B.Sc., BIOTECHNOLOGY

CHOICE BASED CREDIT SYSTEM

Curriculum and Syllabus
(2024-2025)

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

DEPARTMENT OF BIOTECHNOLOGY

FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)
(Established under section 3 of UGC Act, 1956)
(Accredited with A+ Grade by NAAC in the second cycle)
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FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT
UNDERGRADUATE PROGRAMMES
REGULAR MODE
CHOICE BASED CREDIT SYSTEM (CBCS)

REGULATIONS – 2024

The following regulations are effective from the academic year 2024-2025 and are applicable to candidates admitted to Undergraduate (UG) programmes in the Faculty of Arts, Science, Commerce and Management, Karpagam Academy of Higher Education (KAHE) from the academic year 2024-2025 onwards.

1 PROGRAMMES OFFERED, MODE OF STUDY AND ADMISSION REQUIREMENTS

1.1 UG Programmes Offered

A candidate may undergo a programme in any one of the undergraduate programmes approved by the KAHE as given below.

S. No.	PROGRAMME	DISCIPLINE
1.	B.Com.	Commerce
2.	B.Com.	Computer Applications
3.	B.Com.	Professional Accounting
4.	B.Com.	Business Process Services
5.	B.Com.	Financial Analytics
6.	B.Com.	International Accounting and Finance
7.	B.Com.	Information Technology
8.	B.Com.	FinTech
9.	BBA	Business Administration
10.	B.Sc.	Biotechnology
11.	B.Sc.	Microbiology
12.	B.Sc.	Computer Science
13.	B.Sc.	Information Technology
14.	B.Sc.	Computer Technology

15.	B.Sc.	Computer Science (Cognitive Systems)
16.	B.Sc.	Computer Science (Artificial Intelligence and Data Science)
17.	B.Sc.	Computer Science (Cyber Security)
18.	BCA	Computer Applications

1.2 Admission Requirements (Eligibility)

A candidate for admission to the first year of the UG degree programme shall be required to have passed the Higher Secondary Examination (10 + 2) [Academic or Vocational] prescribed by the Government of Tamil Nadu Board or any similar examination of any other Board accepted by the KAHE as equivalent thereto. (Annexure I)

1.3 Mode of Study

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

2. DURATION OF THE PROGRAMMES

2.1 The minimum and maximum period for the completion of the UG Programmes are given below:

Programme(s)	Min. No. of Semesters	Max. No. of Semesters
B.Sc., B.Com., BCA and BBA	8	14

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

2.3 Multiple Entry and Exit

The students are allowed to exit the programme after 2 or 4 or 6 or 8 semesters with Undergraduate Certificate, Undergraduate Diploma, Undergraduate Degree and Undergraduate Degree with Honors/Honors (Research) respectively as per the regulations of NEP 2020. Similarly, the students from other institutions can join our university in the 3rd or 5th or 7th semester with an appropriate Undergraduate Certificate or Undergraduate Diploma or Undergraduate Degree certificates respectively.

3. CHOICE BASED CREDIT SYSTEM

Credit means the weightage given to each course by the experts of the Board of Studies concerned. All programmes are offered under Choice Based Credit System with a total number of 132 credits for three years. Additional credits of 40 can also be earned on successful completion of fourth year. A total of 172 credits are offered as per the UGC Guidelines for the four year UG Programme.

4. STRUCTURE OF THE PROGRAMME

4.1 Tamil or any one of the Indian / Foreign Languages *viz*, Hindi, Malayalam Sanskrit, French is offered as an Ability Enhancement Course (AEC) for Arts, Science, Commerce and Management Programmes. Twelve credits are awarded for each course and the examinations will be conducted at the end of each semester.

4.2. Major Courses, Minor Courses, Multidisciplinary Courses (MDC), Skill Enhancement Courses (SEC), Project Work, Ability Enhancement Courses, Value Added Courses (VAC) (Common to all UG Programmes), Summer Internship, Minor Project (for 3 Year programme), Research Project/Dissertation (for 4 Year programme) are part of curricular structure.

4.2.1. Major Courses

Major Courses consist of theory and practical of department domains for which examinations shall be conducted at the end of each semester. The students have to earn 82 to 86 Credits in Major Courses (Four years).

4.2.2. Minor Courses

Students have courses from disciplinary/interdisciplinary minors and skill-based courses. Students have to earn a minimum of 32 Credits in Minor Courses (Four years).

4.2.3. Multidisciplinary Courses (MDC)

All UG students are required to undergo 3 introductory-level courses relating to any of the broad disciplines. These courses are intended to broaden the intellectual experience and form part of liberal arts and science education. The students have to study three Multidisciplinary Courses and they have to earn a minimum of 09 Credits.

4.2.4. Skill Enhancement Courses (SEC)

These courses are aimed at imparting practical skills, hands-on training, soft skills, etc., to enhance the employability of students. Three Skill Enhancement Courses are offered within the first four semesters. The examination shall be

conducted at the end of respective semester. Students have to earn a minimum of 09 Credits in Skill Enhancement Courses.

4.2.5 Minor Project Work

The project work shall start at the beginning of sixth semester in the Department/Industry/Research Institute (National/International) and the project report has to be submitted at the end of the sixth semester. The project may be an individual or group task**.** The Head of Department concerned shall assign a project supervisor who in turn shall monitor the project work of the student(s). A project / dissertation work shall be carried out by the students and they have to earn 04 to 06 credits.

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

A Project Assessing Committee (PAC) shall be constituted with HoD and two senior faculty members of the Department. The PAC shall announce the dates for the reviews and demonstration. The student shall make a presentation on the progress and demonstration of their project before the PAC in the presence of their supervisor on the scheduled dates.

4.2.6.Ability Enhancement Course (AEC)

There are four Ability Enhancement Courses offered during the first four semesters. Three credits are awarded for each course and the examinations shall be conducted at the end of each semester. Students have to earn a minimum of 12 Credits in Ability Enhancement Courses.

4.2.7. Internship

The students exiting the programme after first year or second year must have completed 04 credits internship/apprenticeship during first year and second year summer term.

4.2.8. Value Added Courses (VAC)

The students will study Value Added Courses in the first four semesters of their programme. 6 to 8 credits need to be earned under VAC. The examinations will be conducted at the end of each semester for VAC courses.

The assessment of the VAC is based on Internal Evaluation. The components of evaluation and distribution of marks is as follows:

S. No.	Category	Maximum Marks
1.	Assignment	5
2.	Attendance	5
3.	Seminar	5
4.	Test – I (2 ½ Units)	12.5
5.	Test – II (2 ½ Units)	12.5
6.	Final Assessment (5 Units)	60
	Total	100

4.2.9. Research Project /Dissertation

The candidates shall undertake the Research Project work in the eighth Semester in the Department/Industry/Research Institute (National / International). The report shall be submitted at the end of the eighth semester. Students have to earn a minimum of 12 Credits in Research Project/Dissertation Work.

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

HoD shall assign a Project Supervisor who shall monitor the student's project work(s). A Project Assessing Committee (PAC) shall be constituted with HoD and two senior faculty members of the Department. The PAC shall announce the dates for the reviews and demonstration. The student shall make a presentation on the progress and demonstration of their project before the PAC in the presence of their Supervisor on the scheduled dates.

Approval of the project
The candidate has to submit, in consultation with his/her supervisor, the title, objective and the action plan of his/her project to the PAC on the first review. Only after obtaining the approval of PAC, the student can initiate the project work.

5. ADVANCED LEARNERS AND ON-DEMAND EXAMINATION

Students
1. Who secure 7.5 CGPA and maintain an attendance of 75% in every semester.
2. Who clear all the courses in their first appearance itself.

are referred to as advanced learners. When a student fails to maintain any of the above conditions at any given time, he cannot be an advanced learner further.

These students can request for an on-demand examination for the courses in their forthcoming semester(s). These students on prior registration can appear for such examinations well in advance and complete the entire courses well before the prescribed period of study and can progress for a full time Research Project/Internship/Minor Project during the remaining prescribed period of study. The Internal and External examinations will be conducted for these courses as like the other courses. One or more faculty mentors will be allocated based on the number of students/courses enrolled for the on-demand examination.

Also, these advanced learners can register for online courses from NPTEL/SWAYAM/SWAYAM Plus portals on prior and proper registration from the department. The credits earned from those courses will be transferred to the mark statement of the students.

6. CREDIT TRANSFER THROUGH ONLINE PLATFORM / INTERNATIONAL STUDIES

Students are encouraged to enroll in courses offered by MOOC platforms and international institutions of higher learning, either virtually or in person. The equivalent credits for these courses will be determined by a committee named Subject Equivalency Committee comprising the Dean, Head of Department (HoD), and one faculty member nominated by the Vice Chancellor. The committee's decision will be submitted for ratification/approval by the Board of Studies (BoS) and the Academic Council. Additionally, the equivalent grade points for marks/grades/grade points awarded by various MOOC platforms and international institutions of higher learning will be determined by a committee named Grade Equivalency Committee duly constituted by the Vice-Chancellor. The decisions of this committee will be submitted for ratification/approval by the Academic Council. This has been approved to be implemented from the even semester of the academic year 2024-25.

7. EXTRA CURRICULAR ACTIVITIES

Every student is encouraged to participate in at least any one of the following activities:

- National Service Scheme (NSS)
- National Cadet Corps (NCC)
- Sports / Mass drill

- Youth Red Cross (YRC)
- Club activities
- Other Extra-curricular activities

The student's performance shall be examined by the staff in-charge of activities along with the faculty mentor and the Head of the respective department. Marks for Extra-curricular shall be sent to the Controller of Examination (CoE) before the commencement of the Sixth End Semester Examinations. The above activities shall be conducted outside the regular working hours of the KAHE.

8. MEDIUM OF INSTRUCTION

The medium of instruction and examinations for the courses under Language I – Tamil / Hindi / Malayalam / French / Sanskrit shall be in the language concerned. For all other courses, the medium of instruction and examination should be in English.

9. MAXIMUM MARKS

Evaluation: Evaluation of the course comprise of two parts such as the Continuous Internal Assessment (CIA) and the End Semester Examination (ESE).

All the theory and practical courses shall carry a maximum of 100 marks, out of which 40 marks is awarded for Continuous Internal Assessment (CIA) and 60 marks for End Semester Examinations (ESE).

10. FACULTY MENTOR

To help students in planning their courses of study and for general advice on the academic programme, the HoD shall allot twenty students to a faculty who will function as a faculty mentor throughout their period of study. A Faculty mentor 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 mentee's progress. The Faculty mentor shall display the cumulative attendance particulars of his / her mentees periodically (once in 2 weeks) on the Notice Board to know their attendance status and satisfy the clause 14 of this regulation.

11. ONLINE COURSE COORDINATOR

To help students for planning their online courses and for general orientation 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 different agencies periodically and inform the same to the students. Further, the coordinators shall orient the students regarding the online courses and monitor their participation.

12. CLASS COMMITTEE

Every class shall have a Class Committee consisting of the faculty members of various courses of the class concerned, student representatives (Minimum 2 boys and 2 girls of various capabilities and Maximum of 6 members) and the concerned HoD / senior faculty as 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 constitution and functions of the Class Committee shall include

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

13. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or department 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 respective 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). Course Committee Meeting is conducted once in a semester.

14. REQUIREMENTS TO APPEAR FOR THE END SEMESTER EXAMINATION

a. Every student is expected to attend all classes and should secure 100% attendance. However, in order to allow for certain unavoidable circumstances, the student is expected to have at least 75% of attendance and the conduct of the candidate has been satisfactory during the programme.

b. A candidate who has secured attendance between 65% and 74% (both included), due to medical reasons (Hospitalization / Accident / Specific Illness) 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 the Dean. The Head of Department has to verify and certify the genuineness of the case before recommending to the Dean concerned. However, the candidate has to execute an undertaking from the parent and the student should assure that, this situation does not arise in the future.

c. However, a Student who has secured less than 65% in any of the semesters due to any reasons, shall not be permitted to appear for the End Semester Examinations. But he/she will be permitted to appear for his/her arrear examinations. In order to redo the semester with lack of attendance he/she has to attend the corresponding semester of the subsequent year(s) with approval of the Dean of the Faculty, Dean - Students Affairs and the Registrar.

15. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

15.1 Attendance and Assessment: Every Faculty is required to maintain an **Attendance and Assessment Record (Log book)** which consists of attendance of students marked for each lecture/practical/ project work, the CIA, Assignment and Seminar marks and the record of class work completed (topic covered), separately for each course. This should be submitted to the HoD once in a week for checking the syllabus coverage, records of test marks and attendance. The HoD shall sign with date after due verification. The same shall be submitted to respective Dean once in a fortnight. After the completion of the semester the HoD should keep this record in safe custody for five years as records of attendance and assessment shall be submitted for inspection as and when required by the KAHE/any other approved body.

15.2 Continuous Internal Assessment (CIA): The performance of students in each course will be continuously assessed. Retest will be conducted and considered based on the requirements and recommendations by the Head of the Department on valid reasons. The distribution of marks for the Continuous Internal Assessment (CIA) are given below:

Theory Courses

S. No.	Category	Maximum Marks
1.	Assignment	5
2.	Attendance	5
3.	Seminar	5
4.	Test – I (2 ½ Units)	12.5
5	Test – II (2 ½ Units)	12.5
	Total	40

Practical Courses

S.No.	Category	Maximum Marks
1.	Attendance	5
2.	Observation work	5
3.	Record work	5
4.	Internal Practical Assessment	20
5.	*Viva – voce* [Comprehensive]*	5
	Total	**40**

*

Includes *Viva- voce* conducted during the model Exam practical.

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

15.3 Portions for Test Question Paper

Portions for Internal Test – I : 2 ½ Units
Portions for Internal Test – II : 2 ½ Units

15.4 Pattern of Test Question Paper

Theory Courses:

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

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

15.5 Attendance

Distribution of Marks for Attendance

S. No.	Attendance (%)	Maximum Marks
1	91 and above	5
2	81 - 90	4
3	76 - 80	3
4	Less than or equal to 75	0

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16. ESE EXAMINATIONS

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

16.2 Pattern of ESE Question Paper:

Theory Courses:

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

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

The 100 Marks will be converted to 60 Marks.

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

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

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

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

16.3. Evaluation of Project Work

16.3.1 The project work shall carry a maximum of 100 marks.

(CIA - 40 and ESE – 60*)

*****Combined valuation of Internal and External Examiners.

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

16.3.3 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 Controller of Examination. In case the supervisor is not available, the HoD shall act as an Internal Examiner for the same.

16.3.4 If a candidate fails to submit the project report on or before the specified date given by the 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 respective viva-voce examinations he/she has to resubmit the Project Report within 30 days from the date of declaration of the results. The same Internal and External examiner shall evaluate the resubmitted report in the subsequent semester.

16.3.5 A Copy of the approved project report after the successful completion

of *viva-voce* examination shall be kept in the KAHE library.

17. PASSING REQUIREMENTS

17.1 Passing minimum: A candidate needs to secure a minimum of 20 marks out of 40 marks in CIA and 30 marks out of 60 marks in ESE. The overall passing minimum in each course is 50 marks out of 100 marks (Sum of the marks in CIA and ESE examination).

17.2 If a candidate fails to secure a pass in a particular course (either CIA or ESE or Both) as per clause 15.1, it is mandatory that the candidate has to register and reappear for the examination in that course during the subsequent semester when examination is conducted for the same till, he / she receives pass both in CIA and ESE (vide Clause 2.1).

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

17.4 The CIA marks secured by the candidate in the first passed attempt shall be retained by the Office of the Controller of Examinations and considered valid for all subsequent attempts till the candidate secures a pass in ESE.

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

18. IMPROVEMENT OF MARKS IN THE COURSES ALREADY PASSED

The Candidates desirous to improve the marks secured in a course which they passed 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.

19. AWARD OF LETTER GRADES

All the 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

20. 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 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.

iv. Remark on Extension Activities (only in the 6th Semester Grade Sheet)

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

GPA of a Semester $\frac{\sum_i CiGPi}{\sum_i Ci}$ = Sum of the product of the GP by the corresponding credits of the courses offered in that Semester / Sum of the credits of the courses of that Semester

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

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

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

where,

Ci is the credit fixed for the course 'i' in any semester

GPi is the grade point obtained for the course 'i' in any semester

'n' refers to the Semester in which such courses are credited.

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

21. REVALUATION

A candidate can apply for revaluation or re-totaling 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. 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 the results will be intimated to the candidate through the HoD concerned**.** Revaluation is not permitted for Supplementary Examinations.

22.TRANSPARENCY AND GRIEVANCE COMMITTEE

Revaluation and Retotaling are allowed on representation (clause 21). Student may get the Xerox copy of the answer script on payment of prescribed fee, if he / she wishes. 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 and the marks awarded by the External examiner will be final. The student has to pay the prescribed fee for the same.

23. ELIGIBILITY FOR THE AWARD OF THE DEGREE

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

- Successfully completed all the components prescribed under Part I to Part IV in the CBCS pattern to earn the minimum required credits as specified in the curriculum corresponding to his / her programme within the stipulated period (vide clause 2.1).
- No pending disciplinary enquiry/ action against him/her.
- The award of the degree must be approved by the Board of Management.

24.CLASSIFICATION OF THE DEGREE AWARDED

24.1 Candidates who qualify for the award of the Degree (vide clause 23) having passed the examination in all the courses in their first appearance, within the specified minimum number of semesters and securing a **CGPA not less than 8** shall be declared to have passed the examination in the **First Class with Distinction.**

24.2 Candidates who qualify for the award of the Degree (vide clause 23) 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 the **First Class**.

24.3 Candidates (not covered in vide clauses 24.1 and 24.2) who qualify for the award of the degree (vide Clause 23) shall be declared to have passed the examination in the **Second Class**.

25. RANKING

Candidates who qualify for the UG 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 VI/VIII 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.

26. 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.

27. DISCIPLINE

27.1.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.

27.2. 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.

27. KAHE ENTRANCE EXAMINATION

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

28. 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.

