M.Sc., BIOTECHNOLOGY
CHOICE BASED CREDIT SYSTEM (CBCS)

Curriculum and Syllabus
Regular (2018-2019)

DEPARTMENT OF BIOTECHNOLOGY
FACULTY OF ARTS, SCIENCE AND HUMANITIES

KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established under section 3 of UGC Act, 1956)
Pollachi Main Road, Eachanari (Post), Coimbatore- 641021, Tamil Nadu, India
Phone: 0422 – 2980011 –15; Fax No: 0422 – 2980022-23
Email: info@karpagam.com Web: www. kaheedu.edu.in
KARPAGAM ACADEMY OF HIGHER EDUCATION
Karpagam Academy of Higher Education
(Deemed University, Established under Section 3 of UGC Act, 1956)
Coimbatore - 641 021, INDIA

FACULTY OF ARTS, SCIENCE AND HUMANITIES
POST-GRADUATE PROGRAMMES
(M.A., M.Sc., M.Com.)
REGULAR PROGRAMME
REGULATIONS 2018
CHOICE BASED CREDIT SYSTEM (CBCS)

The following Regulations are effective from the academic year 2018-2019 and are applicable to the students admitted in Post Graduate (PG) Degree programmes in the Faculty of Arts, Science, and Humanities, Karpagam Academy of Higher Education (KAHE) from the academic year 2018 – 2019 onwards.

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.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Programme Offered</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M.Sc. Biochemistry</td>
</tr>
<tr>
<td>2</td>
<td>M.Sc. Microbiology</td>
</tr>
<tr>
<td>3</td>
<td>M.Sc. Biotechnology</td>
</tr>
<tr>
<td>4</td>
<td>M.Sc. Physics</td>
</tr>
<tr>
<td>5</td>
<td>M.Sc. Chemistry</td>
</tr>
<tr>
<td>6</td>
<td>M.Sc. Mathematics</td>
</tr>
<tr>
<td>7</td>
<td>M.Sc. Computer Science</td>
</tr>
<tr>
<td>8</td>
<td>M.Sc. Applied Astrology</td>
</tr>
<tr>
<td>9</td>
<td>M.Com.</td>
</tr>
<tr>
<td>10</td>
<td>M.Com. with Computer Applications</td>
</tr>
</tbody>
</table>
1.2 MODE OF STUDY

Full-Time
Candidates admitted under ‘Full-Time’ should be present in the University during the complete working hours for curricular, co-curricular and extra-curricular activities assigned to them.

1.3 ADMISSION REQUIREMENTS
Candidates for admission to the first semester Master’s Degree Programme shall be required to have passed an appropriate Degree Examination of this Deemed to be University 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

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of the Programme Offered</th>
<th>Eligibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M.Sc. Biochemistry</td>
<td>B.Sc. Degree with Biology / Biochemistry / Chemistry with Biology Ancillary Biotech / 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 &amp; Biotechnology / Animal Cell &amp; Biotechnology / Agriculture / Medical Lab Technology / Nutrition &amp; Dietetics</td>
</tr>
<tr>
<td>2</td>
<td>M.Sc. Microbiology</td>
<td>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</td>
</tr>
<tr>
<td>No.</td>
<td>Course</td>
<td>Eligibility</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>5</td>
<td>M.Sc. Chemistry</td>
<td>B. Sc. Chemistry (with Physics / Mathematics / Zoology / Botany as one of the allied subjects) Polymer Chemistry</td>
</tr>
<tr>
<td>8</td>
<td>M.Sc. Applied Astrology</td>
<td>B.Sc. Allied Astrology or Equivalent degree</td>
</tr>
<tr>
<td>10</td>
<td>M.Com with Computer Applications</td>
<td>B.Com / B.Com (CA) / B.Com(PA)/B.Com(Finance &amp; insurance)/ B.Com.(IT) B.Com (e-Commerce) / B.B.M / B.B.M (CA) / B.B.A / B.B.A (CA) B.C.S/ B.C.S (CA)/ Bachelor’s Degree in Bank</td>
</tr>
</tbody>
</table>
2 DURATION OF THE PROGRAMMES
2.1 The minimum and maximum period for completion of the P.G. Programmes are given below:

<table>
<thead>
<tr>
<th>Programme</th>
<th>Min. No. of Semesters</th>
<th>Max. No. of Semesters</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.A, M.Sc., M.Sc., (CA)</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>M.Com, M.Com (CA)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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. Credits
Credits means the weightage given to each course of study by the experts of the Board of Studies concerned. A total of 87 to 93 credits are prescribed for the PG programme (two years)

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

b. Electives
Elective courses are to be chosen with the approval of the Head of the 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 shall 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.
Online Course
Student shall study at least one online course from SWAYAM / NPTEL / MOOC in any one of the first five semesters for which examination shall be conducted at the end of the course by the respective organizations. The student can register to the courses which are approved by the Department. The student shall produce a pass certificate from the respective organizations 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 required credits earned from program concerned.

