ* bioremediation; 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

Sewage and wastewater 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 wastewater treatment, composting process and techniques, use of composted materials, vermicomposting (Role of *Eudrilus eugeniae* and *E. fistea).*

UNIT – IV Decomposition and treatment strategies

Biological decomposition of organic carbon, Nitrogen and phosphate removal. Biological removal, biotransformation, and biosorption of metal ions. Aerobic- and anaerobic degradation of xenobiotics. Bioaugmentation for degradation of xenobiotics. Industrial sources of waste water. Treatment strategies.

UNIT – V Fuels and Hazards

Biofuels and biological control of air pollution, plant derived fuels, biogas, landfill 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 Handling rules. Environmental Protection Act, 1986, Water (Prevention and Control of Pollution) Act, 1974.

SUGGESTED READINGS:

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

Semester – III

GENOMICS, PROTEOMICS AND BIOINFORMATICS

22BTP304 4H – 4C

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

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Have a clear understanding on the application of genome sequencing, genome mapping, proteomic data analysis
2. Analyze the genomic and proteomic data
3. Utilize the omics databases for genomic and proteomic data analysis
4. Demonstrate sequence and structural alignments using softwares such as BLAST, tBLASTn and DALI
5. Discuss the application of phylogenetic tree in protein analysis
6. Describe the tools used in the prediction of three-dimensional structure of proteins

UNIT I Genomics:

Genome – Human Genome project (HGP)-Merits and limitations of chemical sequencing method – Dideoxy method – mRNA sequencing – cDNA library – Shotgun method – Automated sequencing – Next generation sequencing – Pyrosequencing –Genome mappings – Restriction mappings – Fluorescence *in situ* hybridization (FISH) – Genetic markers – SNP, VNTR, RFLP, Minisatellite and Microsatellite – Applications of genome mappings.

UNIT II Proteomics:

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 databases:

Genome databases – ENSEMBL - VISTA – FlyBase – OMIM – Protein databases – NCBI – UniProt – Secondary databases – PROSITE - 2D PAGE Database - Structural databases – PDB – SCOP – CATH.

UNIT IV Sequence and structural alignments:

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:

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 – Stereochemical and structural analysis – Molecular visualization tools and Next Generation Sequencing (NGS).

SUGGESTED READINGS:

1. Attwood, T.K. (2007). *Introduction to Bioinformatics* (1st ed.). Pearson Education, London, United Kingdom.
2. Bhat, S. (2008). *Genomics*. Duckworth Press, London, United Kingdom.
3. Gu, J. & Bourne, P.E. (2018). *Structural Bioinformatics* (2nd ed.). Wiley-Blackwell Publishers, New Jersey, United States.
4. Ibrahim, K.S., Gurusubramanian, G., Zothansanga, Yadav, R.P., Kumar, N.S., Pandian, S.K., Borah, P., & Mohan, S. (2017). Bioinformatics - 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.
6. Mount, D.W. (2005). *Bioinformatics –Sequence and Genome Analysis* (2nd ed.). CBS Publishers, CSHL Press, New York, United States.
7. Palzkill, T. (2007). *Proteomics*. Springer Publishers, New York, United States.
8. Primrose, SB & Twyman, R. (2006). *Principles of genome analysis and Genomics*. Wiley-Blackwell Publishers, New Jersey, United States.

FOOD BIOTECHNOLOGY

22BTP305A **3H – 3C**

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

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Understand the beneficial role of microorganisms in fermented foods and food processing
2. Understand the significance and activities of microorganisms in food and role of intrinsic and extrinsic factors on growth and survival of microorganisms in foods
3. Learn the various technological aspects of fermented products such as beer and wine in larger scale production
4. Know the spoilage mechanisms in foods and thus identify methods to control deterioration and spoilage
5. Identify ways to control microorganisms in foods and thus know the principles involving various methods of food preservation
6. Recognize and describe the characteristics of food adulterants and their safety measures

Unit – I Introduction:

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

Unit – II Food microbiology:

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

Unit – III Fermented foods:

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 Food spoilage and preservation: Causes of food spoilage, spoilage of fruits, vegetables, meat, soft Drinks, eggs, sea food products, dairy products. Food Preservation through chemicals - acids, salts, sugars, antibiotics, ethylene oxide, antioxidants. Other methods of food peservation -

Radiations, low and high temperature, drying. Food packaging materials and their properties.