Annexure I

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

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

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

Karpagam Innovation and Incubation Council (KIIC)

(A Section 8 Company)

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

Norms to Student Start-Ups

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

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

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

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

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

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

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

Guide lines to award Credits/ Marks to a Student startup

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

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

DEPARTMENT OF BIOTECHNOLOGY
FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT
UG PROGRAM (CBCS) – B.Sc., Biotechnology (FULL TIME)
(2024–2025 Batch and onwards)

Course Code	Name of the course	Category	Outcomes		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
SEMESTER I												
24LSUT101	Tamil - I	AEC1	2	1	4	-	-	3	40	60	100	1
24LUH101	Hindi - I											
24LUM101	Malayalam - I											
24LUS101	Sanskrit - I											
24LUF101	French - I											
24ENU101	English - I	MDC 1	2	1	3	-	-	3	40	60	100	14
24BTU101	Cell Biology	Major 1	1,6,8,9,11,15	1	6	-	-	4	40	60	100	16
24BTUA101	Chemistry- I	Minor 1	1,5,6,8	1, 2	5	-	-	4	40	60	100	18
24BTU111	Cell Biology - Practical	Major 2	1,6,8,9,11,15	1,2	-	-	4	2	40	60	100	20
24BTUA111	Chemistry Practical-I	SEC1	1,5,6,8	1	-	-	4	2	40	60	100	22
24VAC101	Yoga for Youth Empowerment	VAC1	1,7,11,12,15	1,2	2	-	-	2	100	-	100	23
	Activity: Library/Seminar	-	-	-	-	-	02	-	-	-	-	25
Semester Total					**20**	**-**	**10**	**20**	**340**	**360**	**700**	
SEMESTER II												
24LSUT201	Tamil – II	AEC 2	2	1	4	-	-	3	40	60	100	26
24LUH201	Hindi – II											
24LUM201	Malayalam – II											
24LUS201	Sanskrit – II											
24LUF201	French - II											
24ENU201	English - II	MDC 2	2	1	3	-	-	3	40	60	100	38
24BTU201	Biochemistry and Metabolism	Major 3	1,5,6,8, 11,15	1,2	6	-	-	4	40	60	100	40
24BTUA201	Chemistry - II	Minor 2	1,5,6,8	1	5	-	-	4	40	60	100	42
24BTU211	Biochemistry and Metabolism - Practical	Major 4	1,5,6,7,8, 9,11	1,2	-	-	4	2	40	60	100	44
24BTUA211	Chemistry Practical-II	SEC 2	1,5,6,8	1	-	-	4	2	40	60	100	46

24VAC201	Environmental Studies	VAC 2	1,8,9,11,12,13,15	1,2	2	-	-	2	100	-	100	47
Activity: Library/Seminar				-	2	-	-	-	-	-	-	49
Semester Total					**22**	-	**08**	**20**	**340**	**360**	**700**	
SEMESTER III												
24LSUT301	Tamil - III	AEC 3	2	1	4	-	-	3	40	60	100	50
24LUH301	Hindi – III											
24LUM301	Malayalam – III											
24LUS301	Sanskrit – III											
24LUF301	French – III											
24ENU301	English - III	MDC 3	2	1	3	-	-	3	40	60	100	60
24BTU301	Molecular Biology	Major 5	1,3,5,11	1,2	4	-	-	4	40	60	100	62
24BTU302	General Microbiology	Major 6	1,4,5,6,11, 13,	1,2	4	-	-	4	40	60	100	64
24BTU303A	Bioinstrumentation and Biostatistics	Minor 3	1, 3-9, 13	1,2	3	-	-	3	40	60	100	66
24BTU303B	I.P.R. Bio-entrepreneurship, Bioethics & Biosafety		1, 2-6, 8-10, 13, 15									
24BTU311	Molecular Biology-practical	Major 7	1, 3-6, 8-9, 13, 15	1,2	-	-	4	2	40	60	100	70
24BTU312	General Microbiology-Practical	Major 8	1, 3-6, 8-9, 13, 15	1,2	-	-	4	2	40	60	100	72
24VAC301	Indian Knowledge System	VAC 3	1,11,12,15	1,2	2	-	-	1	100		100	73
24BTU303	Community Engagement and Social Responsibility	Major 9	1-8, 10, 15	2	2	-	-	2	40	60	100	75
24BTU391	Internship	INT 1	11	2	-	-	-	2	100	-	100	77
Semester Total					**22**	-	**08**	**26**	**520**	**480**	**1000**	
SEMESTER IV												
24LSUT401	Tamil – IV	AEC 4	2	2	4	-	-	3	40	60	100	78
24LUH401	Hindi – IV											
24LUM401	Malayalam – IV											
24LUS401	Sanskrit – IV											
24LUF401	French - IV											
24ENU401	English - IV	SEC 3	2	2	3	-	-	3	40	60	100	88
24BTU401	Genetics	Major 10	1,4,6,8,9	1, 2	5	-	-	4	40	60	100	90
24BTU402	Recombinant DNA Technology	Major 11	1, 3-6, 8, 11-12, 15	1,2	5	-	-	4	40	60	100	92

24BTU403A	Basics of Forensic Science	Minor 4	1, 3-10, 14	1,2	3	-	-	3	40	60	100	94
24BTU403B	Evolutionary Biology		1,6,8,14	1,2								
24BTU411	Genetics and Recombinant DNA Technology -Practical	Major 12	1-6, 8-9, 11,13	1-2	-	-	4	2	40	60	100	98
24BTU412A	Basics of Forensic Science - practical	Minor 5	1-6, 8-9, 11,13	1,2	-	-	4	2	40	60	100	100
24BTU412B	Evolutionary Biology - Practical		1-6, 8-9, 11,13	1,2								
24VAC401	Universal Human Values	VAC 4	12,13,15	2	2	-	-	1	100	-	100	104
Semester Total					**22**	**-**	**08**	**22**	**380**	**420**	**800**	
SEMESTER V												
24BTU501	Plant Biotechnology	Major 13	1-6, 8-9,11,13	1,2	5	-	-	4	40	60	100	107
24BTU502	Animal Biotechnology	Major 14	1, 4-7,11,13	1,2	5	-	-	4	40	60	100	109
24BTU503	Immunology	Major 15	1, 4-7,11,13	1,2	5	-	-	4	40	60	100	111
24BTU504A	Microbial Biotechnology	Minor 6	1, 4-9, 11, 13	1, 2	5	-	-	4	40	60	100	113
24BTU504B	Marine Biotechnology		1, 5-6, 8-9, 11, 13	1, 2								
24BTU511	Plant and Animal Biotechnology - Practical	Major 16	1,5-6,8-9,11,13	1,2	-	-	4	2	40	60	100	117
24BTU512	Immunology - Practical	Major 17	1,5-6,8-9,11,13	1,2	-	-	4	2	40	60	100	119
24BTU591	Internship	INT 2	9	1	-	-	-	2	100	-	100	121
	Activity: Library/Seminar	-	-	-	-	-	02	-	-	-	-	122
Semester Total					**20**	**-**	**10**	**22**	**340**	**360**	**700**	
SEMESTER VI												
24BTU601	Bioprocess Technology	Major 18	1, 5-6, 8-9, 11,13	1,2	5	-	-	4	40	60	100	123
24BTU602	Environmental Biotechnology	Major 19	1, 5-6, 8-9, 11,13	1,2	5	-	-	4	40	60	100	125
24BTU603A	Genomics and Proteomics	Minor 7	1, 5-6, 8-9, 11,13	1,2	4	-	-	3	40	60	100	127
24BTU603B	Bioinformatics											
24BTU611	Bioprocess Technology, Environmental Biotechnology-Practical	Major 201	1, 5-6, 8-9, 11,13	1,2	-	-	4	2	40	60	100	131

24BTU612A 24BTU612B	Genomics and Proteomics- Practical Bioinformatics - Practical	Minor 8	1, 5-6, 8-9, 11,13	1,2	-	-	3 1	40	60	100	133
24BTU691	Minor Project	Project	3,4,5,6	2	-	-	9	6	80	120	200	137
24EAU601	NSS/NCC/SPORTS	SEC4	-	-	-	-	-	2	100	-	100	138
Semester Total					**14**	**-**	**16**	**22**	**380**	**420**	**800**	
3rd year total					**120**	**-**	**60**	**132**	**2300**	**2400**	**4700**	
SEMESTER VII												
24BTU701	Pharmaceutical Biotechnology	Major 21	1, 4-6, 8-9,11, 13	1,2	6	-	-	4	40	60	100	142
24BTU702	Nano Biotechnology	Major 22	1, 4-6, 8-9,11, 13	1,2	6	-	-	4	40	60	100	144
24BTU703A / 24BTU703B	Plant Physiology / Animal Physiology	Minor 9	1,6,8,13	1,2	6	-	-	4	40	60	100	146
24BTU704 A/ 24BTU704 B	Molecular Diagnostics / Medical Devices	Major 23	1, 4-6, 8-10, 13	1,2	6	-	-	4	40	60	100	150
24BTU711	Pharmaceutical, Nano Biotechnology- Practical	Major 24	1, 4-6, 8-10, 13	1,2	-	-	4	2	40	60	100	154
24BTU712A / 24BTU712B	Molecular Diagnostics- Practical / Medical Devices - Practical	Major 25	1, 4-6, 8-10, 13	1,2	-	-	3	1	40	60	100	156
	Activity: Library/Seminar	-	-	-	-	-	01	-	-	-	-	160
Semester Total					**22**	**-**	**08**	**19**	**240**	**360**	**600**	
SEMESTER VIII A												
24BTU801	Food Biotechnology	Major 26	1,5-6, 8-9, 13	1, 2	**5**	-	-	4	40	60	100	161
24BTU802	Research Methodology	Minor 10	1-11, 13-15	1,2	**5**	-	-	4	40	60	100	163
24BTU803	Medical Biotechnology	Major 28	1, 4-6, 8, 13	1, 2	**5**	-	-	4	40	60	100	164
24BTU804	Agriculture Biotechnology	Major 29	1, 4-6, 8, 13	1, 2	**5**	-	-	4	40	60	100	167
24BTU805	Stem Cell Biology	Minor 11	1, 4-6, 8, 13	1, 2	**5**	-	-	4	40	60	100	169
24BTU811	Food Biotechnology- Practical	Major 27	1, 4-6, 8, 13	1, 2	-	-	3	1	40	60	100	171
	Activity: Library/Seminar	-	-	-	-	-	02	-	-	-	-	173
Semester Total					**25**	**-**	**05**	**21**	**240**	**360**	**600**	
4th Year Total					**167**	**-**	**73**	**172**	**2780**	**3120**	**5900**	

SEMESTER VIII B												
24BTU801	Food Biotechnology	Major 26	1,5-6, 8-9, 13	1, 2	4	-	-	4	40	60	100	161
24BTU802	Research Methodology	Minor 10	1-11, 13-15	1,2	4	-	-	4	40	60	100	163
24BTU811	Food Biotechnology - Practical	Major 27	1, 4-6, 8, 13	1, 2	-	-	3	1	40	60	100	171
24BTU891	Research Project	Project	3,4,5,6	2		-	19	12	120	180	300	174
Semester Total					**08**	**-**	**22**	**21**	**240**	**360**	**600**	
4th Year Total					**150**	**-**	**90**	**172**	**2780**	**3120**	**5900**	

MC-Minor Courses; SEC: Skill Enhancement Courses; AEC: Ability Enhancement Courses; MDC-Multidisciplinary Courses; VAC-Value added courses

Number of courses and Credits split-up for 3-year B.Sc., Biotechnology programme

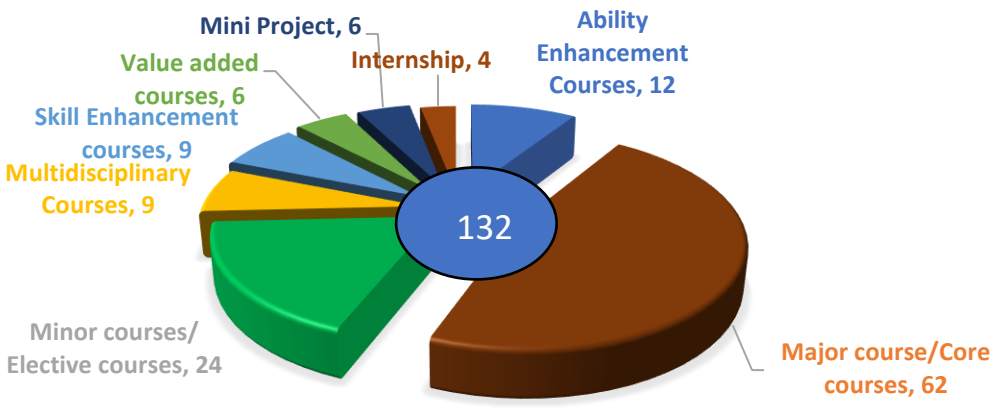
S. No.,	Course Criteria	Number of courses	Total number of credits
1	Ability Enhancement Courses	4	12
2	Major course/Core courses	20	62
3	Minor courses/ Elective courses	8	24
4	Multidisciplinary Courses	3	9
5	Skill Enhancement courses	4	9
6	Value added courses	4	6
7	Mini Project	1	6
8	Internship	2	4
Total		**46**	**132**

Number of courses and Credits split-up for 4-year B.Sc., Biotechnology programme (Hons) – with research

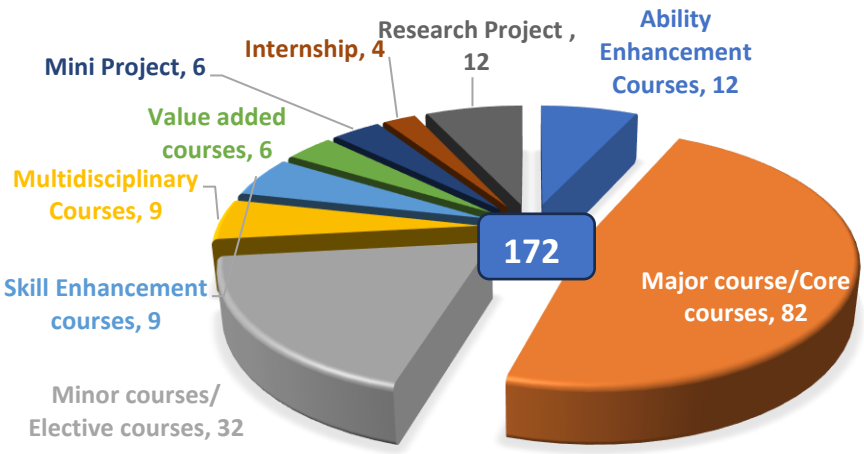
S.No.,	Course Criteria	Number of courses	Total number of credits
1	Ability Enhancement Courses	4	12
2	Major course/Core courses	27	82
3	Minor courses/ Elective courses	10	32
4	Multidisciplinary Courses	3	9
5	Skill Enhancement courses	4	9
6	Value added courses	4	6
7	Mini Project	1	6
8	Internship	2	4
9	Research Project	1	12
Total		**56**	**172**

Number of courses and Credits split-up for 4-year B.Sc., Biotechnology programme (Hons) – without research

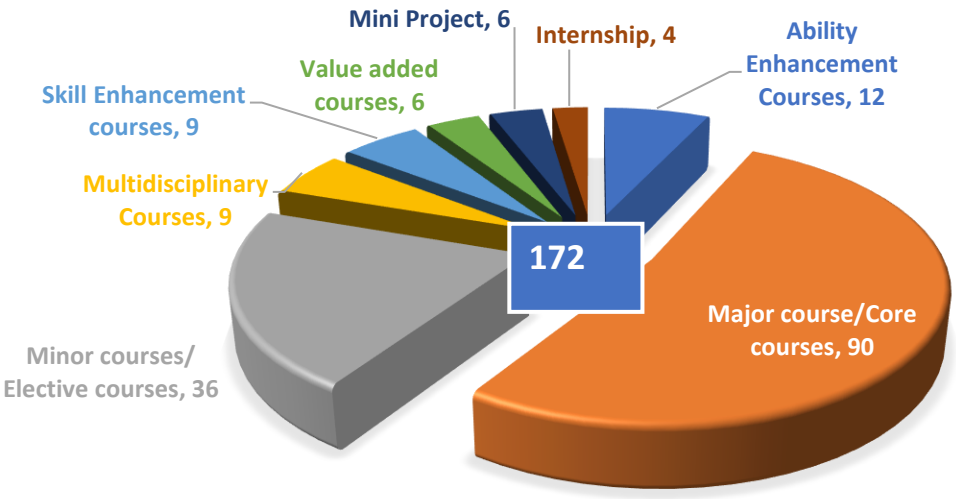
S.No.,	Course Criteria	Number of courses	Total number of credits
1	Ability Enhancement Courses	4	12
2	Major course/Core courses	29	90
3	Minor courses/ Elective courses	11	36
4	Multidisciplinary Courses	3	9
5	Skill Enhancement courses	4	9
6	Value added courses	4	6
7	Mini Project	1	6
8	Internship	2	4
Total		**58**	**172**



TOTAL CREDITS - 3 YEARS



TOTAL CREDITS - (HONS) WITH RESEARCH



TOTAL CREDITS - (HONS) WITHOUT RESEARCH

Major Courses				
S.No.,	**Semester**	**Course Code**	**Name of the course**	**Credits**
1.	I	24BTU101	Cell Biology	4
2.	I	24BTU111	Cell Biology - Practical	2
3.	II	24BTU201	Biochemistry and Metabolism	4
4.	II	24BTU211	Biochemistry and Metabolism- Practical	2
5.	III	24BTU301	Molecular Biology	4
6.	III	24BTU302	General Microbiology	4
7.	III	24BTU311	Molecular Biology - Practical	2
8.	III	24BTU312	General Microbiology - Practical	2
9.	III	24BTU303	Community Engagement and Social Responsibilities	2
10.	IV	24BTU401	Genetics	4
11.	IV	24BTU402	Recombinant DNA Technology	4
12.	IV	24BTU411	Genetics and Recombinant DNA Technology - Practical	2
13.	V	24BTU501	Plant Biotechnology	4
14.	V	24BTU502	Animal Biotechnology	4
15.	V	24BTU503	Immunology	4
16.	V	24BTU511	Plant and Animal Biotechnology - Practical	2
17.	V	24BTU512	Immunology - Practical	2
18.	VI	24BTU601	Bioprocess Technology	4
19.	VI	24BTU602	Environmental Biotechnology	4
20.	VI	24BTU611	Bioprocess Technology and Environmental Biotechnology - Practical	2
			Total Credits (3 years)	62
21.	VII	24BTU701	Pharmaceutical Biotechnology	4
22.	VII	24BTU702	Nano Biotechnology	4
23.	VII	24BTU704A /B	Molecular Diagnostics / Medical Devices	4
24.	VII	24BTU711	Pharmaceutical, Nano Biotechnology - Practical	2
25.	VII	24BTU712A /B	Molecular Diagnostics Practical / Medical Devices Practical	1
26.	VIII A	24BTU801	Food Biotechnology	4
27.	VIII A	24BTU811	Food Biotechnology - Practical	1
			Total Credits (4 years)	82

Minor Courses - MC				
S.No.,	**Semester**	**Course Code**	**Name of the course**	**Credits**
1.	I	24BTUA101	Chemistry I	4
2.	II	24BTUA201	Chemistry II	4
3.	III	24BTU303A/ 24BTU303B	Bioinstrumentation and Biostatistics / I.P.R. Bio-entrepreneurship, Bioethics & Biosafety	3
4.	IV	24BTU403A/ 24BTU403B	Basics of Forensic Science / Evolutionary Biology	3
5.	IV	24BTU412A/ 24BTU412B	Basics of Forensic Science Practical/ Evolutionary Biology Practical	2
6.	V	24BTU504A/ 24BTU504B	Microbial Biotechnology/ Marine Biotechnology	4
7.	VI	24BTU603A/ 24BTU603B	Genomics and Proteomics / Bioinformatics	3
8.	VI	24BTU613A/ 24BTU613B	Genomics and Proteomics Practical / bioinformatics Practical	1
			Total credits (3 years)	24
9.	VII	24BTU703A/ 24BTU703B	Plant Physiology / Animal Physiology	4
10.	VIIIA& B	24BTU802	Research Methodology	4
			Total Credits (4years)	32

Ability Enhancement Courses - AEC				
S. No.,	**Semester**	**Course Code**	**Name of the course**	**Credits**
1.	I	24LSUT101	Tamil - I	3
		24LUH101	Hindi - I	
		24LUM101	Malayalam - I	
		24LUS101	Sanskrit - I	
		24LUF101	French - I	
2.	II	24LSUT201	Tamil – II	3
		24LUH201	Hindi – II	
		24LUM201	Malayalam – II	
		24LUS201	Sanskrit – II	
		24LUF201	French – II	
3.	III	24LSUT301	Tamil - III	3
		24LUH301	Hindi – III	
		24LUM301	Malayalam – III	
		24LUS301	Sanskrit – III	
		24LUF301	French – III	
4.	IV	24LSUT401	Tamil – IV	3
		24LUH401	Hindi – IV	
		24LUM401	Malayalam – IV	
		24LUS401	Sanskrit – IV	
		24LUF401	French - IV	
			Total Credits	12

Value Added Courses - VAC				
S. No.,	**Semester**	**Course Code**	**Name of the course**	Credits
1.	I	24VAC101	Yoga for Youth Empowerment	2
2.	II	24VAC201	Environmental Studies	2
3.	III	24VAC301	Indian Knowledge System	1
4.	IV	24VAC401	Universal Human Values	1
			Total	6

Skill Enhancement Courses - SEC				
S. No.,	**Semester**	**Course Code**	**Name of the course**	Credits
1.	I	24BTUA111	Chemistry Practical - I	2
2.	II	24BTUA211	Chemistry Practical - II	2
3.	IV	24ENU401	English IV	3
4.	VI	24EAU601	NSS/NCC/Sports	2
			Total	9

Multidisciplinary Courses - MDC				
S. No.,	**Semester**	**Course Code**	**Name of the course**	**Credits**
1.	I	24ENU101	English I	3
2.	II	24ENU201	English II	3
3.	III	24ENU301	English III	3
			Total	9

Internship (INT)				
S. No.,	**Semester**	**Course Code**	**Name of the course**	**Credits**
1.	III	24BTU391	Internship	2
2.	V	24BTU591	Internship	2
			Total	4

Project				
S. No.,	**Semester**	**Course Code**	**Name of the course**	**Credits**
1.	VI	24BTU691	Minor Project	6
2.	VIIIB	24BTU891	Research Project	12

PROGRAMME OUTCOMES (POs)

PO1: Disciplinary knowledge: Graduates will be able to understand and demonstrate the basic biotechnological concepts as applicable to various diversified fields such as medical, industrial, environment and agriculture.