5. MEDIUM OF INSTRUCTION
The medium of instruction for all courses, examinations, seminar presentations and project/thesis/dissertation reports shall 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 a 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

<table>
<thead>
<tr>
<th>S. No</th>
<th>Programme</th>
<th>Maximum marks</th>
<th>CIA</th>
<th>ESE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MA, M.Com, M.Com (CA), M.Sc., M.Sc., (CA)</td>
<td>200</td>
<td>80</td>
<td>120</td>
</tr>
</tbody>
</table>

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 has been 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 attendance requirements and shall be permitted to appear for the examination on the recommendation of the Head of the Department concerned and Dean to condone the lack of
attendance. The Head of the 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 University.

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 TUTOR
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 to whom they shall function as faculty tutor throughout their period of study. Faculty tutors shall advise the students and monitor their conduct of behavior and academics. Problems if any, they should be counseled periodically. The Faculty tutor is also responsible to inform the parents of their wards progress. Faculty tutor shall display the cumulative attendance particulars of his / her ward students’ periodically (once in 2 weeks) on the Notice Board to enable the students 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 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 coordinator 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 may be convened at least once in a month. The functions of the class committee 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 is to be constituted by the respective faculty Dean.

• The class committee shall be constituted within the first week of each semester.

• The HoD / Chairperson of the class committee may convene the meeting of the class committee.

• The respective faculty Dean may 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.

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 and shall ensure a uniform evaluation of the tests. It 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 marked in 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 the records of test marks and attendance. The HoD shall sign with date after due verification. The same should 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 University / 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

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Category</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attendance</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Test – I (first 2 ½ units)</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Test – II (last 2 ½ units)</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>Journal Paper Analysis &amp; Presentation*</td>
<td>15</td>
</tr>
</tbody>
</table>

*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

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Category</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Attendance</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Observation work</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Record work</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Model practical examination</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td><em>Viva – voce [Comprehensive]</em></td>
<td>10</td>
</tr>
</tbody>
</table>

*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

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Marks</td>
<td>50 marks</td>
</tr>
<tr>
<td>Duration</td>
<td>2 Hours</td>
</tr>
<tr>
<td>Part – A</td>
<td>Objective type (20x1=20)</td>
</tr>
<tr>
<td>Part - B</td>
<td>Short Answer Type (3 x 2 = 6)</td>
</tr>
<tr>
<td>Part - C</td>
<td>3 Eight mark questions ‘either – or’ choice (3 x 8 = 24 Marks)</td>
</tr>
</tbody>
</table>

11.4 Attendance

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Attendance %</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>91 and above</td>
<td>5.0</td>
</tr>
<tr>
<td>2</td>
<td>86 - 90</td>
<td>4.0</td>
</tr>
<tr>
<td>3</td>
<td>81 - 85</td>
<td>3.0</td>
</tr>
<tr>
<td>4</td>
<td>75 - 80</td>
<td>2.0</td>
</tr>
<tr>
<td>5</td>
<td>Less than 75</td>
<td>0</td>
</tr>
</tbody>
</table>
12. KAHE 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

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Marks</td>
<td>60 marks for ESE</td>
</tr>
<tr>
<td>Duration</td>
<td>3 hours (½ Hr for Part – A Online &amp; 2 ½ Hours for Part – B and C</td>
</tr>
<tr>
<td>Part – A</td>
<td>20 Questions (20 x 1 = 20 Marks ) Question No. 1 to 20 Online Multiple Choice Questions</td>
</tr>
<tr>
<td>Part- B</td>
<td>5 six mark Questions (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)</td>
</tr>
<tr>
<td>Part - C</td>
<td>Question No.26. One Ten mark Question (1 x 10 = 10 Marks)</td>
</tr>
</tbody>
</table>

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 should remain the same at the subsequent appearance by the candidate.
12.3. **Evaluation of Project Work**