Unit – V Food adulteration and food safety:

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

SUGGESTED READINGS

1. Adam, M.R. & Moss, M.O. (2018). *Food Microbiology*. New Age International Publishers, New Delhi, India.
2. Bell, C., Neaves, P., & Williams, A.P. (2005). *Food Microbiology and Laboratory Practice.* Wiley-Blackwell Publishers, New Jersey, United States.
3. Bhatia, S.C. (2017). *Food Biotechnology*. WPI Publishers, New Delhi, India.
4. Export/import data by DGCIS-Calcutta.
5. Export/import policy by Govt. of India.
6. Frazier, W.C., Westhoff, D.C., & Vanitha, N.M. (2017). *Food Microbiology* (5th ed.). McGraw - Hill Education/ Medical, London, United Kingdom.
7. Harrigan, W. F. (2013). *Laboratory methods in Food Microbiology* (3rd ed.). Elsevier Publishers, Amsterdam, Netherlands.
8. Jain, K.S. & Jain, A.V. (2017). *Foreign Trade - Theory, Procedures, Practices and Documentation* (7th ed.). Himalaya Publishing House, Mumbai, India.
9. Jay, J.M., Loessner, J.M., & Golden, A.D. (2008). *Modern Food Microbiology* (7th ed.). Springer Publishers, New York, United States.
10. Suri, S. & Malhotra, A. *Food Science, Nutrition and Safety*. Pearson Education India Publishers, London, United Kingdom.

AGRICULTURAL BIOTECHNOLOGY

22BTP305B **3H – 3C**

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

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Demonstrate the techniques in plant tissue culture
2. Explain the genetic transformation techniques in plants
3. Develop transgenic plants in crop improvement
4. Produce stress resistant crops against microbes and insects
5. Validate the applications of genetic transformation, metabolic engineering, production of pharmaceuticals and industrial products
6. To get a career in Industry / Research and Development

UNIT –I Plant tissue culture and its applications:

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

UNIT –II Genetic and molecular basis:

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

UNIT –III Improvement of crop plants:

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

UNIT – IV Stress resistance on crops:

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

UNIT – V Genetic engineering for increasing crop productivity:

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

SUGGESTED READINGS:

1. Adrian Slater, Nigel Scott and Mark Fowler, Plant Biotechnology: The genetic manipulation of plants, 1st Edition, Oxford University Press, 2003
2. Chakraborty .U, Bishwanath Chakraborty, 2005. Stress biology, Vidhyasekaran, P. 2007. Narosa Publishing House.
3. Denis Murphy, Plant Breeding and Biotechnology: Societal Context and the Future of Agriculture, Cambridge University Press, 2007.
4. Gupta P K Plant Biotechnology, Rastogi Publication, Meerut, India.
5. Jaiwal P K & Singh R P (eds) Plant Genetic Engineering Vol-1 to Vol. 9. Studium Press, USA, 2006.

PHARMACEUTICAL BIOTECHNOLOGY

22BTP305C **3H – 3C**

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

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Evaluate different pharmaceutical parameters of current biotechnology products
2. Determine parameters related to stability and formulation of biotechnology-derived drugs
3. Discuss quality control procedures related to biotechnology products
4. Apply the knowledge of physicochemical properties of drugs in novel drug designing
5. Demonstrate novel formulation methods for better delivery of biotechnology derived drugs
6. Join pharmaceutical biotechnology lab and industries as a research assistant

UNIT –I Introduction:

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:

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

UNIT –III Pharmacokinetics:

Pharmacogenomics. Pharmacokinetics – Order of kinetics – drug safety and effectiveness- Drug

interactions. Pharmacodynamic interactions- Drug tolerance – Adverse drug reactions. Drug tolerance – Adverse drug reactions, Drug repurposing.

UNIT –IV Genetically engineered protein:

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:

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

SUGGESTED READINGS:

1. Abraham, D.J. & Rotella, D.P. (2010). *Burger's Medicinal Chemistry, 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.
5. 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.
6. Rho, J.P. & Louie, S.G. (2003). *Hand book of Pharmaceutical Biotechnology* (1st ed.). CRC Press, Florida, United States.
7. Satoskar, R. S., Rage, N.N., Tripathi, R.K., & Bhandarkar, S. D. (2017). *Pharmacology and Pharmacotherapeutics* (25th ed.). Elsevier India Publishers, Chennai, India.
8. Sethi, P.D. (2008). *Quantitative Analysis of Drugs in Pharmaceutical Formulations* (3rd ed.). CBS Publishers and Distributers, New Delhi, India.

Semester – III

PLANT AND ANIMAL BIOTECHNOLOGY PRACTICAL – V

22BTP311 **4H – 2C**

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

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

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

Course Outcomes

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

1. Acquaint with principles, technical requirement, scientific and commercial applications in plant and animal biotechnology
2. Support methodologies in plant and animal tissue/cell culture
3. Describe basic gene transfer technologies in plants
4. Designate problems associated with plant and animal tissue culture
5. Demonstrate strong knowledge in routine practices of plant and animal tissue culture
6. Join as lab manager or key scientist in plant and animal biotechnological research institute and industries.

Plant Tissue Culture Practicals

1. *In vitro* germination of seeds
2. Multiple shoot induction
3. Hairy root culture
4. Suspension culture and estimate the product yield (Flavanoid)
5. Embryo culture
6. Synthetic seed production.
7. Protoplast isolation
8. *Agrobacterium*-mediated gene transformation
9. Demonstration of gene transfer by particle bombardment.
10. Hardening of PTC plants

Animal Biotechnology practicals

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 phytomolecules by MTT assay

SUGGESTED READINGS:

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* (2nded.). Taylor & Francis Publishers, Abingdon, United Kingdom.
3. Slater, A., Scott, N.W. & Fowler, M.R. (2008). *Plant Biotechnology: The Genetic Manipulation of plants* (2nded.). Oxford University Press, Oxford, United Kingdom.