PO2: Communication Skills: The Graduates will be able to understand the language comprehension and vocabulary usage in languages.

PO3: Critical thinking: The graduate will gain in-depth knowledge of biological mechanisms and demonstrate the key practical skills in adapting suitable modern biotechnological techniques.

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

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

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

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

PO8: Scientific reasoning: The Graduates will be able to conduct investigations, analyze, interpret and draw solutions to mitigate the scientific problems in various fields using biotechnological tools.

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

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

PO 11 Self-directed learning: The Graduates will have the ability to work independently, identify appropriate resources required for a problem-based project and its implementation.

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

PO 13: Moral and ethical awareness/reasoning: The Graduates will be capable to identify unethical issues, and avoiding unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism.

PO 14: Leadership readiness/qualities: The Graduates will be able to strengthen themselves for mapping out the tasks of a team, organization, setting direction to achieve the goals in a smooth and efficient way.

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

PROGRAMME SPECIFIC OUTCOMES (PSOs)

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

PSO2: The Graduates will be able to work independently by updating the constantly evolving technology required for a problem-based project and its implementation.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

To impart the following PEOs to the students of Under-graduates in Biotechnology:

PEO I: To comprehend the skills and vocabulary usage in languages and to ascertain the valuable prospects.

PEO II: To impart knowledge about the origin of living organisms, utilization of bio-resources and its related products for human welfare and the environment.

PEO III: To make the graduates of Biotechnology to adapt in a competitive world and contribute to the nation.

MAPPING OF PEOs AND POs

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

முதல் பருவம்

24LSUT101 **இலக்கிய இன்பம்** **4H - 3C**

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

End Semester Exam: 3 Hours

பாடத்திட்டப் பொதுநோக்கம்

- மாணவர்களுக்குத் தமிழ்மொழி வரலாறு மற்றும் இலக்கியங்களின் வழியாக வாழ்வியல் மதிப்புகளை உணர்த்துதல்.
- சிந்தனைத் திறனையும், படைப்பாக்கத் திறனையும், கருத்து வெளிப்பாட்டுத் திறனையும் மேம்படுத்துதல்.
- வேலைவாய்புக்குரிய வகையில் மொழித்திறனை மேம்படுத்துதல்.

பாடத்திட்டப் பயன்விளைவு

- தமிழ்மொழி வரலாறு குறித்த தெளிந்த அறிவு பெற்றிருத்தல்.
- வாழ்வியல் மதிப்புகளைப் பேணுவதற்குக் கருவியாக இலக்கியங்களை நாடுகின்ற மனப்பான்மை பெற்றிருத்தல்.
- படைப்பிலக்கியத்திறன் பெற்றிருத்தல்.
- இந்தியக் குடியுரிமைப்பணி முதலான போட்டித் தேர்வுகளில், விருப்பப்பாடமாக இடம்பெறுகின்ற,'தமிழ் இலக்கியவரலாறு' தமிழ் இலக்கண அறிவு மேம்பாடு பெற்றிருத்தல்.
- மொழிபெயர்ப்பியல், கணினித்தமிழ் சார்ந்த வேலைவாய்ப்புத்திறன் மேம்பாடு.

அலகு – I **(10 மணிநேரம்)**

சங்க இலக்கியம்–எட்டுத்தொகை-முச்சங்கங்கள் பற்றிய செய்திகள் சங்க இலக்கியத்தின் தோற்றுவாய் – எட்டுத்தொகை அறிமுகம்

சங்க இலக்கியம் - நற்றிணை - நின்ற சொல்லர் –குறிஞ்சி – தலைவி கூற்று–1

சங்க இலக்கியம் - குறுந்தொகை - நிலத்தினும் பெரிதே–குறிஞ்சி – தலைவி கூற்று- 3

அறஇலக்கியம் - திருவள்ளுவர் – திருக்குறள் (எண்கள்-திருக்குறள் வரிசை எண்ணைக் குறிப்பன)

பாயிரம் – 8 அறவாழி அந்தணன்,13 - விண்இன்று பொய்ப்பின், 34 - மனத்துக்கண் மாசிலன் ஆதல்

இல்லற இயல் - இல்வாழ்க்கை - 41- அன்பும் அறனும் உடைத்தா 50- வையத்துள்வாழ்வாங்கு

அன்புடைமை - 80 - அன்பின்வழியது, **விருந்தோம்பல் -** 90 – மோப்பக்குழையும்,

இனியவைகூறல் - 95 – பணிவுடையன் இன்சொலன்,
செய்நன்றி அறிதல் - 103 – பயன் தூக்கார்,
புறங்கூறாமை - 190 – ஏதிலார் குற்றம், **ஒப்புரவுஅறிதல் -** 216 – பயன்மரம்
ஈகை: 228 – ஈத்துவக்கும் இன்பம், **துறவற இயல் - தவம் -** 261 – உற்றநோய்
வாய்மை - 291 – வாய்மை எனப்படுவது, **வெகுளாமை -** 306 - சினமென்னும்
இன்னாசெய்யாமை : 316-இன்னா எனத்தான் உணர்ந்தவை
நிலையாமை - 331 – நில்லாதவற்றை, **ஊழியல் - ஊழ் -** 373 – நுண்ணியநூல்
ஆள்வினை உடைமை - 618 –பொறியின்மை யார்க்கும், 620-ஊழையும் உப்பக்கம்
நட்பு - 792-ஆய்ந்தாய்ந்து, 794-குடிப்பிறந்து, 797-ஊதியம் என்பது.
காப்பியம் - சிலப்பதிகாரம்:
மங்கலவாழ்த்துப் பாடல் - பொதியில்ஆயினும் – 'கோவலன் என்பான்மன்னோ'
(14-38), 'நீலவிதானத்து' – 'நோன்புஎன்னை'(48-53).
மனையறம்படுத்த காதை - 'வார்ஒலிகூந்தலை' – 'சிறப்பின் கண்ணகிதனக்குஎன்' (84-90)
அரங்கேற்று காதை -'மாமலர்நெடுங்கண்' - 'அகம்மறந்து' (170-175).
மதுரைக்காண்டம் -கொலைக்களக்காதை,'இருமுதுகுரவர்'- 'எழுந்தனன்யான்' (67-83),'வினைவிளைகாலம்' - ' கொணர்கஈங்குஎன' (148-153)
கட்டுரை காதை - 'கடிபொழில்' - 'இல்சாபம்பட்டனிர்' (138-170)
வழக்குரைக் காதை -'அல்லவை செய்தார்க்கு' - 'தோற்றான்உயிர்' (82-93)
வஞ்சிக் காண்டம் - நடுகல்காதை - 'மதுரைமூதூர்' - 'மன்னவர்ஏறு' (218-234)
வாழ்த்துக் காதை - 'என்னேஇஃது' - 'தோன்றுமால்' (9)
எழுத்திலக்கணம் - முதல் மற்றும் சார்பெழுத்துகள்

அலகு- 2 **(10 மணிநேரம்)**

சங்க இலக்கியம் – பத்துப்பாட்டு அறிமுகம்
சங்க இலக்கியம் - பதிற்றுப்பத்து : ஏழாம்பத்து- எறிபிணம் இடறிய

செம்மறுக்– 65

சங்க இலக்கியம் - கலித்தொகை : அகன்ஞாலம் விளக்கும் - நெய்தல்கலி – தலைவிகூற்று- 119.

அற இலக்கியம் -முன்றுறையரையனார் - பழமொழி நானூறு 5 பாடல்கள்

காப்பியம் -மணிமேகலை : விழாவறைகாதை : 'தேவரும் மக்களும்' - 'மருங்குஎன்' (66-72)

ஊரலர் உரைத்தகாதை : 'நாவல்ஓங்கிய' - 'உண்டுகொல்'(1-17), 'கற்றுத்துறைபோகிய' – 'தீத்தொழில்படாஅள்' (32-57).

பாத்திரம் பெற்றகாதை : 'போதிநீழல்' - 'நல்அறம்கண்டனை' (73-98)

சிறைக்கோட்டம் அறக்கோட்டம் ஆக்கியகாதை -'வாழிஎம்கோ' - 'அரசுஆள்வேந்துஎன்' (129-163)

சொல்இலக்கணம் - பெயர், வினை, இடை, உரிச்சொல்-விளக்கமும் பயிற்சியும்

அலகு– 3 **(10 மணிநேரம்)**

அறஇலக்கியங்கள் அறிமுகம்

சங்க இலக்கியம் - பரிபாடல்: வையை : பாடல்-6. - நிறைகடல் முகந்து உராய் – சேறுஆடுபுனலதுசெலவு 1-50.

சங்க இலக்கியம் -அகநானூறு - ஈன்று புறம்தந்த எம்மும் உள்ளாள் – பாலை–

நற்றாய்கூற்று-35

அற இலக்கியம் -ஔவையார்- கொன்றை வேந்தன் (1-50 பாடல்கள்)

காப்பியம் - சூளாமணி–அரசியல்சருக்கம்- 1. நாவியே கமழும்(1131), 2. கண்மிசை கனிந்த (1132),3. விரைசெலலிவுளித்(1133), 4. அரைசர்கள் வருக (1134), 5. அருளுமாறடிகள் (1135), 6. விஞ்சையருலக (1136), 7. சொரிகதிர் (1137), 8. கரியவன் வளைந்த(1138), 9. மடித்தவா யெயிறு (1139),10. விஞ்சயரதனைக் (1140), **துறவுச்சருக்கம்** – பயாபதி மன்னனின் துறவுநெறி -1. மன்னிய புகழி(1840), 2. திருமகிழலங்கன் (1841) , 3. ஆங்கவ ரணைந்த (1842),4. அலகுடன் விளங்கு (1843), 5. தன்னையோர் அரசனாக்கி (1844), 6. சென்றநாள்(1845), 7. எரிபுரை (1846.), 8. பிறந்தனர்(1847), 9. பிறந்தநாம் (1848), 10. தொகைமலர் (1849) 11. ஒழுகிய(1850).

பொருள் இலக்கணம் - அகத்திணை மற்றும் புறத்திணை இலக்கணங்கள்.

அலகு- 4 **(10 மணிநேரம்)**

சிற்றிலக்கியங்கள் தோற்றமும் வளர்ச்சியும்

சங்க இலக்கியம் - ஐங்குறுநூறு : தாய்சாப்பிறக்கும் – தோழிகூற்று – மருதம் - களவன்பத்து: 24

சங்க இலக்கியம் - புறநானூறு : உற்றுழிஉதவியும்-183, பல்சான்றீரே – பொதுவியல்-195

அற இலக்கியம் – வேதநாயகம் பிள்ளை -நீதி நூல்- தேர்ந்தெடுக்கப்பட்ட 5 பாடல்கள் மட்டும்

சின்னவோர் பொருள், கடவுளை வருத்தி, எப்புவிகளும், வைத்தவர், ஈன்றவர்.

காப்பியம் – கம்பராமாயணம் – சுந்தரகாண்டம் (தேர்ந்தெடுக்கப்பட்ட பாடல்கள்

மட்டும்) வண்மையில்லை 84 - தாய் ஒக்கும் 171 - ஒரு பகல் 284 - எதிர் வரும் 314 – தருவனத்துள் 327 - எண் இலா 328 - சொல் ஒக்கும் 413 – இவ்வண்ணம் 559 - எண் அரு 598 - தடுத்து இமையாமல் 1979 - தோள் கண்டார் 1008 – மைந்தரை 1339 – அந்நகர் 1445 - சிவந்த வாய் 1550 - ஏய வரங்கள் 1593 – நின்மகன் 1526 – ஆழிசூழ் 1601 – மன்னவன் 1604 – பின்னும் 1752 – கிள்ளையொடு 1701 – எந்தையும் 2159 - பஞ்சி ஒளிர் 2762 - மயில் உடை 3248 – ஆண்டு 3390 –மற்றுஇனி 3812- கண்டனன் 5249 – வேலையுள் 6037 – மண்ணொடும் 6038- வாங்கிய 6170 – இங்குஉள 6172 – கண்டனென் 6031 - பைய பைய 6174 – அந்நெறி 6185 – குகனொடும் 6507 –கூவி 7131 –மாக்கூடு 7760 – அற்றவன் 9168 - ஆள் ஐயா 7271 - கார்நின்ற-10043.

கடிதப்பயிற்சி

1. வேலைவேண்டி விண்ணப்பம் எழுதுதல்
2.பல்கலைக்கழகப் பன்னாட்டுக் கருத்தரங்கச் செய்தியை நாளிதழில் வெளியிட வேண்டி நாளிதழின் பதிப்பாசிரியருக்குக் கடிதம்
3. கருத்தரங்கப் பங்கேற்புக்கான அனுமதிக் கடிதம்
4. பல்கலைக்கழக விழாவுக்குத் தலைமையேற்க வேண்டி, மாவட்ட ஆட்சியருக்கு விண்ணப்பம்.

அலகு – 5 **(8 மணிநேரம்)**

காப்பியங்கள் - தோற்றமும் வளர்ச்சியும்

சங்க இலக்கியம் - பத்துப்பாட்டு: சிறுபாணாற்றுப்படை

வானம் வாய்த்த – யாம் அவண்நின்றும் வருதும் (அடிகள்: 84-143),

செய்நன்றி அறிதலும் – நல்லியக்கோடனை நயந்தனிர் செலினே (207-269).

அற இலக்கியம் – குமரகுருபரர் - நீதி நெறி விளக்கம்

(தேர்ந்தெடுக்கப்பட்ட 5 பாடல்கள் மட்டும்)

உறுதி பயப்ப, முயலாது வைத்து, உலையாமுயற்சி, காலம் அறிந்து, மெய்வருத்தம்

கடிதப்பயிற்சி

5. கல்விக் கடன்வேண்டி வங்கிமேலாளருக்கு விண்ணப்பம்
6. வசிப்பிடத்திற்கு அடிப்படை வசதிவேண்டி வட்டாட்சியருக்கு விண்ணப்பம்
7. விருதுபெற்ற நண்பனுக்குப் பாராட்டுக் கடிதம்
8. புத்தகங்கள் அனுப்பி உதவவேண்டி, பதிப்பகத்தாருக்கு விண்ணப்பம்

பார்வை நூல்கள்

1. **கற்பகச் சோலை – தமிழ்ப்பாட நூல், இலக்கிய நெறிகள்,** தமிழ்த்துறை வெளியீடு,
2. கற்பகம் உயர்கல்விக்கழகம், கோயம்புத்தூர் – 21.
3. **தமிழ் இலக்கிய வரலாறு, முனைவர் கா.கோ. வேங்கடராமன்,** கலையக வெளியீடு, நாமக்கல்.

இணையதளம்

1. www.tvu.org.in
2. www.maduraitamilproject.com

இதழ்கள்

1. International Research Journal of Indian Literature, irjil.in
2. International Tamil Research Journal, iorpress.in

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	**2.8**	**2.6**	**2.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

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

2024-2025

Semester I

24LAUH101/24LUH101 **HINDI-PAPER- I** **4H-3C**

(Prose, Non-detailed, Nibandh, Grammar)

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

End Semester Exam: 3 Hours

PREREQUISITE: Not Required

COURSE OBJECTIVES(CO):

- Understand the text styles and grammatical elements
- Discuss the content of a reading passage
- Develop an interest in the appreciation of short stories

COURSE OUTCOMES(COs) :

- Develop an interest in the appreciation of literature.
- Discuss and respond to content of a reading passage.
- Learning the literacy knowledge of Hindi specially reading and writing .
- Learning the literary knowledge specially reading and understanding of Hindi short Stories
- Learning the history of Hindi literature.

UNIT -I a) Prose - Bharathiya Sangrah
b) Non-Detailed - Naya Mehman
c) Nibandh - Anushasan
d) Grammar - Bhasha Aur Vyakaran

UNIT -II a) Prose - Pahtha Pani Nirmal
b) Non-Detailed - Eakankki ki Visheshatha
c) Nibandh - Onam
d) Grammar – Varna Vichar , Sangya

UNIT -III a) Prose – Rashtriya Pitha Mahathma
b) Non-Detailed – Maha Bharat ki Eak Sanjh
c) Nibandh – Eakatha Ka Mahathva
d) Grammar – Sarvanam , Gender

UNIT-IV a) Prose – Gapshap
b) Non-Detailed – Yahang Sona Mana Hai
c) Nibandh – Ganga Pradhushan Ki Samasya
d) Grammar – Number , Karak , Visheshan

UNIT-V a) Prose – Nindha Ras
b) Non – Detailed Eakanki ki Katha Vasthu
c) Nibandh – Paropkar
c) Nibandh – Paropkar
d) Grammar - Kriya , Kriya Visheshan

TOTAL: 48 HOURS

REFERENCE BOOKS:

I. Prose :Nuthan Gathya Sangrah (lesson-1,5,6,8,9).

Editor : Jayaprakash

Publisher : Sumithra Prakasan,

16|5.Hasting Road,

Illahabad.211001.

ll. Non-detailed: Naveen Ekhanki Sangrah

Editor : Dr. Srimathi Malathi Tiwari

Publisher: Sumithra Prakashan,

204.Leela Apartment,

Ashok Nagar, Illahabad-211001.

lll. Nibandh : Subod Hindi Nibandh

Editor : Dr. Braj Kishor Prasad Sing

Publisher: Manoj Publication

1583-84 Dariba Kala, Chandni Chouk,

Delhi – 110006.