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

12.3.2 The project report prepared according to approved guidelines and duly signed by the supervisor(s) shall be submitted to HoD. Guidelines to prepare the project report
a. Cover page
b. Bona fide certificate
c. Declaration
d. Acknowledgement
e. Table of contents
f. Chapters
   Introduction
   Aim & Objectives
   Materials & 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 a 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 KAHE. In case the guide 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, 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 for CIA and it is 20 marks out of 40 marks. The passing minimum in ESE is 30 marks
out of 60 marks. 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 a pass is secured 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 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 of improving 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:
<table>
<thead>
<tr>
<th>Letter grade</th>
<th>Marks Range</th>
<th>Grade Point</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>91 - 100</td>
<td>10</td>
<td>OUTSTANDING</td>
</tr>
<tr>
<td>A+</td>
<td>81 - 90</td>
<td>9</td>
<td>EXCELLENT</td>
</tr>
<tr>
<td>A</td>
<td>71-80</td>
<td>8</td>
<td>VERY GOOD</td>
</tr>
<tr>
<td>B+</td>
<td>66-70</td>
<td>7</td>
<td>GOOD</td>
</tr>
<tr>
<td>B</td>
<td>61 – 65</td>
<td>6</td>
<td>ABOVE AVERAGE</td>
</tr>
<tr>
<td>C</td>
<td>55 - 60</td>
<td>5</td>
<td>AVERAGE</td>
</tr>
<tr>
<td>D</td>
<td>50 - 54</td>
<td>4</td>
<td>PASS</td>
</tr>
<tr>
<td>RA</td>
<td>&lt;50</td>
<td>-</td>
<td>REAPPEARANCE</td>
</tr>
<tr>
<td>AAA</td>
<td>-</td>
<td>-</td>
<td>ABSENT</td>
</tr>
</tbody>
</table>

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.

\[
\text{GPA of a Semester} = \frac{\sum CiGPi}{\sum Ci}
\]

i.e. \( \text{GPA of a Semester} = \frac{\sum_i CiGPi}{\sum_i Ci} \)

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

CGPA of the entire programme = \( \frac{\sum CiGPi}{\sum Ci} \)

Sum of the credits of the courses of the entire programme
i.e. CGPA of the entire programme = \[ \frac{\sum_{i}^{n} C_{ni} GP_{ni}}{\sum_{i}^{n} C_{ni}} \]

where,

- \( C_{i} \) is the credit fixed for the course ‘i’ in any semester
- \( GP_{i} \) 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 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 Examination will arrange for the revaluation and the results will be intimated to the candidate through the concerned HoD. Revaluation is not permitted for supplementary theory courses.

18. TRANSPARENCY AND GRIEVANCE COMMITTEE
Revaluation and Re-totalling 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 University), HoD of the Department concerned, the faculty of the course and Dean from other discipline nominated by the University and the CoE. If the Committee feels that the grievance is genuine, the script may be sent for external valuation; the marks awarded by the External examiner will be final. The student has to pay the prescribed fee for the same.

19. ELIGIBILITY FOR THE AWARD OF THE DEGREE
A student shall be declared to be eligible for the conferment of the Degree if he / she has

- Successfully completed all the components in clause 3 and gained the required number of total credits as specified in the curriculum corresponding to his / her Programme within the stipulated period.
• No disciplinary action is 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, may for valid reasons and on prior application, 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. Every student is required to observe disciplined 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 University. The erring students will be referred to the disciplinary committee constituted by the University, to enquire into acts of indiscipline and recommend the University about the disciplinary action to be taken.

25.2. If a student indulges in malpractice in any of the University / Internal Examination he / she shall be liable for punitive action as prescribed by the university from time to time.

26. REVISION OF REGULATION AND CURRICULUM
The University 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 AND HUMANITIES
**PG PROGRAM (CBCS) – M.Sc. Biotechnology**
*(2018–2019 Batch and onwards)*

### Objectives and Outcomes

<table>
<thead>
<tr>
<th>Course code</th>
<th>Name of the course</th>
<th>EOE’s</th>
<th>PO’s</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credit(s)</th>
<th>CIA</th>
<th>ESE</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>18BTP101</td>
<td>Biochemistry and Microbiology</td>
<td>a</td>
<td></td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>60</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>18BTP102</td>
<td>Cell Biology and Molecular genetics</td>
<td>a</td>
<td></td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>60</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>18BTP103</td>
<td>Ecology, Evolutionary and Developmental Biology</td>
<td>a</td>
<td></td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>60</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>18BTP104</td>
<td>Bioinstrumentation and Biostatistics</td>
<td>a, b</td>
<td></td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>40</td>
<td>60</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>18BTP105A</td>
<td>Biodiversity, Biosafety And IPR</td>
<td>a</td>
<td></td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>60</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>18BTP105B</td>
<td>Nano-Biotechnology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18BTP105C</td>
<td>Bio-energy Technology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18BTP111</td>
<td>Biochemistry and Microbiology - Practical – I</td>
<td>b, c</td>
<td></td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>20</td>
<td>60</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>18BTP112</td>
<td>Cell Biology and Molecular Genetics - Practical – II</td>
<td>b, c</td>
<td></td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>20</td>
<td>60</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Journal Paper Analysis &amp; Presentation</td>
<td>d</td>
<td></td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Semester total**