Semester – III

GENOMICS, PROTEOMICS AND BIOINFORMATICS PRACTICAL – VI

22BTP312 **3H – 2C**

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

End Semester Exam: 3 Hours

Course Objectives

The main objectives of the course are

- To give knowledge on genomics, proteomics and bioinformatics and their application
- To gain knowledge to assess biological databases
- To understand and to analyze protein/nucleotide sequences and to predict its 3D structure
- To comprehend the various online databases for submitting and retrieving data
- To recognize how the phylogeny plays a vital role in finding ambiguities
- To get practiced with the tools and techniques for analyzing the data

Course Outcomes

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

1. Understand the relationship between sequence - structure - function of genes
2. Familiarize with the algorithms required to compare sequences and require to know the phylogenetic relationship between the gene sequences
3. Inculcate knowledge on building 3D structures of genes
4. Locate and use the main databases at the NCBI and EBI resources
5. Know the difference between databases, tools, repositories and be able to use each one to extract specific information
6. Use selected tools at RasMol, JMol and PyMol to run simple analyses on genomic sequences

Practicals

1. Exploring of primary databases (Proteins) and sequence retrieval
2. Exploring of primary databases (Nucleic acids) and sequence retrieval
3. Exploring of secondary databases (Nucleic acids) and sequence retrieval
4. Physicochemical and structural analyses of primary sequences (Proteins and Nucleic acids)
5. Multiple sequence alignments and phylogenetic analysis
6. Comparative modeling using online and standalone tools
7. Structural analysis and verification tools
8. 3D structure prediction and validation tools
9. Molecular visualization tools: RasMol, JMol and PyMol
10. Molecular dockings of biological macromolecules

SUGGESTED READINGS:

1. Baxevanis, A.D. & Ouellette, B.F. (2001). *Bioinformatics – A practical guide to the analyze of genes and proteins* (2nd ed.). Wiley-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.

Semester – III

JOURNAL PAPER ANALYSIS AND PRESENTATION

1H-0C

Semester – III

OPEN ELECTIVE

3H – 2C

Instruction Hours/week: L: 3 T: 0 P: 0

Marks: Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Semester – III

INTERNSHIP PROGRAMME

22BTP391 2C

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

PROJECT – VIVA VOCE

22BTP491 **15C**

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

Course Objectives

The main objective of the course is

- To give hands-on training through one full semester project with thesis gives special expertise within one of the research areas represented at the Department of Biotechnology.

Course Outcomes

On successful completion of the course, the learners will be able to apply their knowledge on

1. This dissertation programme provides the candidate with knowledge, general competence, and analytical skills on an advanced level, needed in industry, consultancy, education and research.
2. Students will acquaint core knowledge in the domain field of biotechnology.
3. Intensive hands on training in advanced techniques in molecular biology.
4. Students will have adequate experience in doing PhD research.
5. Students will be skilled analyst in operating instruments and experiments.
6. Will get employment opportunity in research labs, pharmaceutical industries.

Open Elective Course **2022-2023**

Semester – III

PLANT TISSUE CULTURE AND ITS APPLICATION

22BTPOE301 **3H-2C**

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

Course Objectives

The main objectives of the course are

- To cognize and get the knowledge on plant tissue culture
- To give knowledge about macro and micro nutrients
- To impart knowledge about media preparation and sterilization
- To understand the process of callus induction
- To estimate the plant growth
- To acquaint recent developments in artificial seed production

Course Outcomes

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

1. Understand the growth conditions required to culture the plants in *in vitro* conditions
2. Inculcate the knowledge about explant selection
3. Acquire strong knowledge on culture maintainence
4. Implement methods to estimate the plant growth
5. Analyse the secondary metabolites of plant
6. Know the method of artificial seed production

Unit I

Introduction to Plant tissue culture

History and scope - Definitions - laboratory arrangement of plant tissue culture

Unit II

Nutritional requirements

Macro & micro nutrients - organic supplements - phytohormones - tissue culture media and types

Unit III

Sterilization techniques

Media preparation and sterilization - glassware, instruments and phytohormones sterilization - explant selection - explants types - surface sterilization of explants

Unit IV

Micro propagation

Aseptic seed germination - induction of callus - regeneration of shoots - culture maintenance and subculture - rhizogenesis - estimation of growth - hardening.

Unit V

Applications

Production of secondary plant metabolites - hairy root culture - artificial seed production - tissue culture methods for production of haploid cell lines

SUGGESTED READINGS:

1. Bhojwani, S.S., & Razdan, (2004). Plant Tissue Culture and Practice.
2. Reinert, J., & Bajaj, Y.P.S. (1997). Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House.
3. Slater, A., Scott, N.W., & Fowler, M.R. (2008). Plant Biotechnology: The Genetic Manipulation of Plants. Oxford University Press.
4. Halford, N. (2006). Plant Biotechnology: Current and Future Applications of Genetically Modified Crops. Wiley-Blackwell, New Jersey, United States.