IV Grammar: Sugam Hindi Vyakaran
Writer: Pro. Vamshidhar & Dharmapal
Publication: Shiksha Bharathi, Kashmir Gat, Delhi - 110006

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO14	PO14	PO15	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	**2.8**	**2.4**	**2.4**	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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

Semester I

24LAUM101/24LUM101 MALAYALAM I 4H-3C

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

PREREQUISITE: Not required

COURSE OBJECTIVE(CO):

- Improves grammatical knowledge
- Will continue to read and learn about articles and think about them
- It is possible to read and understand short stories and understand the thoughts and life of the people of this state.

COURSE OUTCOME(COs):

- Understand the text styles and grammatical elements
- Discuss the content of a reading passage
- Develop an interest in the appreciation of short stories
- Comprehend the grammatical structures and sentence making
- Understand the language and developing English to Malayalam translation skill

	PART I MALAYALAM PAPER I	
Unit No.		**HOURS**
I	Novel – Pathummayude Aadu - Vaikam Muhammed Basheer	**10**
II	Novel- - Pathummayude Aadu - Vaikam Muhammed Basheer	**10**
III	Short Story - Ente Priyappeta Kadhakal – Akbar Kakkattil)	**09**
IV	Short Story - Ente Priyappeta Kadhakal – Akbar Kakkattil)	**10**
V	Composition &Translation(English to Malayalam)	**09**
	TOTAL	**48**

TEXT BOOKS:

1. Novel- PathummayudeAadu - Vaikam Muhammed Basheer(D.C.Books, Kottayam, Kerala)
2. Short Story - Ente Priyappeta Kadhakal – Akbar Kakkattil)(D.C. Books, Kottayam, Kerala)
3. Expansion of ideas, General Eassay and Translation. (A simple passage)

REFERENCE BOOKS:

1.Malayala Novel Sahithya Charitram-K.M.Tharakan (N.B.S.Kottayam)
2.Cherukatha Innale Innu-M. Achuyuthan (D.C Books, Kottayam)
3.Sahithya Charitram Prasthanangalilude- Dr.K.M George, (D.C.Books Kottayam)
4. Malayala Sahithyavimarsam-Sukumar Azheekode (D.C.books)

CO, PO, PSO Mapping

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

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

2024-2025

Semester I

24LAUS101/24LUS101 **SANSKRIT I** **4H-3C**

(POETRY, GRAMMAR AND TRANSLATION**)**

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

End Semester Exam: 3 Hours

PREREQUISITE: Not required

COURSE OBJECTIVES(CO):

- The fundamental objective of the curriculum is to impart effective science education at the undergraduate level, exposing them to recent trends and developments in the subject.
- Creating scientific temper is another major objective of this curriculum.
- Another major thrust given here is to develop an environmental concern in all activities of the students. 'Go green', the motto of the syllabus emphasizes the urgent need to conserve nature without destruction of natural resources.

COURSE OUTCOMES(COs) :

- **Critical Thinking** :Take informed actions after identifying the assumptions that frame students' thinking and actions.
- **Problem Solving**: Understand and solve problems of relevance to society to meet the specified needs using the knowledge, skills and attitudes acquired.
- **Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **Effective Citizenship**: Demonstrate empathetic social concern and equity centered national development.
- **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.

UNIT I

Introduction to Poetry, Definition of Poetry

UNIT II

Five Maha Kavyas

UNIT III

Text Prescribed : Raghuvamsa (Canto – 1) First Ten Slokas

UNIT IV

Text Prescribed : Raghuvamsa (Canto – 1) Slokas Eleven to Thirty

UNIT V

Text Prescribed : Raghuvamsa (Canto – 1) Slokas Thirty One to Fifty

Grammar: Text prescribed : Sanskrit Self Teacher
By Dr.V.Varadhachari
(Present tense and Declension of „a‟ endingnouns
(Masculine)

TOTAL: 48 HOURS

TEXT BOOKS:

1.Raghuvamasa (Canto – 1)R.S.Vadhyar and Sons Palghat, kerala

2.Sanskrit Self Teacher By Dr.V.VaradhachariT.S.Sriraman 32, Tank Bund Road
Near Loyola College, Nungambakkam Chennai 600 034.

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	**2.6**	**2.6**	**2.8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

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

Semester I

24LAUF101/24LUF101 FRENCH I 4H-3C

(Leçon, Communication, Grammaire, Verbes, Lexique, Culture)

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

End Semester Exam: 3 Hours

PREREQUISITE: Not Required

COURSE OBJECTIVES (CO):

- To enable the learner to communicate effectively and appropriately.
- To develop and integrate the use of the four language skills.
- To train students to acquire proficiency in French by reading different genres of literature and learning grammar.

COURSE OUTCOMES (COs):

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

COs	Course Outcomes	Blooms Level
CO1	Retrieve fundamentals of French language to construct error free sentences.	Apply
CO2	Construct and maintain social relationships.	Analyze
CO3	Construct business letters, proposals and E-Mail communication	Apply
CO4	Adopt the skills of planning, structuring, and delivery techniques in group discussions and presentations.	Understand
CO5	Classify communication skills in business environment	Understand

Unite – I

a) Leçon – Bienvenue
b) Communication –Un cours de francais,Entrer en contact saluer,
c) Verbes - être ou avoir
d) Lexique –Les couleurs, l' alphabet
e) Culture – La France

Unité - II

a) Leçon -Bonjour ça va ?
b) Communication -Demander et dire,Comment ça va
c) Verbes – Les verbes réguliers en –er.
d) Lexique - Les Pays et les nationalités , Les animaux domestiques, Les jours de la semaine.
e) Culture – La France et la Francophonie

Unité - III

a) Leçon - Salut ! Je m'appelle Agnès
b) Communication - Se présenter et présenter quelqu'un Demander et dire la date
c) Grammaire - Les pronoms personnels sujets ,Les verbes être et avoir , Les articles définis et indéfinis
d) Verbes - Les verbes aller et venir
e) Lexique - Les mois de l'année, Les nombres de 0 à 69 » La famille (1)
f) Culture - La France physique et politique

Unité IV

a) Leçon - Qui est-ce ? Dans mon sac, j ' ai

b) Communication - Demander et répondre poliment ,Demander des informations Personnelles

c) Grammaire - La formation du feminine, La formation du pluriel , Le adjectifs possessifs

d)Verbes -Les verbes ir et re

e)Lexique -Les professions ,Quel ques objets ,La fiche d'identité

f)Culture -Les symbols de la France,

Unité V

a) Leçon - Il est comment ? Allô ?

b)Communication - Décrire l'aspect physique et le caractère Parler au téléphone

c)Grammaire - La formation du féminin , La phrase interrogative Qu'est-ce que... ? La phrase négative

d)Verbes - Le verbe Faire

e) Lexique - L'aspect physique , Le caractère, Les prépositions de lieu , Les nombres à partir de 70

f) Culture- Les frontiers de la france,les villes connues en france.

TOTAL: 48 HOURS

REFERENCE BOOKS:

- Cocton Marie –Noëlle , Duplex Dorothée, Heu Elodie , Kasazian Emilie, Ripaud Delphine, **Saison 1- Méthode de francais**, Didier, paris.2015.
- Cocton Marie – Noëlle, Dupleix, Heu Elodie, Kasazian Emilie ,Ripaud **Deldphin, Saison 1 – Cahier d'activites** , Dider ,Paris , 2015
- Anne Akyüz,Bernadette Bazelle- Shahmael,JoëlleBonenfant, Marie- Françoise Gliemenn,**Les exercices de grammaire**,Hachette FLE, Paris,2005
- Christian Beaulieu, Je **pratique, Exercises de grammaire A1**, Dider,Paris,2015
- Nathalie BIE, philippe SANTINAN,**Grammaire pour adolescents-250 exercises,** CLE International , Paris , 2005

WEBSITES :

1. http:// enseigner.tv5 monde.com/
2. bonjourdumonde.com /exercises/contenu/le – francais-du- tourisme.html
3. http://www.bonjurdefrance.com/
4. https://www.lepointdufle.net/

CO, PO, PSO Mapping

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

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

2024-2025

Semester I

24ENU101 **ENGLISH I** **3H-3C**

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

End Semester Exam: 3 Hours

PREREQUISITE: Not required

COURSE OBJECTIVES(CO):

- To enable the learner to communicate effectively and appropriately.
- To develop and integrate the use of the four language skills.
- To train students to acquire proficiency in English by reading different genres of literature and learning grammar.

COURSE OUTCOMES (COs):

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

COs	Course Outcomes	Blooms Level
CO1	Retrieve fundamentals of English language to construct error free sentences.	Apply
CO2	Construct and maintain social relationships.	Analyze
CO3	Construct business letters, proposals and E-Mail communication	Apply
CO4	Adopt the skills of planning, structuring, and delivery techniques in group discussions and presentations.	Understand
CO5	Classify communication skills in business environment	Understand

UNIT-I **8 HOURS**

LISTENING: Listening –Types of Listening
SPEAKING: Face to Face Conversation
READING: Reading – Types of Reading
WRITING: Jumbled Sentences
LITERATURE: Ode on a Grecian Urn by John Keats
GRAMMAR: Parts of Speech

UNIT- II **7 HOURS**

LISTENING: Principles of Listening Skills
SPEAKING: Descriptions
READING: Reading Techniques
WRITING: Paragraph Writing
LITERATURE: Of Friendship by Francis Bacon
GRAMMAR: Articles

UNIT- III **7 HOURS**

LISTENING: Barriers of Listening
SPEAKING: Telephone Conversations
READING: Reading Comprehension Passages
WRITING: Precise Writing
LITERATURE: The Umbrella man by Roald Dahl
GRAMMAR: Tense

UNIT- IV **7 HOURS**

LISTENING : Story Narrations
SPEAKING : Group Discussion
READING : Reading Reports and profiles
WRITING : Letter Writing
LITERATURE: Tyger by William Blake
GRAMMAR : Subject and Predicate-Question Tags

UNIT V **7 HOURS**

LISTENING: Listening Strategies
SPEAKING: Interview Skills
READING: Tips for MOC- Anchoring
WRITING: Circular Writing and Summary Writing
LITERATURE: Short story: Rapunzel by the Brothers Grimm
GRAMMAR: Framing Questions

TOTAL: 36 HOURS

TEXT BOOK

1. Board of Editors , *Acrostic I* (2024*)*. Karpagam Academy of Higher Education

REFERENCE BOOKS:

1. *Martin's, St* (2013). *Oxford Handbook of Writing: Handbook of Writing.* Cambridge University Press.
2. Julian Treasure ,*Sound Business,* (2012). Oxford University Press
3. Hornby, A,S.(1975). *The Guide to patterns and usage in English:* oxford university Press.
4. Ellis, R.(1990). *Instructed second language acquisition,* Oxford: oxford university Press New York:Pergamon Press.

WEB SITES:

1. https://langster.org/en/blog/fundamentals-of-english-grammar-everything- you-need-to-know/
2. https://medium.com/@phonicstandardvideo.am/fundamentals-of-english- grammar-for-novices-24b355d2cd83

CO, PO, PSO Mapping

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

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

SEMESTER I

24BTU101 **CELL BIOLOGY** **6H–4C**

Instruction Hours/week: L: 6 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 hours

PREREQUISITE: Student should be familiar with biological system.

COURSE OBJECTIVES (CO)

- To provide the fundamental knowledge on structures and role of basic components in prokaryotic and eukaryotic cells
- To know about the role of macromolecules, membranes, and organelles in cells
- To understand the mechanism of cellular components underlying mitotic cell division

COURSE OUTCOMES (COs)

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

COs	Course Outcomes	Blooms Level
CO1	Define the composition and function of prokaryotic and eukaryotic cells.	Remember
CO2	Summarize information about intracellular and extracellular organelles and their functions.	Understand
CO3	Build knowledge to prevent cellular abnormalities and associated disorders.	Apply
CO4	Analyze the knowledge on energy production and its utilization in cells for solving variety of problem in biological system.	Analyze
CO5	Determine the gene regulation pattern of biological organisms in normal and abnormal cells.	Evaluate

UNIT- I BASIC OF CELL BIOLOGY: **15 HOURS**

Cell as a basic unit: discovery of the cells, Function of cells, classification of cell types, development of cell theory, early chemical investigation in cell biology. Prokaryotic and Eukaryotic cell organization.

UNIT-II STRUCTURE AND FUNCTIONS OF CELL ORGANELLES: **15 HOURS**

Cell membrane, cytosol, ribosomes, mitochondria, chloroplasts, lysosomes, Vacuoles and micro bodies peroxisomes, glyoximes, nucleus and chromosomes. Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.

UNIT - III CELL DIVISION AND INTERACTIONS: **15 HOURS**

Mitosis and meiosis. Cell cycle – stages of interphase and M-phase, Check points in cell cycle, cell synchrony and its applications. Cell-cell interactions –Cell adhesion, Metabolic cooperation, electrical coupling, contact inhibition, autocrine, paracrine and endocrine signaling**.**

UNIT- IV MEMBRANE TRANSPORT: **15 HOURS**

Membrane transport, Transport across cell membrane, simple diffusion, passive transport, active transport, Na/K ion channel, vesicular transport, Membrane potential, Depolarization, hyperpolarization of membrane (neuronal). Generation of action potential. Types of biopotentials. Biopotential measurement instrument.

UNIT – V CELL DIFFERENTIATION, SENESCENCE AND DEATH: **12 HOURS**

Fertilization, initial divisions, seed formation, germination, primordial layer formation (sources of organs from each layer), Role of hormones in cellular differentiation, Cell death and abnormalities – Biochemical changes during senescence, necrosis and programmed cell death, Cancer biology and Autophagy.

TOTAL: 72 HOURS

TEXT BOOK:

1. Karp G. (2013). Cell and Molecular Biology: Concepts and Experiments. 7th edition. Hoboken, US: John Wiley & Sons. Inc.
2. Cooper GM, and Hausman RE. (2013). The Cell: A Molecular Approach. 6th edition. Washington, USA: ASM Press & Sunderland, D.C., Sinauer Associates.
3. Becker WM, Kleinsmith LJ, Hardin J. and Bertoni GP. (2015). The World of the Cell. 8th edition. San Francisco: Pearson Benjamin Cummings Publishing.

REFERENCE BOOK:

1. De Robertis EDP, and De Robertis E.M.F. (2017). Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
2. Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter (2018). Molecular Biology of the Cell Sixth Edition Garland Science publishers.

WEBSITE:

1. http://172.16.25.76/login/index.php
2. https://nptel.ac.in/courses/102103012/

CO, PO, PSO Mapping

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

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

SEMESTER I

24BTUA101 **CHEMISTRY– I** **5H–4C**

Instruction Hours/week: L: 5T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3Hours

PREREQUISITE: Elementary level understanding of various organic, inorganic and physical chemistry principles at the +2 Level.

COURSE OBJECTIVES (CO):

- To learn about the chemical bonding, covalent bond and stereoisomerism of chemical molecule.
- To understand about the important industrial chemicals like silicones, fuel gases and fertilizers and their impact on environment.
- To gain the knowledge about the dyes, chemotherapy and vitamins.

COURSE OUTCOMES (CO's):

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

COs	Course Outcomes	Blooms Level
CO1	Illustrate molecular orbital theory and valence bond theory and apply them to various molecules.	Understand
CO2	Distinguish the polar effects and apply them in exploring the properties of molecules.	Analyze
CO3	Explain isomerism and synthesis, properties and uses of gases and fertilizers.	Understand
CO4	Demonstrate the elements in photochemistry, and chemical kinetics.	Understand
CO5	Analyze about the dyes, chemotherapy, vitamins and chromatography.	Analyze

UNIT I CHEMICAL BONDING **12 HOURS**

Molecular orbital theory-linear combination of atomic orbitals-bonding and antibonding molecular orbitals-energy level diagram-bond order- M.O. configuration of H_2, N_2 and F_2 molecules. Diborane: Preparation, properties and structure. $NaBH_4$: Preparation and uses. Borazole: Preparation and properties. Interhalogen compounds: ICl, BrF_3, IF5- preparation, properties, uses and structure. Basic properties of iodine. Compounds of sulphur: Sodium hydrosulphite- preparation, properties, uses and structure. Per acids of sulphur: Preparation, properties, uses and structure.

UNIT II COVALENT BOND AND STEREOISOMERISM **12 HOURS**

Covalent Bond: Orbital overlap, hybridization and geometry of CH_4, C_2H_4 and C_2H_2. Polar effects: Inductive effect- electromeric effect- mesomeric effect- steric effect- hyperconjugation. Stereoisomerism: Elements of symmetry-polarised light and optical activity-isomerism in tartaric acid- racemisation- resolution- geometrical isomerism of maleic and fumaric acids-keto-enol tautomerism of acetoacetic esters.

UNIT III INDUSTRIAL CHEMISTRY **12 HOURS**

Silicones: Synthesis, properties and uses. Fuels gases: Natural gas-water gas-semi water gas- carbureted water gas-producer gas- oil gas (Manufacturing details not required). Fertilizers: NPK fertilizer-ammonium sulphate-urea-superphosphate of lime-triple superphosphate- potassium nitrate- ammonium nitrate. Pollution: Water, air and soil pollution-sources and remedies-acid rain-ozone hole- greenhouse effect.

UNIT IV ELEMENTS OF PHOTOCHEMISTRY, CHEMICAL KINETICS AND CHROMATOGRAPHY **12 HOURS**

Elements of Photochemistry: Photochemical laws-Beer Lambert's law-Grotthuss-Draper law-Stark- Einstein law (statement only). Chemical Kinetics: Rate-order-molecularity-pseudo first order reactions- zero order reactions-determination of order of reaction-measurement of order and rates of reactions- effect of temperature on reaction rate-energy of activation. Chromatography: Principles and applications of Column, Paper and Thin Layer Chromatography.

UNIT V DYES, CHEMOTHERAPY AND VITAMINS **12 HOURS**

Dyes: Terms used chromophore, auxochrome, bathachromic shift and hypsochromic shift- classification of dyes– based on chemical structure and application-one example each for azo, triphenylmethane, vat and mordant dyes-preparation. **Chemotherapy**: Preparation, uses and mechanism of action sulpha drugs- preparation and uses of prontosil, sulphadiazine and sulphafurazole. Antibiotics: Structure and uses of pencillins and Chloromycetin. **Vitamins:** Diseases caused by the deficiency of vitamins A, B_1, B_2, C and D-sources of these vitamins.

TOTAL: 60 HOURS

TEXT BOOKS:

1. Thangamani, A. (2018). *Text Book on Allied Chemistry* (1st Edition). Coimbatore: Karpagam Publication.
2. Puri, B.R., Sharma, L. R., & Kalia, K. C. (2017). *Principles of Inorganic Chemistry* (33rd Edition). Jalandar: Vishal Publishing Company.
3. Bahl, A., & Bahl, B.S. (2015). *A Textbook of Organic Chemistry* (21st Revised Edition). New Delhi: S. Chand & Company Pvt. Ltd.
4. Puri, B. R., Sharma, L. R. & Pathania, M. S. (2014). Elements of Physical Chemistry (46th Edition). Jalandhar: Vishal Publishing Company.