### SEMESTER - I

<table>
<thead>
<tr>
<th>Course code</th>
<th>Name of the course</th>
<th>EOE’s</th>
<th>PO’s</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credit(s)</th>
<th>CIA</th>
<th>ESE</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>18BTP201</td>
<td>Recombinant DNA technology</td>
<td>a, e, f</td>
<td></td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>60</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>18BTP202</td>
<td>Fermentation and BioprocessTechnology</td>
<td>a, e, f</td>
<td></td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>60</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>18BTP203</td>
<td>Enzyme Technology</td>
<td>a, e, f</td>
<td></td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>40</td>
<td>60</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>18BTP204</td>
<td>Immunotechnology</td>
<td>a, e, f</td>
<td></td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>60</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>18BTP205A</td>
<td>Pharmaceutical Biotechnology</td>
<td>a, e, f</td>
<td></td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>60</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>18BTP205B</td>
<td>Agricultural Biotechnology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18BTP205C</td>
<td>Industrial Toxicology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18BTP211</td>
<td>Recombinant DNA, Fermentation and BioprocessTechnology - Practical – III</td>
<td>b, c</td>
<td></td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>20</td>
<td>60</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>18BTP212</td>
<td>Immuno and Enzyme Technology</td>
<td>b, c</td>
<td></td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>20</td>
<td>60</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Journal Paper Analysis &amp; Presentation</td>
<td>d</td>
<td></td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Semester total**

### SEMESTER - II

<table>
<thead>
<tr>
<th>Course code</th>
<th>Name of the course</th>
<th>EOE’s</th>
<th>PO’s</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credit(s)</th>
<th>CIA</th>
<th>ESE</th>
<th>Total</th>
</tr>
</thead>
</table>

Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021
Elective courses

<table>
<thead>
<tr>
<th>Course code</th>
<th>Name of the course (Theory)</th>
<th>Course Code</th>
<th>Name of the course (Theory)</th>
<th>Course Code</th>
<th>Name of the course (Theory)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18BTP105A</td>
<td>Biodiversity, Biosafety And IPR</td>
<td>18BTP205A</td>
<td>Pharmaceutical Biotechnology</td>
<td>18BTP305A</td>
<td>Applied Biotechnology</td>
</tr>
<tr>
<td>18BTP105B</td>
<td>Nano-Biotechnology</td>
<td>18BTP205B</td>
<td>Agricultural Biotechnology</td>
<td>18BTP305B</td>
<td>System Biology</td>
</tr>
<tr>
<td>18BTP105C</td>
<td>Bio-energy Technology</td>
<td>18BTP205C</td>
<td>Industrial Toxicology</td>
<td>18BTP305C</td>
<td>Tissue Engineering</td>
</tr>
</tbody>
</table>

*Electives are Transborder / cross disciplinary / Discipline centric elective nature.
PROGRAMME OUTCOMES (POs)

a) Graduates will be 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 in both verbal and written form as independent researchers.
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, formulate and solve to deliver process/product with professional, societal and ethical responsibilities.
g) Graduates will be able to recognize need for self learning and lifelong learning.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

To enable the student to emerge as:

h) An expert to work on biotechnological concepts and allied fields (medical, microbial, agricultural, environmental, plant and animal) with modern tools and techniques towards product and process development for academic, industrial and research applications.
i) 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 and allied fields.

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 entrepreneurs in a competitive world of technology update and also contribute to all forms of life.
### MAPPING OF PEOs AND POs

<table>
<thead>
<tr>
<th>PEOs</th>
<th>(a)</th>
<th>(b)</th>
<th>(c)</th>
<th>(d)</th>
<th>(e)</th>
<th>(f)</th>
<th>(g)</th>
<th>(h)</th>
<th>(i)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEO I</td>
<td>×</td>
<td>×</td>
<td></td>
<td>×</td>
<td>×</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEO II</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEO III</td>
<td></td>
<td></td>
<td>×</td>
<td>×</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEO IV</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>×</td>
</tr>
</tbody>
</table>
Course Objectives

- This course is designed to provide clear understanding on the underlying principles of structures and functions of biomolecules to the students.

- To outline the microorganisms and their applications and thereby producing various products of industrial- and commercial uses.

Course Outcomes (CO’s):
1. It gives an overall understanding of structure of biomolecules, enzyme kinetics, bio polymers and metabolic reactions in a living system.
2. The course provides the basic understanding and uses of the microorganisms and helps to find out newer methods and applications of microorganisms.

UNIT –I Introduction:
Chemical basis of life; Bonding; Theories; Composition of living matter; Water – properties, pH, ionization and hydrophobicity; Emergent properties of biomolecules in water; Biomolecular hierarchy; Biomolecules – Structure, classifications and properties of carbohydrates, amino acids, proteins, lipids, Ribonucleic acids and deoxy- ribonucleic acids, nucleoprotein complexes.

UNIT –II Metabolisms:
Carbohydrates, lipids (fatty acid oxidation and biosynthesis), amino acids biosynthesis, nucleotides (de novo synthesis and salvage pathways). Disorders of lipid, carbohydrate, nucleic acid, amino acid metabolism. Inborn errors of metabolism. Metabolomics.

UNIT – III 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.

UNIT- IV Microbial Diversity and techniques:
Diversity- Bacteria, fungi, algae - distribution, reproduction, characteristics, nutrition. Techniques - staining, Microscopy - Principle, types, applications. Microbial growth - nutrients, media, isolation, maintenance, preservation, curve, measurements, factors, regulation.

UNIT –V Applications, Diseases and control measures:
SUGGESTED READINGS


Course Objectives:
- Students will understand the structures and purposes of basic components of cells, and how these cellular components are used to generate and utilize energy in cells
- To impart knowledge in genetics and genome organizations in organisms.

Course Outcomes (CO’s):

1. This paper will enable the students to learn the basics and lay strong foundation in understanding the composition of cells, how cells works is fundamental to living systems.
2. The structural and functional aspects of the cell provide the student with a strong foundation in the molecular mechanisms underlying cellular function.

UNIT-I Cell Organization and regulation:

UNIT – II

UNIT -III Genetics:

UNIT – IV Methods of genetic transfers:
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, Nomenclature - Insertion sequences - Mechanism – Transposons of E. coli, Bacteriophage and Yeast.

UNIT –V Microbial and Human genetics:
Gene transfer in Bacteria, 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 their
genetic implications, Quantitative genetics - Polygenetic inheritance, heritability and its measurements, QTL Mapping.

SUGGESTED READINGS


Course Objectives:
To make the students to:

- Understand the principles and concepts about the evolution.
- Understand the origin and evolution of biotic community.
- Understand the significance of nature using scientific methods.

Course Outcomes (CO’s):
On successful completion of course, students should be able to:

1. Learn the fundamental principles and concepts of evolutionary theory and ecology and they can use this knowledge to explore the evolution.
2. Students will also learn basic ecological theory and can use these principles in understanding and proposing solutions to the major environmental problems facing the biosphere. Describe evolutionary and ecological patterns & processes related to the survival, diversity, relationships, distribution, abundance and interactions of organisms, their populations and environments.

UNIT – I Ecological principles:

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, eustarine). 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 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, tools.

UNIT – IV Population genetics:
Populations, Hardy-Weinberg Law, Speciation; Convergent evolution. Brain, Behavior and Evolution: Approaches, methods. Biological clocks; Development of behavior; Social communication; Habitat, Domestication and behavioral changes
Developmental Biology:
Concepts, determination and differentiation; morphogenetic gradients; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.
UNIT –V Gametogenesis, fertilization and early development:
Production, development in animals, plants; formation, germination or establishment in plants, animals. Morphogenesis and organogenesis in animals: Cell aggregation and differentiation Dictyostelium, Drosophila, amphibia and chick; organogenesis (Caenorhabditis elegans, vertebrates), development- environmental regulation of normal development; sex determination. Morphogenesis and organogenesis in plants: Organization, development and transition - shoot, root, leaf, floral in Arabidopsis and Antirrhinum

SUGGESTED READINGS


Course Objectives:

- To impart technical information on Instrumentation related to Biotechnology and statistical analysis.

Course Outcomes (CO’s):

1. This paper makes the student to understand the working principles of instruments and vital statistical techniques for analysis of biological data used in modern biology and biotechnology research.

UNIT – I Colorimetry:

UNIT – II Centrifugation:
Principle, types of centrifuges, Principles and applications of analytical- and preparative centrifuge, density gradient and ultra centrifuge. Chromatography: Principles, Type – Paper, thin layer, ion-exchange, affinity, gel filtration, HPLC and HPTLC

UNIT – III Electrophoresis:
Principle, instrumentation and applications of agarose gel electrophoresis, sodium dodecyl sulphate – polyacrylamide gel (SDS-PAGE), native PAGE, isoelectric focusing, immuno, pulsefield, gel, capillary, 2D electrophoresis, gel documentation.

UNIT- IV Biostatistics:

UNIT- V Applications of biostatistics:

SUGGESTED READINGS


Course Objectives:

- To expose the students on the biosafety aspects to follow in their work and research, need of IPR components of transgenic products and transgenic research guidelines and rules.

Course Outcomes (CO's):

1. Knowing the biosafety, IPR and biodiversity aspects would help the student in carry out their research in basic and advanced biotechnology.