REFERENCE BOOK:

1. Gopalan, R., & Sundaram, S. (2013). *Allied Chemistry* (3rd Edition). New Delhi: Sultan Chand & Sons.

CO, PO, PSO Mapping

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

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

SEMESTER I

24BTU111 **CELL BIOLOGY – PRACTICAL** **4H–2C**

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

End Semester Exam: 3 Hours

PREREQUISITE: Student should be familiar with biological system and mechanism of cellular components.

COURSE OBJECTIVES

- To provide the fundamental knowledge on structures and role of basic components in prokaryotic and eukaryotic cells
- To know about the role of macromolecules, membranes, and organelles in cells
- To understand the mechanism of cellular components underlying mitotic cell division

COURSE OUTCOMES

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

COs	Course Outcomes	Blooms Level
CO1	Define the composition and function of prokaryotic and eukaryotic cells.	Remember
CO2	Summarize information about intracellular and extracellular organelles and their functions.	Understand
CO3	Build knowledge to prevent cellular abnormalities and associated disorders.	Apply
CO4	Match different cell types, and cellular structures using different microscopic techniques.	Remember
CO5	Distinguish the cells of various living organisms and understand the physiological processes	Analyze

Practicals **48 hours**

1. Study of Prokaryotic and Eukaryotic cell structure.
2. Study the effect of temperature and organic solvents on semi-permeable membranes.
3. Demonstration of dialysis.
4. Study of plasmolysis and de-plasmolysis.
5. Cell division in the onion root tip.
6. Microtomy: Fixation, block making, section cutting, double staining of animal tissues like liver, pancreas, and kidney.
7. Cell counting methods.
8. Chromosomal banding techniques.
9. Preparation of Nuclear, Mitochondrial & cytoplasmic fractions.

TOTAL: 48 HOURS

TEXT BOOKS:

1. Becker WM, Kleinsmith LJ, Hardin J. and Bertoni GP. (2015). The World of the Cell. 8th edition. San Francisco: Pearson Benjamin Cummings Publishing.
2. Cooper GM, and Hausman, RE. (2013). The Cell: A Molecular Approach. 6th edition. ASM Press & Sunderland, D.C., Sinauer Associates. Washington, USA.
3. De Robertis EDP, and De Robertis E.M.F. (2017). Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia
4. Karp G. (2013). Cell and Molecular Biology: Concepts and Experiments. 7th edition. Hoboken, US: John Wiley & Sons. Inc.

CO, PO, PSO Mapping

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

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

SEMESTER I

24BTUA111 **CHEMISTRY PRACTICAL – I** **4H–2C**

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

End Semester Exam: 3 Hours

PREREQUISITE: Elementary level understanding of organic chemistry principles at the +2 Level.

COURSE OBJECTIVES (CO)

- To understand the principles behind the qualitative analysis by semi micro-qualitative analysis method.
- To apply the preliminary test to confirm the organic compounds.
- To analyze the systematic analysis of the organic compounds.

COURSE OUTCOMES (CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Recall the procedure for semi micro-qualitative analysis.	Remember
CO2	Demonstrate the preliminary test to do the semi- micro qualitative analysis.	Understand
CO3	Explain the basic concept of semi-micro qualitative analysis.	Understand
CO4	Identify the organic compounds systematically.	Apply
CO5	Analyze the functional groups with their special tests for organic compound	Analyze

Systematic analysis of an organic compound **48 hours**

1. Preliminary tests.
2. Detection of elements present.
3. Aromatic or aliphatic.
4. Saturated or unsaturated.
5. Nature of the functional group.
6. Confirmatory tests– aldehydes, ketones, amines, amides, diamide, carbohydrates, phenols, acids, esters & nitro compounds.
   Note: Each student should analyze a minimum 6 compounds.

TOTAL: 48 HOURS

TEXT BOOK:

1. Ramasamy R. (2011). Allied Chemistry Practical Book. Karur: Priya Publications.
2. Thomas A.O. (2012). Practical Chemistry for B.Sc. Main Students. Cannanore: Kerala, Scientific Book Centre.
3. Venkateswaran V, Veeraswamy R, and Kulandaivelu AR. (2015). Basic Principles of Practical Chemistry. 2nd edition. S. Chand Publications. New Delhi.

CO, PO, PSO Mapping

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

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

SEMESTER I

24VAC101 **YOGA FOR YOUTH EMPOWERMENT** **2H-2C**

Instruction Hours/ week: L:2 T:0 P: 0 **Marks: Internal:100 Total:100**

End Semester Exam: 3 Hours

PREREQUISITE: Not required.

COURSE OBJECTIVES (CO)

- To create awareness about Yoga and Physical Health
- To provide Value Education to improve the student's character and understanding Greatness of Life force and Mind
- To know about five aspects of life and to develop good Qualities and eliminate bad ones
- Learning introspection practices like Analysis of Thoughts, Moralization of Desires, Neutralization of Anger, and Eradication of Worries about Diversity in Men (Why Men Differ).
- To understand the yoga, life, and practice of Yogasanas

COURSE OUTCOMES (CO's:

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

COs	Course Outcomes	Blooms Level
CO1	Understand the concepts of about Yoga and Physical Health	Understand
CO2	Study the concepts a Greatness of Life force and Mind	Understand
CO3	Learn the aspects of Personality Development - Sublimation	Understand
CO4	Practices Human Resource Development	Apply
CO5	Understand about the yoga, life and Law of Nature	Apply

UNIT I: YOGA AND PHYSICAL HEALTH **5 HOURS**

Manavalakalai (SKY) Yoga: Introduction Education as a means for youth empowerment- Greatress of Education Yoga for youth Empowerment. Simplified Physical Exercises Hand, Leg, Breathing, Eye exercises Kapalabathi, Makarasana Part I, Makarasana Part II, Body Massage, Acupressure, Relaxation exercises Benefits Yogasanas 1: Pranamasana HasthaUttanasana Pada Hasthasana - Aswa Sanjalana Asana Thuvipatha asva Sarjalana asana Astanga Namaskara - Bhujangasana Atha Muktha Savasana Aswa Sanjalana Asara Pada Hasthasana-Hastha Uttanasana Pranamasana - Pranayama: Naddi sudei- Clearance Practice- Benefits - Simplified Physical Exercise-Kayakalpa Practices - Meditation Practices. **Philosophy of life:** Purpose of life Philosophy of life (Needs Protections Virtues Development of knowledge) Five Types of duties-Protection of the natural resources.

UNIT: II GREATNESS OF LIFE FORCE AND MIND **5 HOURS**

Reasons for Diseases Natural reasons (Genetic/imprints, Planetary Position, Natural calamities and climatic changes) Unnatural reasons (Food habits, Thoughts, Deeds) Philosophy of Kaya Kalpa: Physical body-Sexual vital fluid-Life force-Bio-Magnetism- Mind Maintaining youthfulness: Postponing old age seven components - Importance of sexual vital fluid Transformation of food into Measure and method in five aspects of life- Controlling undue Passion. Kayakalpa practice: Aswini Mucra-Ojas Breath-Benefits of Kaya Kapa.

UNIT:III PERSONALITY DEVELOPMENT – SUBLIMATION **5 HOURS**

Mental Frequencies: Beta, Alpha, Theta, and Delta wave Agna Meditation explanation benefits. Shanti meditation: Shanthi Meditation explanation-benefits - Thuriya Meditation: Thuriya Meditation explanation benefits - Benefits of Blessing Self blessing (Autosuggestion) Family blessing. Blessing the others World blessing- Divine protection Human Values: Set-cortio- Sell-confidence Honesty Contentment Humility Modesty to France Adjustment- Sacrifice-Forgiveness Purity (Body, Dress, Enviorment) Physical purity- Mental Purity-Spiritual purity. Social Values: Nonviolence-Service Patriotism-Equality Respect for parents and elders care and protection Respect for teacher Punctuality-Time Management

UNIT: IV HUMAN RESOURCE DEVELOPMENT **5 HOURS**

Morality (virtues): Importance of Introspection: 1 Mine (Ego, Possessiveness) Six Evi Temperaments- Greed-Anger-Miserliness Immoral sexual passion - Inferiority and superiority Complex - Vengeance Maneuvering of Six Temperaments: Contentment-Tolerance-Charity- Chastity -Equality-Pardon (Forgiveness) - Five essential Qualities acquired through Meditation: Perspicacity Magnanimity Receptivity Adaptability-Creativity (Improved Memory Power)

UNIT: V LAW OF NATURE **4 HOURS**

Ten stages of the Mind - Five kosas of the mind Maintaining good Relationships Thought- Importance of thoughts - Reasons for Thoughts Practice of Analysis of Thoughts Definition of Desire-Root causes for desires Types of desires Desires Essential for success Practice for Moralization of Desires Thought- Reformation-Frugality. Anger- Reasons for Anger-Anger and Peace Ill effects of anger Tolerance and Forgiveness - Neutralization of Anger- practice. Diversity in Men (Why Men Differ) Love and compassion, Eradication of Worries: Reasons for Worries-Fout types of worries Il effects-results- Practice for Eradication of Worries. **Yoga Practices:** Thandasana Chakrasana (sideways) Vruchasana Thirikonasana Varasana

TOTAL:24 HOURS

TEXT BOOK:

Yoga for Youth Empowerment, 2023 Reference Books:

1. Kayakapam Thathuvagnani Vethathiri Maharishi
2. Light on yoga BKS. lyenger
3. Manavalakala Part-1-Thathuvagnani Vethathiri Maharishi.
4. Manavalakala part-2-Thathuvagnani Vethathiri Maharishi
5. Mind Thathuvagnari Vethathir Maharishi
6. Simplified Physical Exercises- Thathuvagnani Vethathiri Maharishi
7. Sound Health through yoga - Dr.Chandrasekaran
8. The world orcer of Holistic unity- Thathuvagnani Vethathiri Mahanshi
9. Thirukkural-Rev. Dr.G.U.pope
10. Yoga for modern age Thathuvagnani Vethathin Maharishi

CO, PO, PSO Mapping

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

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

SEMESTER I

ACTIVITY: LIBRARY/SEMINAR **2H**

Instruction Hours/week: L:0 T:0 P:2

இரண்டாம் பருவம்

24LSUT201 **இலக்கிய நெறிகள்** **4H - 3C**

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

End Semester Exam: 3 Hours

பாடத்திட்டப் பொதுநோக்கம்

- மாணவர்களுக்குத் தமிழ்மொழி வரலாறு மற்றும் இலக்கியங்களின் வழியாக வாழ்வியல் மதிப்புகளை உணர்த்துதல்.
- சிந்தனைத் திறனையும், படைப்பாக்கத் திறனையும், கருத்து வெளிப்பாட்டுத் திறனையும் மேம்படுத்துதல்.
- வேலைவாய்புக்குரிய வகையில் மொழித்திறனை மேம்படுத்துதல்.

பாடத்திட்டப் பயன்விளைவு

- தமிழ்மொழி வரலாறு குறித்த தெளிந்த அறிவு பெற்றிருத்தல்.
- வாழ்வியல் மதிப்புகளைப் பேணுவதற்குக் கருவியாக இலக்கியங்களை நாடுகின்ற மனப்பான்மை பெற்றிருத்தல்.
- படைப்பிலக்கியத்திறன் பெற்றிருத்தல்.
- இந்தியக் குடியுரிமைப்பணி முதலான போட்டித் தேர்வுகளில், விருப்பப்பாடமாக இடம்பெறுகின்ற,'தமிழ் இலக்கியவரலாறு' தமிழ் இலக்கண அறிவு மேம்பாடு பெற்றிருத்தல்.
- மொழிபெயர்ப்பியல், கணினித்தமிழ் சார்ந்த வேலைவாய்ப்புத்திறன் மேம்பாடு.

அலகு – I (8 மணிநேரம்)

நாயன்மார்கள் : தமிழ் இலக்கிய வரிசையில் திருமுறைகளும் நாலாயிரத் திவ்யப்பிரபந்தமும் – பன்னிரு திருமுறைகள் அறிமுகம் – திருமுறை ஆசிரியர்களின் இலக்கியப் பங்களிப்பு

சைவம்-பெரியபுராணம் - காரைக்கால் அம்மையார் புராணம் .

முக்கூடற்பள்ளு - 2 பாடல்கள் - சித்திரக்காலிவாலான் (நெல் வகைகள்) குற்றாலத் திரிகூடமால்வரை (மீன்வகைகள், காளை வகைகள்)

கவிதை : மகாகவி பாரதியார் - யோகசித்தி

கவிதை : கவிமணி தேசிக விநாயகம் பிள்ளை - வாழ்க்கைத் தத்துவங்கள்

கவிதை : கவிஞர் சுகந்திசுப்பிரமணியம் - புதையுண்டவாழ்க்கை

சிறுகதை : மகாமசானம் - புதுமைப்பித்தன்

இலக்கணம் - வாக்கியஅமைப்பு : தனிவாக்கியம் – தொடர்வாக்கியம் – கலவைவாக்கியம் -தன்வினை வாக்கியம் – பிறவினை வாக்கியம்- செய்வினை,

செயப்பாட்டு வினைவாக்கியம், கட்டளைவாக்கியம் – வினாவாக்கியம் – உணர்ச்சி வாக்கியம். நன்னூல் – பொதுவியல் - அறுவகைவினா (385) - எண்வகைவிடை (386).

அலகு– 2 **(12 மணிநேரம்)**

ஆழ்வார்கள் : இலக்கியப் பங்களிப்பு - திவ்யப் பிரபந்தத்தில் பக்திநெறியும் இலக்கிய நயமும்

உரைநடை : தோற்றமும் வளர்ச்சியும்

வைணவம் : பெரியாழ்வார் திருமொழி: 3 -ஆம் பத்து – பத்தாம் திருமொழி

'நெறிந்தகருங்குழல் மடவாய்' – சீதைக்கு அனுமன் தெரிவித்த அடையாளம்.

கவிதை - கவிஞர் வைரமுத்து - வித்தியாசமான தாலாட்டு

சிற்பி பாலசுப்பிரமணியன் - பாரதி எங்கள் கண்மணி

அரங்க பாரி - கண்ணீர்! கண்ணீர்!

தமிழலங்காரம் – வண்ணச்சரபம் தண்டபாணி சுவாமிகள் - 10 பாடல்கள் 1. கடல் நீரில் கல்மிதக்கும், 2. வண்டமிழ் ஆற்றுதி, 3. கோளத்தை முட்டி 4. எக்காலம்என்று, 5. கடவூர் மயானத்தொர், 6. தேவாதிதேவன், 7. விண்மாரி, 8. தேவர்முனிவர், 9. அழுதேங்கிநஞ்சிட்ட,

10. அத்தனை பொத்து.

சிறுகதை : ஆர். சூடாமணி - அந்நியர்கள்

கட்டுரை : ஆளுமைத்திறன் அறிவோம்- தன்னம்பிக்கை மாதஇதழிலிருந்து

அணிஇலக்கணம் : உவமையணி – பிறிதுமொழிதல் அணி – சிலேடை அணி – தீவக அணி- ஏகதேச உருவக அணி – வேற்றுமையணி – பின்வருநிலையணி

அலகு - 3 **(10 மணிநேரம்)**

புதுக்கவிதை - தோற்றமும் வளர்ச்சியும்

சிற்றிலக்கியம் -தோற்றமும்வளர்ச்சியும்

மதுரைசொக்கநாதர் - தமிழ்விடுதூது – தமிழின் சிறப்பு பாடியருள பத்துப்பாட்டும் - விளம்பக்கேள்.

கவிதை- ஈரோடுதமிழன்பன் – இன்னொரு சுதந்திரம்

சிறுகதை - கு. அழகிரிசாமி - இருவர் கண்ட ஒரேகனவு

கட்டுரை - ஔவைதுரைசாமி - ஏட்டில் இல்லாத இலக்கியம்

படைப்பிலக்கியப் பயிற்சிகள் - மரபுக்கவிதை, புதுக்கவிதை, சிறுகதை, கட்டுரை படைப்பாக்க உத்திகள் –பயிற்சிகள்

அலகு – 4 **(10 மணிநேரம்)**

சிறுகதை - தோற்றமும் வளர்ச்சியும்

கலிங்கத்துப்பரணி – தேவாசுரம், உடலின்மேல், நெடுங்குதிரை மிசைக்கலணை, விருந்தினரும் வறியவரும், தரைமகள் தன்கொழுநன்றன், பொருதடக்கை
வாளெங்கே, வெயில்தாரை.

அருள்தரும் பூங்கோதையன்னை அந்தாதி - 11பாடல்கள் 1. பகவன்பெயரை, 2. மெல்லியல்மேலை, 3.வாலின்குரங்கு, 4.தவளேஇவள், 5.சுரக்கும் திருவருட், 6. வதிவாய்விளைபயில், 7. உறைவான், 8.பச்சைப்பேர், 9.வித்தகம், 10.துணையாய், 11.கலந்தார்.

கவிதை - கவிஞர்தாமரை - தொலைந்துபோனேன்

சிறுகதை – அம்பை - வல்லூறுகள்

கட்டுரை- முனைவர் ப. தமிழரசி - நொய்யல்,

சொல்லின் செல்வர் ரா.பி.சேதுப்பிள்ளை - காளத்திவேடனும் கங்கைவேடனும்

மொழிபெயர்ப்புப் பயிற்சிகள் : தமிழ்-ஆங்கில மொழிபெயர்ப்புப் பயிற்சிகள் - 2.

அலகு – 5 **(8 மணிநேரம்)**

நாட்டுப்புற இலக்கியங்கள் – அறிமுகம்

கவிதை – புரட்சிக்கவிஞர் பாரதிதாசன் - தமிழின் இனிமை

கவிதை - கவிஞர் அறிவுமதி - நட்புக்காலம்

சிறுகதை - நாஞ்சில்நாடன் - இந்நாட்டு மன்னர்

கீழடி - வைகை நதிக்கரையில் சங்ககால நகரநாகரிகம்

மொழிபெயர்ப்புப் பயிற்சிகள் : ஆங்கிலம் - தமிழ் மொழிபெயர்ப்புப் பயிற்சிகள்-2.

பார்வை நூல்கள்

1. **கற்பகச் சோலை – தமிழ்ப்பாட நூல், இலக்கிய நெறிகள்,** தமிழ்த்துறை வெளியீடு, கற்பகம் உயர்கல்விக்கழகம், கோயம்புத்தூர் – 21.
2. **தமிழ் இலக்கிய வரலாறு, முனைவர் கா.கோ. வேங்கடராமன்,** கலையக வெளியீடு, நாமக்கல்.

இணையதளம்

1. **www.tvu.org.in**
2. **www.maduraitamilproject.com**

இதழ்கள்

1. International Research Journal of Indian Literature, irjil.in

2. International Tamil Research Journal, iorpress.in

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	**2.6**	**2.8**	**2.6**	**-**	**-**	**-**	**-**	**-**	-	**-**	**-**	-	-	-	-	-	**-**

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

2024-2025

Semester II

24LAUH201/24LUH201 HINDI-PAPER- II 4H-3C

(Modern Poetry, Drama, Novel, Grammar)

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

End Semester Exam: 3 Hours

PREREQUISITE: Not Required

COURSE OBJECTIVES(CO):

- Understand the text styles and grammatical elements
- Discuss the content of a reading passage
- Develop an interest in the appreciation of short stories

COURSE OUTCOMES(COs) :

- Basic knowledge of Hindi language will be improved.
- Knowledge of glossaries will increase.
- Hindi language expression will rise.
- Learners will enrich their grammar in Hindi.
- The desire to read literature, such as the essay on a poem, develops.