UNIT –I Biodiversity:

UNIT –II Biosafety:
Introduction; Background; Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels; Recommended Biosafety Levels, Cartagena protocol on biosafety. Biological risk assessment: Biosafety guidelines for Genetically Modified Micro organisms (GMM) and Plants (GMP)-Risk assessment, guidelines for research activities, Guidelines for environmental release of GMM, GMP and GLP. GATT and World Trade Organizations. Establishment and functions of GATT, WTO and WIPO.WTO Guidelines and Summits. Physical and Intellectual Property. Tangible and Intangible property. Roles of IBSC, RCGM and GEAC.

UNIT –III Intellectual Property Rights:

UNIT – IV Patent application:

UNIT – V Bioethics:
Introduction. Animal Rights. 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.
SUGGESTED READINGS


Course Objectives:
- To understand the preliminary/basic information on nano particles and their applications

Course Outcomes (CO’s):
1. Students will get an idea on nano-particle and usage in sustainable environment and in various biological applications.

UNIT – I Nanotechnology:
Definition, The fundamental Science behind nanotechnology- electrons, atoms and ions, molecules, metals, biosystems. Nanoanalysis

UNIT – II Microfluidics and Lab-on-a-chip:

UNIT – III Natural Nano-scale sensors:

UNIT – IV Microcontact printing of proteins:
Strategies for printing proteins on surfaces, Contact processing with hydrogel stramps, Affinity contact printing, Micro contact printing polypeptides and proteins, Printing one type of biomolecules, substrates, resolution and contrast of patterns, Activity of printed molecules, Printing multiple types of proteins, Molds and stamps, Surface chemistry, Characterization of printed patterns.

UNIT – V Nanotechnology & Environment:
Nanoparticles in bio- degradation, nano-material-based adsorbents for water treatment, possible mutagenic properties of nanoparticles, nanoparticle bioaccumulation. Nanoparticles in biomedical and clinical applications

SUGGESTED READINGS


Course Objectives:
- This paper aims to provide the concept on the global change from fossil to renewable energy sources.

Course Outcomes (CO’s):
1. Makes the student to understand the importance on alternative sources of bioenergy and their usage.

UNIT – I Biofuel:

UNIT – II Biogas:
Substrate, digester, microorganisms, process of biogas production, factors affecting biogas yield, precautions, advantages and disadvantages.

UNIT – III Bioethanol:
Introduction, bioethanol vs. petrol, production of bioethanol – yeast, sugar and starch crops, ethanol recovery.

UNIT – IV Biodiesel:
Introduction, lipids as a source of biodiesel – algae, sunflower, rapeseed, linseed, soybean, jatropha, peanut, biodiesel from hydrocarbons. Biobutanol – Clostridium, molasses.

UNIT – V Biohydrogen:

SUGGESTED READINGS
Course Objectives:

- 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 foundation in various methods to cultivate the microbes and maintenance of the microorganism.

Course Outcomes (CO’s):

1. Students of the subject will acquire skills to quantitatively estimate various biomolecules and as well to carry out enzyme kinetics.
2. After completion of this course students should have outline knowledge on isolation, sub culture and maintenance of microbes.

BIOCHEMISTRY

1. Quantification of proteins – Lowry et al/ Bradford method
2. Quantification of sugars – Anthrone method
3. Total free amino acids
4. Quantification of lipids
5. Quantification of Ascorbic acid
6. Thin Layer Chromatography (Amino acids/ fatty acids/ sugar/ nucleic acids)
7. Effect of pH, temperature, substrate concentration (any one enzyme - Catalase/ SOD/ amylase by OD method)

Microbiology

1. Pure culture technique – pour spread, loop out technique and streaking, preservation,
2. Staining technique – grams and fungal.
3. Motility – Flagellar staining, hanging drop and soft agar analysis.
4. Growth curve (Bacteria and Fungi) and Biomass estimation

SUGGESTED READINGS

CELL BIOLOGY AND MOLECULAR GENETICS - PRACTICAL II

18BTP112

Instruction Hours / week: L: 4 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

Course Objectives:
- To develop practical skills such as identification of cell types, cellular component and cell division, etc.
- Genetic laboratory course is to introduce the students to learn about prokaryotic and eukaryotic genetic system using modern techniques.

Course Outcomes (CO's):
1. It will provide an understanding of the unique features of plant cells and animal cell.
2. Gain understanding on the interaction between cells and the environment
3. This curse will provide the mechanics of experimentation methods of genetics.

CELL BIOLOGY
1. Identification of cell types- Microbe/plant /Human
2. Fractionation of cellular component – Nuclear Components, Mitochondria, Chloroplast.
3. Sucrose Fractionation of Castor Bean
4. Lipid Solubility of Membranes
6. Cell division (Mitosis/Meiosis)

MOLECULAR GENETICS
2. Nuclear staining (Giemsa / acridine orange /feulgen)
3. Metaphase preparation and karyotyping (Human leucocytes/ onion root tip)
4. Conjugation
5. Transduction

SUGGESTED READINGS
Course Objectives:
- The main objective of the paper is to expose students in using the current tools for rDNA technology and their applications.