UNIT-I a) Poetry - Nagarjun
b) Drama -Dhruva Swamini
c) Novel - Nirmala , Thotharam
d) Grammar – Kaal , Theen Prakar

UNIT-II a) Poetry – Sita , Ram
b) Drama – Mandhakini , Koma
c) Novel – Mansaram , Jiyaram
d) Grammar – Upsarg, Prathyay

UNIT-III a) Poetry – Lakshman, Valmiki
b) Drama – Ramaguptha , Chandhraguptha
c) Novel – Sudha, Bhuvan Mohan Singh
d) Grammar – Sabda Vyutpathi

UNIT-IV a) Poetry -Vishvaamithra, Thrijada
b) Drama –Sikhar Swami,Shakraj
c) Novel – Udhaybanulaal, Siyaram
d) Grammar – Sambandh Chochak

UNIT-V a) Poetry – Bhagirath , Sagar
b) Drama – Khingal , Mihirdev , Prohith
c) Novel – bhalchandra Sinha,Kalyani, Rangili Bai
d) Samuchchaybodhak, Vishmayathibodhak

TOTAL: 48 HOURS

REFERENC BOOKS:

1. Modern Poetry : Bhoomija
   Writer : Nagarjun
   Editors : Somdev & shobhakanth
   Publisher : Rdha Krishna Publication New Delhi - 110051
2. Drama : Dhruva Swamini
   Writer : Jaysankar Prasad
   Publisher : Sakshi Publication S 16,Naveen Shahdhara Delhi – 110032
3. Novel : Nirmala
   Writer : Premchandh
   Publisher : Prabhath Prakashan 4/19 Asaf Ali Road New Delhi – 110002
4. Grammar : Sugam Hindi Vyakaran
   Writer : Pro. Vamsidhar & Dharmapal
   Publisher : Siksha Bharathi Madharsa Road New Delhi – 110006.

CO, PO, PSO Mapping

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

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

24LAUM201/24LUM201 MALAYALAM II 4H-3C

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

PREREQUISITE: Not required

COURSE OBJECTIVE(CO):

- A basic understanding of contemporary poetry can be gained and the nature ofmodern poetry can be realized.
- Realizing the nature of drama and its nature and improving the knowledge ofreading and understanding the nature of contemporary plays.
- Understands the benefits of correspondence and can enhance the correspondence you need.

COURSE OUTCOME(COs):

- Get a basic understanding of Memories
- It will create basic knowledge about Environmental Psychology.
- It will create awareness about our environment.
- Knowledge is gain about our country, culture etc.
- It will be an eye opener to the students towards our Mother Earth.

	PART I – MALAYALAM II	
Unit No.		**Hours**
I	Novel **-**Enmakaje	**10**
II	Novel – Enmakaje	**10**
III	Memmories – Neermaathalam Pootthakaalam	**10**
IV	Memmories – Neermaathalam Pootthakaalam	**9**
V	Translation(English to Malayalam)	**9**
	TOTAL	**48**

TEXT BOOKS:

1.Emakaje – AmbikasuthanMangad – DC Books Kottayam,Kerala
2. NeermaathalamPootthakaalam - Madhavikutty -DC Books Kottayam, Kerala

REFERENCE BOOKS:

1. Athmakathasahithyam Malayalathil-Dr.Vijayalam Jayakumar (N.B.S.Kottayam)Malayala Novel SahithyaCharitram-K.M.Tharakan (N.B.S.Kottayam) SahithyaCharitramPrasthanangalilude- Dr.K.M George,
2. (D.C.Books Kottayam)
3. MalayalaSahithyavimarsam-Sukumar Azheekode (D.C.books)

CO, PO, PSO Mapping

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

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

Semester II

24LAUS201/24LUS201 SANSKRIT II 4H-3C

(PROSE, GRAMMAR AND TRANSLATION**)**

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

End Semester Exam: 3 Hours

PREREQUISITE: Not required

COURSE OBJECTIVES(CO):

- The fundamental objective of the curriculum is to impart effective science education at the undergraduate level, exposing them to recent trends and developments in the subject.
- Creating scientific temper is another major objective of this curriculum.
- Another major thrust given here is to develop an environmental concern in all activities of the students. 'Go green', the motto of the syllabus emphasizes the urgent need to conserve nature without destruction of natural resources.

COURSE OUTCOMES(COs) :

- **Critical Thinking** :Take informed actions after identifying the assumptions that frame students' thinking and actions.
- **Problem Solving**: Understand and solve problems of relevance to society to meet the specified needs using the knowledge, skills and attitudes acquired.
- **Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **Effective Citizenship**: Demonstrate empathetic social concern and equity centered national development.
- **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.

UNIT I

Introduction to Sanskrit Prose, Important prose works in Sanskrit

UNIT II

Balaramayana – Balakanda

UNIT III

Balaramayana – Ayodhyakanda

UNIT IV

Balaramayana – Aranyakanda

UNIT V

Athmanepada Declension of ending nouns (feminine)

Passages from Sanskrit Self Teacher (Simple sentences)

TOTAL: 48 HOURS

TEXT BOOK:

1. Balaramayana – a simple prose version.R.S. Vadhyar and sons,Palghat, Kerala.

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	**2.6**	**2.6**	**2.8**	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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

24LAUF201/24LUF201 FRENCH II 4H-3C

(Leçon, Communication, Grammaire, Verbes, Lexique, Culture)

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

End Semester Exam: 3 Hours

PREREQUISITE: Not Required

COURSE OBJECTIVES (CO):

- To make the students to speak and write errors free French.
- To help the students develop their listening, speaking, reading and writing skills.
- Introducing literary works to the students to enhance their analytical and aesthetic skills.

COURSE OUTCOMES (COs):

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

COs	Course Outcomes	Blooms Level
CO1	Strengthen the foundation of the language.	Remember
CO2	Standardize and demonstrate understanding of LSRW skills.	Understand
CO3	Utilize fundamentals of language for reading, writing and effective communication.	Apply
CO4	Enhancing the reading skill to build the leadership quality.	Apply
CO5	Develop the moral and aesthetic values.	Evaluate

Unité I	a) Leçon	- Les loisirs
	b) Communication	- Parler de ses goûts et de ses préférences
	c) Grammaire	- Les adjectifs interrogatifs , Les nombres ordinaux, L'heure, Les pronoms personnels COD
	d) Verbes	-savoir et connaitre
	e) Lexique	- Les loisirs, Les activités quotidiennes ,Les matières
	f) Culture	- les grands fleuves de france.
Unité II	a) Leçon	- La routine
	b) Communication	- Décrire sa journée
	c) Grammaire	- Les verbes pronominaux, Les verbes du premier groupe en -e_er, -é_er, -eler, -eter, Le verbe prendre
	d) Verbes	- manger, boire
	e) Lexique	- Le temps et l'heure ,La fréquence
	f) Culture	- les bandes dessinees.
Unité III	a) Leçon	-Où faire ses courses
	b) Communication	- Au restaurant : commander et commenter
	c) Grammaire	- Les articles partitifs, Le pronom en (la quantité) très ou beaucoup ? La phrase négative
	d) Verbes	- les verbs irregulliers
	e) Lexique	- Les aliments, Les quantités, Les commerces et les commerçants
	f) Culture	-Les plats francais
Unité IV	a) Leçon	- Decourvez et dégustez
	b) Communication	- Inviter et répondre ,à une invitation
	c) Grammaire	- L'impératif ,Il faut, c'est/ il est,future proche
	d) Verbes	- Les verbes devoir, pouvoir, savoir, vouloir

	e) Lexique	- Demander et dire le prix, Les services, Les moyens de paiement
	f) Culture	- Le festival du mot
Unité V	a) Leçon	- Tout le monde s'amuse, Les ados au quotidien
	b) Communication	- Décrire une tenue , Écrire un message amical
	c) Grammaire	-Les adjectifs demonstratives, La formation du féminin Le pronom indéfini on, passé compose'.
	d) Verbes	- Les verbes du premier groupe en –yer, Les verbes voir et sortir
	e) Lexique	- Les sorties Situer dans le temps, La famille ,(2) Les vêtements et les accessoires
	f) Culture	- Le pays des gourmands

TOTAL: 48 HOURS

REFERENCE BOOKS:

- Cocton Marie –Noëlle , Duplex Dorothée, Heu Elodie , Kasazian Emilie, Ripaud Delphine, **Saison 1- Méthode de francais,** Didier, paris.2015.
- Cocton Marie – Noëlle, Dupleix, Heu Elodie, Kasazian Emilie ,Ripaud Deldphin, **Saison 1 –**
- **Cahier d'activites ,** Dider ,Paris , 2015
- Anne Akyüz,Bernadette Bazelle- Shahmael,JoëlleBonenfant, Marie- Françoise Gliemenn,**Les exercices de grammaire,**Hachette FLE, Paris,2005
- Christian Beaulieu, Je **pratique, Exercises de grammaire A1,** Dider,Paris,2015
- Nathalie BIE, philippe SANTINAN,**Grammaire pour adolescents-250 exercises,** CLE International , Paris , 2005

WEBSITES :

1. http:// enseigner.tv5 monde.com/
2. bonjourdumonde.com /exercises/contenu/le – francais-du- tourisme.html
3. http://www.bonjurdefrance.com/
4. https://www.lepointdufle.net/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
Average	--	2.5	2.5	-	-	-	-	-	2	-	-	-	-	-	-	-	-

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

Semester II

24ENU201	**ENGLISH II**	**3H-3C**

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

End Semester Exam: 3 Hours

PREREQUISITE: Not required

COURSE OBJECTIVES(CO):

- To make the students to speak and write errors free English.
- To help the students develop their listening, speaking, reading and writing skills.
- Introducing literary works to the students to enhance their analytical and aesthetic skills.

Course Outcomes (COs):

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

COs	Course Outcomes	Blooms Level
CO1	Strengthen the foundation of the language.	Remember
CO2	Standardize and demonstrate understanding of LSRW skills.	Understand
CO3	Utilize fundamentals of language for reading, writing and effective communication.	Apply
CO4	Enhancing the reading skill to build the leadership quality.	Apply
CO5	Develop the moral and aesthetic values.	Evaluate

UNIT-I **7 HOURS**

LISTENING : Listening for Pleasure
SPEAKING : Developing speaking skills
READING : Reading strategies
WRITING : Developing a story with pictures
LITERATURE: Refuge Mother and Child by Chinua Achebe (Poetry)
GRAMMAR : Voice

UNIT- II **7 HOURS**

LISTENING : Listening for Pleasure (Story)
SPEAKING : Oral presentation
READING : Reading Passages
WRITING : Essay writing
LITERATURE : Prose: Dimensions of Creativity by A.P.J. Abdul Kalam (Story)
GRAMMAR : Subject, verb, agreement

UNIT-III **8 HOURS**

LISTENING : Dictation
SPEAKING : Public speaking and secrets of good delivery
READING : Note Making
WRITING : Writing agendas, memos and minutes
LITERATURE: River by A.K. Ramanujan
GRAMMAR : Degrees of comparison

UNIT- IV **7 HOURS**

LISTENING : Listening to instructions and announcements
SPEAKING : Debating
READING : Silent reading and methods of reading
WRITING : Writing Notices
LITERATURE: Two Gentlemen of Verona by A.J. Cronin
GRAMMAR : Phrases and clauses

UNIT-V **7 HOURS**

LISTENING : Testing listening
SPEAKING : Situational Conversation
READING : Developing reading activities
WRITING : E - Mail Writing
LITERATURE: The Postmaster by Rabindranath Tagore
GRAMMAR : Direct and indirect speech

TOTAL: 36 HOURS

TEXT BOOK

1. Board of Editors (2024), Acrostic II. Karpagam Academy of Higher Education

REFERENCE BOOKS:

1. *Martin's, St* (2013). *Oxford Handbook of Writing: Handbook of Writing.* Cambridge University Press.
2. Julian Treasure, *Sound Business,* (2012). Oxford University Press
3. Hornby, A,S.(1975). *The Guide to patterns and usage in English*: oxford university Press.
4. Ellis, R. (1990). *Instructed second language acquisition*. Oxford: oxford university Press.

WEB SITES:

1. https://shortstoryproject.com/stories/the-postmaster/
2. https://www.gradesaver.com/rabindranath-tagore-short-stories/study-guide/summary-the-postmaster

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
Average	**--**	**2.5**	**2.5**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

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

SEMESTER II

24BTU201 **BIOCHEMISTRY AND METABOLISM** **6H–4C**

Instruction Hours/week: L: 6 T: 0 P:0 **Marks: Internal: 40 External: 60 Total: 100**

End Semester Exam: 3 Hours

PREREQUISITE: Student should be familiar with structures and functions of bio molecules.

COURSE OBJECTIVES (CO)

- To provide clear understanding on the underlying principles, structures and functions of bio molecules.
- To acquire fundamental knowledge about the anabolism and catabolism in living organisms.
- To obtain the facts of metabolism and its disorders in the living system.

COURSE OUTCOMES (CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Recall knowledge of the structure and function of carbohydrates and its metabolism	Remember
CO2	Interpret the basic information on the structure and function of proteins and amino acids	Understand
CO3	Develop in-depth knowledge on the classification of Enzymes and enzymatic processes in living systems	Apply
CO4	Categorize the knowledge about classification, metabolism, and role of lipids	Analyze
CO5	Evaluate the metabolic process of nucleic acid and its role in the living system.	Evaluate

UNIT- I CARBOHYDRATES AND METABOLISM: 15 HOURS

Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis, TCA cycle.

UNIT-II PROTEIN AND AMINO ACID: 15 HOURS

Amino acids & Proteins: Structure, properties and function of Amino acids and Protein, Amino acid and protein classification. Protein Synthesis. Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins; Glycoproteins and their biological functions.

UNIT-III ENZYMES: 15 HOURS

Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites, Role of: NAD+, NADP+, FMN/FAD, coenzymes A. Photosynthesis – Photosystem I and II. Hormonal regulation and metabolism.

UNIT-IV LIPIDS: 15 HOURS

Structure and functions – Classification, nomenclature and properties of fatty acids, essential fatty acids. Structure, functions and Metabolism of Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol. ß-oxidation of fatty acids, Digestion, Absorption, and Transport of Lipids, Lipid metabolism disorders - Atherosclerosis.

UNIT-V NUCLEIC ACIDS: 12 HOURS

Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines, biologically important nucleotides, Amino acid Metabolism, Nucleotide metabolism, Double helical model of DNA structure, A, B & Z – DNA, Structure and types of RNA, DNA and RNA metabolism, denaturation and renaturation of DNA.

TOTAL: 72 HOURS

TEXT BOOK:

1. Berg JM, Tymoczko JL, and Stryer L. (2011). Biochemistry. 7th edition. New York: W.H. Freeman & Company.
2. Buchanan B, Gruissem W, and Jones R. (2015). Biochemistry and Molecular Biology of Plants. 2nd edition. American Society of Plant Biologists.
3. Hopkins WG, and Huner P.A. (2008). Introduction to Plant Physiology. 4nd edition. John Wiley & Sons.

REFERENCE BOOK:

1. Murray RK, Bender DA, Botham KM, and Kennelly P.J. (2018). Harper's illustrated Biochemistry. 31th edition. London: McGraw-Hill Medical.
2. Nelson DL, and Cox MM. (2017). Lehninger: Principles of Biochemistry. 7th edition. New York: W.H. Freeman and Company.

WEBSITE:

1. http://172.16.25.76/course/view.php?id=1607.

CO, PO, PSO Mapping

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

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

SEMESTER II

24BTUA201 **CHEMISTRY - II** **5H–4C**

Instruction Hours/week: L: 5 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3Hours

PREREQUISITE: Elementary level understanding of various organic, inorganic and physical chemistry principles at the +2 Level.

COURSE OBJECTIVES (CO)

- To know about the basic concepts of metals and coordination chemistry.
- To understand about the basic properties and preparation of aromatic and heterocyclic compounds, amino acids, proteins and carbohydrates.
- To learn the basic concepts of the thermodynamics and electrochemistry.

COURSE OUTCOMES (CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Recall the basic principles and methods involved in the extraction of metals and the applications of coordination chemistry	Remember
CO2	Demonstrate the aromaticity principles, electrophilic substitution reactions of benzene, and the preparation and properties of naphthalene and heterocyclic compounds.	Understand
CO3	Compare and contrast the classification, preparation methods, properties of amino acids, peptides, proteins, and carbohydrates.	Understand
CO4	Identify the different types of thermodynamic systems and processes.	Apply
CO5	Analyze the concepts in electrochemistry, including conductometric titrations and galvanic cells.	Analyze

UNIT-I METALS AND COORDINATION CHEMISTRY: 15 HOURS

Metals: General methods of extraction of metals-methods of ore dressing-types of furnaces-reduction methods-electrical methods-types of refining-Van Arkel process-Zone refining. **Coordination Chemistry:** Nomenclature-theories of Werner, Sidgewick and Pauling-chelation and its industrial importance-EDTA- hemoglobin-chlorophyll-applications in qualitative and quantitative analysis.

UNIT-II AROMATIC COMPOUNDS AND HETEROCYCLIC COMPOUNDS: 15 HOURS

Aromatic Compounds: Aromaticity-Huckel's (4n+2) rule- aromatic electrophilic substitution in benzene- mechanism of nitration, halogenation, alkylation, acylation and sulphonation. Naphthalene: Isolation, preparation, properties and structure. **Heterocyclic Compounds:** Preparation and properties of pyrrole, furan, thiophene and pyridine.

UNIT-III AMINO ACIDS, PROTEINS AND CARBOHYDRATES: 10 HOURS

Amino acids: Classification, preparation and properties. Peptides-preparation of peptides (Bergmann method only). **Proteins:** Classification, properties, biological functions and structure. **Carbohydrates:** Classification, preparation and properties of glucose and fructose- discussion of open chain and ring structures of glucose and fructose-glucose-fructose interconversion.

UNIT-IV ENERGETICS: 10 HOURS

Type of systems-processes and their types - isothermal, adiabatic, reversible, irreversible and spontaneous processes-statement of first law of thermodynamics-need for the second law of thermodynamics-heat engine-

Carnot cycle-efficiency-Carnot theorem-thermodynamics scale of temperature-Joule-Thomson effect- Enthalpy-Entropy and its significance-Free energy change.

UNIT-V ELECTROCHEMISTRY: 10 HOURS

Kohlrausch law-conductometric titrations-hydrolysis of salts-galvanic cells-E.M.F.-standard electrode potentials-reference electrodes- electrochemical series and its applications-buffer solution-buffer solution in the biological systems-pH and its determination-principles of electroplating.