Course Outcomes (CO’s):
1. This paper provides the student a thorough knowledge in principles and methods in genetic engineering and their applications.

UNIT – I Tools in Genetic Engineering:
Nucleic acid manipulating enzymes- restriction- nucleases, ligases, polymerases, modification enzymes - kinases, phosphatases, adapters and linkers. Polynucleotide tailing.

UNIT – II Cloning Vectors:

UNIT – III Gene transfer methods:

UNIT – IV Analytical Techniques:
PCR, RAPD, RFLP, AFLP, SSCP, protein engineering- site directed mutagenesis, PCR mediated. Alteration of restriction sites, Molecular diagnosis and therapy of cancer, DNA based detection of microbial infection/ contamination, sequence analysis, SNP, NGS, gene editing tool CRISPR.

UNIT – V Application:
Antisense technology, RNAi technology, terminator gene technology, gene therapy- in vivo and ex vivo. Gene delivery systems - viral and non viral; DNA marker technology in plants, DNA fingerprinting, genetically engineered biotherapeutics and vaccines.

SUGGESTED READINGS


Course Objectives:

- This paper aims to empower the students with various designs of fermenter and process kinetics to enable the students to manipulate it for improvement.

Course Outcomes (CO’s):

1. This paper provides technical information on fermenter designing and kinetics involved in the bioprocesses.

UNIT – I Introduction:


UNIT – II Media:


UNIT – III 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, PID controller, computer aided control.

UNIT – IV Downstream processing:

Cell distribution methods for intracellular products; foam separation, precipitation. Filtration – micro and ultra filtration; Solvent extraction-, chromatographic separation- FPLC, HPLC, dialysis, centrifugation, distillation, drying, crystallization, turbidity analysis and cell yield determination. Fermentation products-available in market.

UNIT – V Kinetics:

Transport phenomena – Rheological properties, determination of $O_2$ mass transfer, heat transfer, role of aeration and agitation, factors affecting $O_2$ transfer. Production of chemicals – alcohol, antibiotics – Penicillin and Streptomycin, Single cell proteins.

SUGGESTED READINGS


Course Objectives:
- To enable the students to understand in detail about the fundamentals of enzymes and their functions.

Course Outcomes (CO’s):
1. This course includes the isolation, purification and characterization of enzymes and their applications.

UNIT – I Definition:
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:

UNIT – III Improvement of 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; Enzyme immobilization - types, advantages, drawbacks and applications; Artificial enzymes; Isolation and purification of industrially important enzymes.

UNIT – IV Enzyme Technology:

UNIT – V Applications of enzymes:
Enzymes used in different industries, Enzyme catalysis in organic solvents, enzyme replacement therapy – definition, modes of administration, enzyme deficiency disorders and enzyme therapy; Application of enzymes: Cosmetic benefits, 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


### 18BTP204 IMMUNOTECHNOLOGY

**Instruction Hours / week:** L:43 T: 0 P: 0  
**Marks:** Internal: 40 External: 60 Total: 100  
**End Semester Exam:** 3 Hours

**Course Objectives:**
- To expose the students with the immune system of human body.

**Course Outcomes (CO’s):**
1. The students may understanding the immune system, its components and various techniques used in bio manipulation.

**UNIT –I Introduction:**
History and scope, Immunity – types, Antigen and Antibody - biology, structure and functions, super antigens, antigen- antibody interactions, primary and secondary immune response. Humoral and cell mediated immunity.

**UNIT –II Immune system:**
Hematopoiesis and differentiation, Lymphocytes, Lymphoid organs: Primary and secondary lymphoid organs. Antigen recognition and presentation, activation of B and T lymphocytes, cytokines and their role in immune regulation. Complement system - Classical and alternate pathway. MHC I and II complex.

**UNIT-III Transplantation:**
MLR, MHC and HLA typing, bone marrow transplantation, organ transplants, immunosuppressive therapy. Hybridoma technology and monoclonal antibodies, immuno-diagnosis and application of monoclonal antibodies in biomedical research, human monoclonal antibodies and catalytic antibodies, Xeno transplantation from various species.

**UNIT –IV Hyper-sensitivity reactions, auto-immune disorders. Tumor immunology:**
Tumor antigens, immune response to tumours, cancer immunotherapy. Immunodeficiencies – primary and secondary.

**UNIT –V Vaccines:**
Vaccine technology including DNA vaccines, identification of B and T epitopes for vaccine development. Immunodiagnosis of infectious diseases, immuno screening of recombinant library.

**SUGGESTED READINGS**


Course Objectives:
- To facilitate the students to know the definite path of metabolism of drugs and drug discovery. The information gained will help the students to formulate novel drugs.

Course Outcomes (CO's):
1. This course gives information on drug designing, novel techniques in drug discovery and the role of biotechnology in pharmaceutics.

UNIT –I Introduction:
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 Biotechnology and health:
Drug design; drug development; random screen up, target identification and validation, drug discovery, drug delivery. Drug abuse, self-poisoning. pharmacogenomics, biochip.

UNIT –III Biotechnology and Pharmacy:
Genetically engineered protein and peptide agents, novel drug delivery systems – non convectional routes of administration, Anti-AIDS drug development, oncogenes as targets for drugs, Multi-drug resistance, vaccine development and role of genetic engineering in controlling infectious diseases, gene therapy, and stem cell therapy.

UNIT –IV Enzyme Technology:
Sources of enzymes, extraction and purification: Applications pharmaceutical, therapeutic and clinical. Production of amylglucosidase, glucose isomerase, amylase and trypsin, Techniques of immobilization of enzymes and their applications in the industry. Reactors for immobilized systems and perspective of enzyme engineering.

UNIT -V Novel Drug Delivery Systems:

SUGGESTED READINGS


Course Objectives:
- To facilitate the students to know the biotechnological aspects in plant growth and improvement.

Course Outcomes (CO’s):
1. This course gives information on plant tissue culture and may help the students to initiate a start-up units.

UNIT –I Plant tissue culture and its application:
Recombinant DNA technology, methods of gene transfer in plants, Development of transgenics 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:
Increase in iron, protein and amino acids, golden rice colours – anthocyanins, betalaines, crocin and crocetins. Flavours–capsaicin, vanillin, stevioside thaumatin. Developing vaccine and plantibodies, terminator technology and male sterility;

UNIT – IV Biotic and abiotic resistance:
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: phosphinothricin, glyphosate, sulfonyl urea, atrazine. Drought, salinity, thermal stress, flooding and submergence tolerance

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; biodegradable plastics; Plants as biofactories; Biosafety and risk assessment of GM crops.

SUGGESTED READINGS

Course Objectives:
- The objective of the course is to introduce fundamental concepts in toxicology.

Course Outcomes (CO’s):
1. This course deals with the application of the management of toxicological problems in concepts to biological problems.

UNIT – I Introduction:
Scope, Divisions of Toxicology, General principles of toxicology, - Classification of Toxic Agents. Mechanism of action of toxicants, Routes of exposure-absorption and translocation.

UNIT – II Toxicokinetics:
Absorption, Distribution, Metabolism and Excretion, Factors influencing Toxicity, Dose-effect and Dose response relationship- LD50, LC50.

UNIT – III Human Toxicology:
Pollution induced biochemical, hematological and pathological changes, Immunotoxicity, genotoxicity and carcinogenic effects

UNIT – IV Ecotoxicology:
Influence of ecological factors on the effects of toxicity; Pollution of the Ecosphere by industries; degradable and non-degradable toxic substances; food chain. Eco-system influence on the fate and transport of toxicants.

UNIT – V Regulatory issues and testing:
Bacterial mutation assays, Mammalian cell mutation assays, in vitro chromosome aberration assays, In vivo carcinogenicity assays and Comet assay.

SUGGESTED READINGS
Course Objectives:
- To make the students to understand the various techniques involved in genetic engineering, characterization of the microorganism in fermentation and downstream processing.

Course Outcomes:
1. Students will able to perform the DNA and RNA isolation and manipulation techniques.
2. Students will able to perform the production of industrially important metabolites from microbial source using fermentation and bioprocess techniques.

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

Fermentation Technology
1. Isolation and secondary screening of industrially important microorganisms
2. Production of amylase or protease, Enzyme immobilization
3. Wine Production an alcohol determination by chromic acid method
4. Downstream processing by Solvent extraction

SUGGESTED READINGS
18BTP212

IMMUNO - AND ENZYME TECHNOLOGY – PRACTICAL IV

Instruction Hours / week: L: 0 T:02 P: 4
Marks: Internal: 40 External: 60 Total:100
End Semester Exam: 3 Hours

Course Objectives:
- To make students familiar with principles of enzyme activity, analysis of enzyme.
- To impart knowledge on the immune system and characterization of immune aspects.

Course Outcomes:
1. Students will get an knowledge on enzyme characteristic analysis.

Immuno-technology
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. Counter Current Immunoelectrophoresis
7. WIDAL test
8. DOT-ELISA

Enzyme technology
1. Purification of an enzyme from any natural resource
2. Quantitative estimation of proteins by Bradford/Lowry’s method.
3. Perform assay for the purified enzyme.
4. Calculation of kinetic parameters such as Km, V_{max}, K_{cat}

SUGGESTED READINGS