TOTAL:60 HOURS

TEXT BOOKS:

1. Veeraiyan, V., & Vasudevan, A.N.S. (2012). *Text Book of Allied Chemistry* (II Edition). Chennai: Highmount Publishing House.
2. Puri, B.R., Sharma, L. R., & Kalia, K. C. (2017). *Principles of Inorganic Chemistry* (33rd Edition). Jalandar: Vishal Publishing Company Co.
3. Bahl, A., & Bahl, B.S. (2015). *A Textbook of Organic Chemistry* (21st Revised Edition). New Delhi: S.Chand & Company Pvt. Ltd.
4. Puri, B. R., Sharma, L. R. & Pathania, M. S. (2014). *Elements of Physical Chemistry* (46th Edition). Jalandhar: Vishal Publishing Company Co.

REFERENCE BOOK:

1. Gopalan, R., & Sundaram, S. (2013). *Allied Chemistry* (III Edition). New Delhi: Sultan Chand & Sons.

CO, PO, PSO Mapping

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

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

SEMESTER II

24BTU211 BIOCHEMISTRY AND METABOLISM – PRACTICAL 4H–2C

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

End Semester Exam: 3Hours

PREREQUISITE: Student should be familiar with structures and functions of bio molecules.

COURSE OBJECTIVES (CO)

- To acquire skill on various experimental methods and techniques in order to analyze the given biological samples.
- To know the standard procedures for handling the biochemical assays and instruments.
- To Understand Good laboratory practices in a laboratory.

COURSE OUTCOMES (CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Choose the skills on quantitative estimation methods for various biomolecules from natural sources	Remember
CO2	Demonstrate the handling skills to handle the spectroscopy instrumentations	Understand
CO3	Categorize the skills in primary screening of biochemical markers	Analyze
CO4	Develop skills to equip themselves in the medical laboratories	Apply
CO5	Formulate biochemical experiments and operate respective equipment	Create

Practicals **48 hours**

1. Qualitative tests for Carbohydrates, lipids and proteins
2. Principles of Colorimetry: (i) Beer's law (ii) To study the relation between absorbance and % transmission
3. Estimation of carbohydrates
4. Estimation of proteins
5. Estimation of lipids
6. Separation of Amino acids by paper chromatography/Thin layer chromatography
7. Effect of pH and temperature on amylase activity.
8. Estimation of urea, and creatinine in urine sample.

TOTAL: 48 HOURS

TEXT BOOK:

9. Berg JM, Tymoczko JL, and Stryer L. (2011). Biochemistry. 7th edition. Newyork: W.H. Freeman & Company.
10. Buchanan B, Gruissem W, and Jones R. (2015). Biochemistry and Molecular Biology of Plants. 2nd edition. American Society of Plant Biologists.
11. Hopkins WG, and Huner P.A. (2008). Introduction to Plant Physiology. 4nd edition. John Wiley & Sons.
12. Murray RK, Bender DA, Botham KM, and Kennelly P.J. (2018). Harper's illustrated Biochemistry. 31th edition. London: McGraw-Hill Medical.
13. Nelson DL, and Cox MM. (2017). Lehninger: Principles of Biochemistry. 7th edition. New York: W.H. Freeman and Company.

CO, PO, PSO Mapping

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

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

SEMESTER II

24BTUA211 **CHEMISTRY PRACTICAL – II** **4H–2C**

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

End Semester Exam: 3 hours

PREREQUISITE: Elementary level understanding of inorganic chemistry principles at the +2 Level.

COURSE OBJECTIVES (CO)

- To know the principles of volumetric analysis.
- To estimate the compounds by acidimetry, alkalimetry and permanganometry.
- To determine the amount of chemical substance.

COURSE OUTCOMES (CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Recall the principles of quantitative analysis of inorganic compounds	Remember
CO2	Demonstrate the estimation of sample present in a solution.	Understand
CO3	Summarize the basic concept of volumetric analysis.	Understand
CO4	Utilize the mathematical skills doing calculations	Apply
CO5	Estimate the amount of substance present in a given solution	Evaluate

Volumetric analysis **24 hours**

A. Acidimetry & Alkalimetry

1. Estimation of sodium carbonate using standard sodium hydroxide
2. Estimation of sodium hydroxide using standard sodium carbonate
3. Estimation of sulphuric acid using standard oxalic acid
4. Estimation of potassium permanganate using standard sodium hydroxide

B. Permanganometry **24 hours**

1. Estimation of ferrous sulphate using standard Mohr's salt
2. Estimation of oxalic acid using standard ferrous sulphate
3. Estimation of calcium-direct method

TOTAL:48 HOURS

TEXT BOOK:

1. Thomas AO. (2012). Practical Chemistry for B.Sc. Main Students. Scientific Book Centre. Cannanore: Kerala.
2. Ramasamy R. (2011). Allied Chemistry Practical Book. Priya Publications. Karur.
3. Venkateswaran V, Veeraswamy R, and Kulandaivelu AR. (2015). Basic Principles of Practical Chemistry. 2nd edition. S. Chand Publications. New Delhi.

CO, PO, PSO Mapping

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

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

SEMESTER II

24VAC201 **ENVIRONMENTAL STUDIES** **2H–2C**

Instruction Hours/week: L:2 T:0 P:0 **Marks:** Internal: **100** External: **0** Total: **100**

End Semester Exam: 3Hours

PREREQUISITE: Student should know about fundamentals of environment.

COURSE OBJECTIVES (CO)

- To create awareness about structure and functions of various ecosystems
- To develop an attitude of concern for the natural resources availability and its environment protection
- To learn about the environment, resources available, biodiversity and its conservation

COURSE OUTCOMES (CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Define the structure and functions of various ecosystems	Remember
CO2	Learn the ethical, cross-cultural, and historical context of natural resources and the methods for conservation	Understand
CO3	Predict current scenarios and find ways for the protection and betterment of habitat	Analyze
CO4	Analyze the interactions between social and environmental problems	Apply
CO5	Develop systems concepts and methodologies to analyze and understand interactions between social and Environmental processes	Create

UNIT I INTRODUCTION - ENVIRONMENTAL STUDIES & ECOSYSTEMS: 5 HOURS

Environment Definition, Scope and Importance; Ecosystem, Structure, classification, and functions of ecosystem. Energy flow, Food chains and food webs, Ecological succession. Forest ecosystem, Grassland Ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

UNIT II NATURAL RESOURCES - RENEWABLE AND NON-RENEWABLE RESOURCES: 5 HOURS

Natural resources - Renewable and Non–renewable resources. Land resources, Land degradation, desertification. Forest resources – Deforestation: Causes and impacts due to mining. Water resources- Use and over-exploitation of surface and groundwater.

UNIT III BIODIVERSITY AND ITS CONSERVATION: 5 HOURS

Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity. Values of Biodiversity - Ecological, economic, social, ethical, aesthetic value. Bio-geographical classification of India. Hot-spots of biodiversity. Endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.

UNIT IV ENVIRONMENTAL POLLUTION: 5 HOURS

Definition, causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution. Nuclear hazards and human health risks.

UNIT V SOCIAL ISSUES AND THE ENVIRONMENT: 4 HOURS

Concept of sustainability and sustainable development. Climate change, global warming, ozone layer depletion, acid rain and its impacts on human communities and agriculture. Environment Laws (Environment Protection Act, Air Act, Water Act, Wildlife Protection Act, Forest Conservation Act).

TOTAL: 24 HOURS

TEXT BOOK:

1. Anonymous. 2004. A Text book for Environmental Studies, University Grants Commission and Bharat Vidypeeth Institute of Environmental Education Research, New Delhi.
2. Anubha Kaushik., and Kaushik, C.P. 2008. Perspectives in Environmental Studies. (3rd ed.). New Age International Pvt. Ltd. Publications, New Delhi.
3. Arvind Kumar. 2009. A Textbook of Environmental Science. APH Publishing Corporation, New Delhi.
4. Mishra, D.D. 2010. Fundamental Concepts in Environmental Studies. S. Chand & Company Pvt. Ltd., New Delhi.
5. Odum, E.P., Odum, H.T. and Andrews, J. 1971. Fundamentals of Ecology. Philadelphia: Saunders.
6. Sing, J.S., Sing. S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand & Publishing Company, New Delhi.
7. Tripathy. S.N., and Sunakar Panda. (2011). Fundamentals of Environmental Studies (3rd ed.). Vrianda Publications Private Ltd, New Delhi.
8. Uberoi, N.K. 2010. Environmental Studies. (2nd ed.). Excel Books Publications, New Delhi.

REFERENCE BOOK

1. Botkin., and Keller. 2014. Environmental Science: Earth as a Living Planet. (9th ed.) Wiley
2. Rajagopalan, R. 2016.Environmental Studies: From Crisis to Cure, Oxford University Press.
3. Singh, M.P., Singh, B.S., and Soma, S. Dey. 2004. Conservation of Biodiversity and Natural Resources. Daya Publishing House, New Delhi.
4. Verma, P.S., and Agarwal V.K. 2016. Environmental Biology (Principles of Ecology). S. Chand and Company Ltd, New Delhi.
5. Environmental Biotechnology: Principles and Applications, Second Edition 2nd Edition by Bruce Rittmann and Perry McCarty, 2020.

CO, PO, PSO Mapping

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

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

SEMESTER II

ACTIVITY: LIBRARY/SEMINAR **2H**

Instruction Hours/week: L:0 T:0 P:2

மூன்றாம் பருவம்

24LSUT301 தமிழ் இலக்கிய வரலாறு 4H - 3C

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

End Semester Exam: 3 Hours

பாடத்திட்டப் பொதுநோக்கம்

- தமிழ் மொழியின் சிறப்புகளை அறியச் செய்தல்.
- முச்சங்கங்கள் சங்ககால இலக்கண நூல்கள் பற்றித் தெரிந்து கொள்ளுதல்.
- பல்வேறு சமயம் சார்ந்த இலக்கியங்களை ஒப்பீடு செய்தல்,தொன்ம இலக்கியங்களை அறியச் செய்தல்

பாடத்திட்டப் பயன்விளைவு

- சங்க இலக்கிய மேன்மைகள்- திணைக்கோட்பாடுகள் அறிவு பெற்றிருத்தல்.
- வேற்றுமொழிப் படையெடுப்புகளுக்குஈடுகொடுத்து நிற்கும்திறன் குறித்து அறிதல்.
- ஐம்பெருங்காப்பியங்கள் ஐஞ்சிறுகாப்பியங்களின் சிறப்பை உணர்தல்.
- பிற அறநூல்களின் கருத்துக்களைத் தெரிந்து கொள்ளுதல்.
- செம்மொழியின் சிறப்பையும், தொன்மையையும் அறிதல்.

அலகு:1 சங்க இலக்கியம்

தமிழ் இலக்கிய வரிசை-அறிமுகம்-முச்சங்க வரலாறு-பாட்டும் தொகையுமாகிய சங்க இலக்கியத் தொகுப்பு-அறிமுகம்-எட்டுத்தொகையில் அகத்திணை-புறத்திணை-பத்துப்பாட்டில் அமைந்த ஆற்றுப்படை இலக்கியங்கள்-பத்துப்பாட்டில் அகமும் புறமும்-புலவர்களும் பாடல்களும்-பெண்பாற் புலவர்கள்.

அலகு: 2 அற இலக்கியமும் காப்பியமும்

திருக்குறள்-அமைப்பு-இலக்கியச் சிறப்பு-உலகப் பொதுமைத் தன்மை-பொருட் சிறப்பு-இலக்கியச் சிறப்பு-நாலடியார் முதலாக குமரகுருபரரின் நீதிநெறிவிளக்கம் ஈறாக அமைந்த நீதி இலக்கியங்கள்-நீதி நூல்களில் அகமும் புறமும்-தமிழ் இலக்கிய வரிசையில் ஐம்பெருங் காப்பியங்களும், ஐஞ்சிறு காப்பியங்களும்- சிலம்பும் மணிமேகலையும் – இரட்டைக்காப்பியங்கள்- கம்பராமாயணம்-பெரியபுராணம் - சீறாப்புராணம்-தேம்பாவணி-இராவண காவியம்.

அலகு:3 திருமுறைகளும் திவ்யப்பிரபந்தமும்

தமிழகத்தில் பக்தி இயக்கத்தின் தோற்றமும் வளர்ச்சியும்-பன்னிரு திருமுறைகளும், பதிநான்கு சித்தாந்த சாத்திரங்களும்-திவ்யப்பிரபந்தமும், இராமானுஜ நூற்றந்தாதி முதலான வைணவ இலக்கியங்களும்.

அலகு: 4 சிற்றிலக்கியங்களும் இக்கால இலக்கியங்களும்

குற்றாலக்குறவஞ்சி, முக்கூடற்பள்ளு, மதுரை மீனாட்சியம்மை பிள்ளைத்தமிழ், மதுரை சொக்கநாதர் தமிழ்விடு தூது, அழகர் கிள்ளைவிடு தூது முதலான சிற்றிலக்கிய வரிசை-தமிழில் புதுக்கவிதை இயக்கங்களின் தோற்றமும் வளர்ச்சியும்-தமிழ்ப் புதுக்கவிதை வடிவங்கள்-தமிழின் நாடக

இலக்கியங்கள்- மனோண்மணீயம் – தமிழின் உரைநடை இலக்கிய வளர்ச்சி-தமிழின்பம் முதலான உரைநடை நூல்கள்-தமிழில் சிறுகதை இலக்கிய வளர்ச்சி-இருபதாம் நூற்றாண்டுச் சிறுகததைகள்-தமிழில் புதின இலக்கியங்கள்-இக்கால இலக்கியங்களில் காலந்தோறும் தனி மனிதப் பதிவுகளும், சமுதாயப் பதிவுகளும்.

அலகு: 5 தமிழின் ஐந்திலக்கணம்

தமிழின் எழுத்து – சொல் – பொருள் – யாப்பு - அணி இலக்கணச் சிந்தனைகள் .

பாடநூல்:

தமிழ் இலக்கிய வரலாறு - மொழிகள் துறை - தமிழ்ப்பிரிவு, கற்பகம் உயர்கல்விக்கழகம், கோயம்புத்தூர் -21.

பார்வை நூல்கள்:

1. தமிழ் இலக்கிய வரலாறு – தமிழண்ணல், மீனாட்சி புத்தக நிலையம்- மதுரை.
2. தமிழ் இலக்கிய வரலாறு – வேங்கடராமன்.கா.கோ. கலையகம் பதிப்பகம், நாமக்கல்.
3. புதிய நோக்கில் தமிழ் இலக்கிய வரலாறு-சுந்தரமூர்த்தி.செ, அவ்வை பதிப்பகம், திருவாரூர்.
4. தற்காலத் தமிழ் இலக்கிய வரலாறு - கவிஞர் திலகம் மானூர் புகழேந்தி, நிலாப் பதிப்பகம், 63,பாரதிதாசன் நகர், இராமநாதபுரம், கோவை – 641045.

இணையதளம்

1. **www.tvu.org.in**
2. **www.maduraitamilproject.com**

இதழ்கள்

1. **International Research Journal of Indian Literature, irjil.in**
2. **International Tamil Research Journal, iorpress.in**

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	**3**	**2.6**	**2.6**	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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

Semester III

24LAUH301/24LUH301 HINDI-PAPER- III 4H-3C

(Story, History of Hindi Literature, Novel, Letter Writing

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

End Semester Exam: 3 Hours

PREREQUISITE: Not Required

COURSE OBJECTIVES(CO):

- Knowledge of contemporary drama contents of Hindi literature
- Learn novels and its techniques. The ability to read novels and express criticism about it and the ability to express social thoughts will improve
- There will also be litigation messages in Hindi and news on speech techniques

COURSE OUTCOMES(COs):

- Develop an interest in the appreciation of literature.
- Discuss and respond to content of a reading passage.
- Learning the literacy knowledge of Hindi specially reading and writing.
- Learning the literary knowledge specially reading and understanding of Hindi short Stories
- Learning the history of Hindi literature

UNIT-I a) Story – Bade Ghar Ki Beti
b) Hindi Bhasha Ka Vikas
c) Novel – Ramnath,Jalpa
d) Letter Writing –Personal Letter

UNIT-II a) Story – Puraskar
b) Kaal Vibhajan , Char Prakar
c) Ramesh Babu ,Devdeen
d) Letter Writing – Leave Letter

UNIT-III a) Story – Usne Kaha Tha
b) Literature – Adhikaal
c) Indhubhooshan, Rathna,Johra
d) Letter Writing – Letter for the Publisher

UNIT-IV a) Story – Paanchminte
b) Poorva Madhya Kaal
c) Manibhooshan,Dhayanath,Rameshwari
d) Letter Writing – Application for job

UNIT-V a) Story – kafan

b) Reethi Kaal,Adhunik Kaal

c) Dheen Dhayal,Manaki,

d) Letter Writing – Complaint Letter

TOTAL: 48 HOURS

REFERENCE BOOKS

1.Story : Kahani Manjari

Publisher : D.B.Hindi Prachar Sabha T.Nagar , Chennai – 600017

2.History of Hindi

Literature : Hindi Sahithya ka Saral Ithihas

Writer : Rajnath Sharma.A

Publisher : Vinoth Pusthak Mandir Aagra – 02

3.Novel : Gaban

Writer : Premchandh

Publisher : Rajkamal Prakashan New Delhi – 110002

4.Letter Writing : Sumitha Hindi Nibandh Aur Pathra Lekhan

Writer : Sri Sharan

Publisher : Kalda Publication Mukhar Ji Nagar, Delhi - 09

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	2	3	3	-	-	-	-	-	-	-	-	-	-	-		-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-		-	-
CO3	2	2	3	-	-	-	-	-	-	-	-	-	-	-		-	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	-	-		-	-
CO5	3	2	3	-	-	-	-	-	-	-	-	-	-	-		-	-
Average	**2.6**	**2.6**	**2.8**	**-**	**-**	**-**	**-**	**-**	-	-	-	-	-	-		-	-

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

Semester III

24LAUM301/24LUM301 MALAYALAM III 4H-3C

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

End Semester Exam: 3 Hours

PREREQUISITE: Not required

COURSE OBJECTIVE(CO):

- May have knowledge of the contents of primitive poetryLearn about contemporary poetry and its techniques.
- Interest in reading poetry and the ability to express social thoughts will improve
- This will help you to understand the basics of Malayalam Poetry and to understand Malayalamliterature properly

COURSE OUTCOME(COs):

- Get a basic knowledge of the history of Malayalam literature.
- Enhances the art and taste of Malayalam literary works
- Literary genres can be learned
- Create more to read and enjoy Malayalam poetry
- Get the basic Knowledge of poetry techniques

Unit No	PART I – MALAYALAM III	Hours
I	Poetry – Chinthavishtayaya Seetha	10
II	Poetry – Chinthavishtayaya Seetha	10
III	Poetry – Mrugasikshakan-(Murgasikshakan,Kausalya,Varavu,VittupokuEkalavyan,Mazha) 6 poetries	10
IV	Poetry – Mrugasikshakan-(Kayal,Karkkadakam,Bhagavatham,Vazhivakkile naikutty,Edavelayil oru nimisham,Verumoru kathu) 6 poetries	09
V	Poetry - Aayisha	09
	TOTAL	48

TEXT BOOKS:

1. Chinthavishtayaya Seetha –Kumaranasan,Kerala Book Store Publishers.
2. Mrugasikshakan – Vijayalakshmi,DC Books, Kottayam
3. Aayisha – VayalarRamavarma - Kerala Book Store Publishers

REFERENCE BOOKS:

1. Kavitha SahithyaCharitram-Dr.M.Leelavathi (Kerala SahithyaAcademy,Trichur)
2. Kavitha Dwani-Dr.M.Leelavathi (D.C.Books, Kottayam)
3. Aadhunika SahithyacharithramPrasthanangalilude-Dr.K.M.George (D.C.Books, Kottayam)
4. Padya SahithyaCharithram – T.M.Chummar (Kerala SahithyaAcademy,Trichur)

CO, PO, PSO Mapping

CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO12	PO1 3	PO1 4	PO1 5	PSO1	PSO2
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	3	2.5	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-

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

Semester III

24LAUS301/24LUS301	**SANSKRIT III**	**4H-3C**

(Drama and History of Sanskrit Literature)

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

End Semester Exam: 3 Hours

PREREQUISITE: Not required

COURSE OBJECTIVES(CO):

- The fundamental objective of the curriculum is to impart effective science education at the undergraduate level, exposing them to recent trends and developments in the subject.
- Creating scientific temper is another major objective of this curriculum.
- Another major thrust given here is to develop an environmental concern in all activities of the students. 'Go green', the motto of the syllabus emphasizes the urgent need to conserve nature without destruction of natural resources.

COURSE OUTCOMES (COs):

- **Critical Thinking** :Take informed actions after identifying the assumptions that frame students' thinking and actions.
- **Problem Solving**: Understand and solve problems of relevance to society to meet the specified needs using the knowledge, skills and attitudes acquired.
- **Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **Effective Citizenship**: Demonstrate empathetic social concern and equity centered national development.
- **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.

UNIT I

History of Sanskrit Drama and its origin.

UNIT II

Important Sanskrit Dramas and important authors.

UNIT III

Text Prescribed: "Dutavakyam" of Bhasa, (First half)

UNIT IV

Text Prescribed: "Dutavakyam" of Bhasa, (Second half)

UNIT V

Translation : From the known passages of the above text.

TOTAL: 48 HOURS

TEXT BOOK :

1."Dutavakyam of Bhasa" R.S.Vadhyar and Sons Palghat, Kerala.

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	**2.6**	**2.6**	**2.8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

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

Semester III

24LAUF301/24LUF301 FRENCH III 4H-3C

(Histoire, histoire de la littérature frencais,roman, rédaction de lettres)

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

End Semester Exam: 3 Hours

PREREQUISITE: Not Required

COURSE OBJECTIVES (CO):

- To enable students to recognizenative accent and usage of French language.
- To help students to become autonomous and self-directed French language learners.
- To produce entrepreneurs among students by making them French language trainers and take communicative French to schools and colleges around.

COURSE OUTCOMES (COs):

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

COs	Course Outcomes	Blooms Level
CO1	Identify new words by employing vocabulary building techniques.	Apply
CO2	Build correct sentence structures and grammatical patterns in oral and written communication	Apply
CO3	develop the ability to speak French language with the way of pronunciation.	Understand
CO4	Follow leadership, work ethics and management principles	Analyze
CO5	express values and skills gained through effective communication to other disciplines.	Analyze

Unite – I
a) Leçon – Vivre la ville,,Visiter une ville
b) Communication - Indiquer le chemin
c) Grammaire - La comparaison,Les prépositions avec les noms géographiques,Les pronoms personnels COI
d) Lexique –La ville, Les lieux de la ville, Les transports
e) Culture – Le français : une ouverture sur le monde

Unité – II
a) Leçon **-•** On vend ou on garde ?
b) Communication -Demander des renseignements touristiques
c) – Grammaire - Le pronom y (le lieu), La position des pronoms compléments Les verbes du premier groupe en -ger et -cer,
d) Les verbes ouvrir et accueillir
e) Lexique - Les points cardinaux,Les prépositions de lieu (2)
f) Culture –Le français : une ouverture sur le monde

Unité – III
a) Leçon -
b) Communication- permetter,defendre.
c) Grammaire -La formation du pluriel (2)
Les adjectifs de couler, Les adjectifs beau, nouveau, vieux
d) Lexique - Les couleurs, Les formes,Les me
e) culture – les grandes fleuves en Francais.

Unite – IV a) Leçon – Félicitations !
b) Communication - Décrire un objet
c) Grammaire - Les pronoms relatifs qui et que,
. L'imparfait, Les verbes connaître, écrire, mette et vendre
d) Lexique – Les mesures, L'informatique
DIRE, LIRE, ECRIRE , Les sons [E] / [O] / [Œ]
e)Culture –Les lieux de la ville.

Unité - V a) Leçon -En voyage !
b) Communication -• Présenter ses vœux, Faire une réservation
c) Grammaire - Les pronoms démonstratifs,La question avec Inversion,Les adverbes de manière,
d) Lexique -Les voyages,L'aéroport et l'avion,Les fêtes
e) Culture –Noël

TOTAL: 48 HOURS

REFERENCE BOOKS:

- Cocton Marie –Noëlle , Duplex Dorothée, Heu Elodie , Kasazian Emilie, Ripaud Delphine, **Saison 1- Méthode de franca**is, Didier, paris.2015.
- Cocton Marie – Noëlle, Dupleix, Heu Elodie, Kasazian Emilie ,Ripaud Deldphin, S**aison** 1 –
- **Cahier d'activites** , Dider ,Paris , 2015
- Anne Akyüz,Bernadette Bazelle- Shahmael,JoëlleBonenfant, **Marie- Françoise Gliemenn,Les exercices de grammaire,Hachette FLE, Paris,200**5
- Christian Beaulieu, **Je pratiqu**e, Exercises de grammaire A1, Dider,Paris,2015
- Nathalie BIE, philippe SANTINAN,**Grammaire pour adolescents-250 exercises, CLE International , Paris , 2005**

WEBSITES :

- http:// enseigner.tv5 monde.com/
- bonjourdumonde.com /exercises/contenu/le – francais-du- tourisme.html
- http://www.bonjurdefrance.com/
- https://www.lepointdufle.net/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	**3**	**2.5**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

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

Semester III

24ENU301 ENGLISH III 3H-3C

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

End Semester Exam: 3 Hours

PREREQUISITE: Not required

COURSE OBJECTIVES (CO):

- To enable students to recognizenative accent and usage of English language.
- To help students to become autonomous and self-directed English language learners.
- To produce entrepreneurs among students by making them English language trainers and tocommunicative English to schools and colleges around.

Course Outcomes (COs):

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

COs	Course Outcomes	Blooms Level
CO1	Identify new words by employing vocabulary building techniques.	Apply
CO2	Build correct sentence structures and grammatical patterns in oral and written communication	Apply
CO3	Develop the ability to speak English language with the correct pronunciation.	Understand
CO4	Follow leadership, work ethics and management principles	Analyze
CO5	Express values and skills gained through effective communication to other disciplines.	Analyze

UNIT-I **8 HOURS**

LISTENING: Listening Comprehension-Listening for Specific Information- Interpreting Chartsand Diagrams

UNIT- II **7 HOURS**

SPEAKING: Essentials of effective Communication- **Telephone Skills**: Understanding Telephone Conversation-Handling Calls-Leaving Messages-Making Requests-Giving Instructions and Orders.

UNIT-III **7 HOURS**

READING: Reading with a purpose-Skimming and Scanning-Locating Main Points-ReadingCritically- Sequencing of Sentences-Reading Comprehension

UNIT- IV **7 HOURS**

WRITING: Descriptive and Narrative-Safety Instructions- Suggestions-Expansion ofAbbreviations-Spellings Rules

Translation- Translating Short Sentences and Passages from English to Tamil

UNIT-V **7 HOURS**

VOCABULARY: Synonyms-Antonyms-Prefixes-Suffixes- Idioms- Different Types of English-Homonyms and Homophones (British and American)

TOTAL: 36 HOURS

TEXT BOOKS

1. Board of Editors (2024). *Proficiency in Communication I*. Karpagam Academy of Higher Education

REFERENCE BOOKS:

1. *Martin's, St* (2013). *Oxford Handbook of Writing: Handbook of Writing*. Cambridge University Press.
2. Wren & Martin, (2008). *High School English Grammar & Composition*, S.Chand & Company Ltd,Board of Editors,
3. Krashen, Stephen D (1982). *Principles and Practice in Second Language Acquisition*, New York:Pergamon Press

WEB SITES:

1. https://www.scribbr.com/
2. https://www.quora.com/

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	**3**	**2.5**	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-

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

24BTU301 **MOLECULAR BIOLOGY** **4H–4C**

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

End Semester Exam: 3Hours

PREREQUISITE: Student should be familiar with organization of DNA and RNA

COURSE OBJECTIVES (CO)

- To emphasize the basic knowledge about the organization of DNA
- To obtain adequate knowledge on the replication of DNA gene regulations
- To gain information about the DNA damage and repair mechanisms

COURSE OUTCOMES (CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Achieve basic knowledge about the organization of DNA	Remember
CO2	Acquire an in-depth knowledge of replication of DNA	Understand
CO3	Gain an insight into the most significant molecular and cell-based methods used today for DNA damage and repair mechanisms	Apply
CO4	Analyze the mechanisms behind gene regulations.	Analyze
CO5	Assess the mechanism behind translation and transcription.	Evaluate

UNIT-I DNA ORGANIZATION: **8 HOURS**

DNA as genetic material. Organization of DNA in prokaryote and eukaryotic cells, Genome Organization (Griffith's experiment, Avery, MacLeod and McCarty's experiment, Hershey-Chase experiment), Chromosome biology - histone and non-histone proteins, organization, structure and functions, Cot analysis, melting curve of DNA.

UNIT-II DNA REPLICATION: **10 HOURS**

Replication of DNA in prokaryotes and eukaryotes: Semi-conservative nature of DNA replication, Bi- directional replication, DNA polymerases and its types of enzymes involved in replication. Replication complex: Pre-priming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication. DNA Topology, Mechanism of DNA replication in prokaryotic and eukaryotic systems, DNA repair and recombination

UNIT-III TRANSCRIPTION AND RNA PROCESSING: **10 HOURS**

RNA structure and types of RNA, Central dogma of life, 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. transcriptional and post-transcriptional gene silencing.

UNIT-IV REGULATION OF GENE EXPRESSION AND TRANSLATION: **10 HOURS**

Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation, Posttranslational modifications of proteins. Translation: Genetic code, Prokaryotic and Eukaryotic translation, Regulation of translation, Coand post-translational modifications of proteins.

UNIT-V DNA DAMAGE REPAIR AND ANTISENSE TECHNOLOGY: **10 HOURS**

Causes and types of DNA damage, Spontaneous mutations, Induced mutations – physical mutagen: radiations, temperature as a mutagen, chemical mutagens: alkylating agents, nitrous acid, hydroxylamine. Mechanism of DNA repair: SOS repair, Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, recombinational repair, non-homologous end joining. Homologous recombination: models and mechanism. RNA interference, Molecular mechanism of antisense molecules, Inhibition of splicing, polyadenylation and translation, Disruption of RNA structure and capping, Ribozyme.

TOTAL: 48 HOURS

TEXT BOOK:

1. Becker, W.M., Kleinsmith, L.J., Hardin. J., & Bertoni, G. P. (2009). *The World of the Cell* (7th ed.). San Francisco: Pearson Benjamin Cummings Publishing.
2. De Robertis, E.D.P., & De Robertis, E.M.F. (2011). *Cell and Molecular Biology* (8th ed.). Lippincott Williams and Wilkins, Philadelphia.
3. Karp, G. (2015). *Cell and Molecular Biology: Concepts and Experiments* (8th ed.). Hoboken, US: John Wiley & Sons. Inc.

REFERENCE BOOK:

1. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2014). *Molecular Biology of the Gene* (7th ed.). Cold Spring Harbour Lab. Press, Pearson Pub.

CO, PO, PSO Mapping

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

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

SEMESTER III

24BTU302 **GENERAL MICROBIOLOGY** **4H–4C**

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

End Semester Exam: 3 Hours

PREREQUISITE: Student should be familiar with organization of DNA and RNA

COURSE OBJECTIVES (CO)

- To inculcate knowledge on fundamentals of microorganisms
- To acquire knowledge about the structural organization, morphology, and reproduction of microbes
- To know the principles and advancements in various microscopic techniques and microbial techniques.

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Gain knowledge on fundamentals and historical perspective of Microorganisms	Understand
CO2	Acquire basic knowledge of different structures of microbes	Understand
CO3	Analyze the structure of microbes on different types of microscopes	Analyze
CO4	Apply the different applications of microbes in biotechnology	Apply
CO5	Assess the genetic, and metabolic strategies of microorganisms	Analyze

UNIT-I INTRODUCTION: **10 HOURS**

Introduction to Microbiology, Haeckel's three–kingdom concept, Whittaker's Five-kingdom concept, Three-domain concept of Carl Woese, Classification of Bacteria according to Bergey's manual. Contribution of Leeuwenhoek, Louis Pasteur, Robert Koch and Alexander Fleming. Spontaneous & Biogenesis theory.

UNIT-II STRUCTURE AND CLASSIFICATION: **10 HOURS**

Morphology and cell structure of major groups of microorganisms e.g. Bacteria, Fungi, Unique features of Viruses and Protozoans. Microbial taxonomy, criteria used to include molecular approaches, Microbial phylogeny and current classification of bacteria. Principles, types and applications of microscopy (Light and electron microscope).

UNIT-III CULTIVATION AND MAINTENANCE OF MICROORGANISMS: **8 HOURS**

Nutritional categories of micro-organisms, Media, Types of media, Sterilization, Methods of isolation (pour plate and spread plate), Staining types (Simple, Gram positive, Gram negative, flagella staining), Pure culture techniques, culture preservation.

UNIT-IV MICROBIAL GROWTH & STERILIZATION: **10 HOURS**

Growth curve, Microbial growth kinetics, batch and continuous culture, Measurement of growth, growth factors, factors affecting growth of microbes. Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria. Sterilization – Physical and chemical methods. Growth of bacteria-multiplication –nutritional requirements –factors affecting growth -growth curve –Determination of growth. Media and its types. Culture techniques – Pure culture, anaerobic culture – preservation of cultures

UNIT-V APPLIED MICROBIOLOGY: **10 HOURS**

Water Microbiology. Major waterborne diseases. Food Microbiology: Important microorganisms in food processing: Moulds, yeasts, and bacteria. Role of microbes in fermented foods, probiotics, prebiotics. Clinical Microbiology: Bacterial diseases – tuberculosis, cholera, typhoid; Viral diseases – measles, AIDS, hepatitis B; Fungal diseases – mycosis, candidiasis; Protozoan diseases – malaria, sleeping sickness. Antimicrobial agents.

TOTAL: 48 HOURS

TEXT BOOK:

1. Gerard Tortora, Berdell Funke, Christine Case (2018), Microbiology: An Introduction 13th Edition, Pearson.
2. Aneja KR, and Mehrotra RS. (2015). An Introduction to Mycology. 4nd edition. New Age International.
3. Jay JM, Loessner MJ, and Golden DA. (2005). Modern Food Microbiology. 7th edition. CBS Publishers and Distributors. Delhi: India.
4. Madigan MT, Martinko JM, and Parker J. (2010). Brock Biology of Microorganisms. 13th edition. Pearson/Benjamin Cummings. McGraw Hill Publishers, Boston

REFERENCE BOOK:

1. Prescott, L.M., Harley, J.P. and Klein, D.A. (2014). Microbiology (9th Edition),
2. Robert Edward Lee, (2008). Phycology. 4th edition. Cambridge University Press.
3. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
4. Tortora GJ, Funke BR, and Case CL. (2018). Microbiology: An Introduction. 13th edition. Pearson Education
5. Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India

CO, PO, PSO Mapping

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

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

SEMESTER III

24BTU303A **BIOINSTRUMENTATION AND BIOSTATISTICS** **3H–3C**

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

End Semester Exam: 3Hours

PREREQUISITE: Student should be familiar with organization of DNA and RNA

COURSE OBJECTIVES(CO)

- To understand the fundamental principles of bio-instrumentation commonly used in biotechnological research labs and hospitals
- To comprehend the colorimetric and spectroscopic principles
- To recognize the concepts of centrifugation and chromatography

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Demonstrate the bioinstrumentation principles concerning instruments and their applications	Understand
CO2	Perform colorimetric and spectroscopic analysis to scrutinize biological samples	Understand
CO3	Apply the principles of centrifugation and chromatography for compound separation	Apply
CO4	Carryout the separation of nucleic acids and proteins using electrophoresis	Analyze
CO5	Apply the biostatistical tools and data representation methods to analyze biological samples	Evaluate

UNIT – I MICROSCOPY, COLORIMETRY, AND SPECTROSCOPY: 8 HOURS

Microscopy: Transmission and scanning electron microscope (TEM & SEM), Fluorescence microscope. Colorimetry and Spectroscopy: Colorimetry, basic principles, Color and absorption spectra, Beer's and Lambert's law. Instrumentation and applications of UV-visible light spectroscopy, Spectrofluorimeter, FTIR, atomic spectroscopy, and NMR spectroscopy.

UNIT – II CENTRIFUGATION AND CHROMATOGRAPHY: 4 HOURS

Principle, types of centrifuges, 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, HPLC.

UNIT – III ELECTROPHORESIS: 8 HOURS

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

UNIT- IV BIOSTATISTICS: 8 HOURS

Basis of Statistics. Definition- Statistical Methods- Kinds of Biological Data Collection and Organization. Types of data: primary Data, secondary Data. Methods of Collecting Data. Sampling and Sampling Designs- Definition: Random and Non-random sampling. Editing the Data: Definition, Objectives of Editing. Classification of Data: Definition, Objectives of classification of Data: Ungrouped raw data- continuous-discrete variation.

UNIT- V TABULATION, REPRESENTATION OF THE DATA AND MEASURES OF CENTRAL TENDENCY: **8 HOURS**

Tabulation: Definition. Parts of table – advantages. Representation of the Data: Diagrammatic: simple bar diagram, Rectangles, squares, circles or Pie diagram – Graphic representation: Histogram, Frequency- Polygon frequency curve, cumulative frequency curve. Measures of central Tendency: Explanation, Types of averages: Arithmetic mean, Median, Mode. Explanation problems related to: ungrouped data, Simple grouped data: continuous, discrete series.

TOTAL: 36 HOURS

TEXT BOOK:

1. Hofmann, A. &Clokie, S. (2018). *Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (*8th ed.). Cambridge University Press, Cambridge, United Kingdom.
2. Sawhney, S.K.& Singh, R. (2018). Introductory *Practical Biochemistry* (6th ed.). Alpha Science International Ltd. Publishers, Oxford, United Kingdom.

REFERENCE BOOK:

1. Marcello Pagano, Kimberlee Gauvreau. (2018). *Principles of Biostatistics* (2nd ed.). Chapman and Hall/CRC Publishers, New York, United States of America.
2. Rosner, B. (2019). *Fundamentals of Biostatistics* (8th ed.). Cengage Learning Publishers, Massachusetts, United States.

CO, PO, PSO Mapping

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

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

SEMESTER III

24BTU303B I.P.R., BIO-ENTREPRENEURSHIP, BIOETHICS & BIOSAFETY 3H–3C

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

End Semester Exam: 3Hours

PREREQUISITE: Student should be familiar with patent, trademark and copyright.

COURSE OBJECTIVES(CO)

- To understand the basic knowledge of intellectual property rights, filling the patents and copyrights
- To develop bio-entrepreneurship skills using biological product formation.
- To acquire fundamental knowledge of bioethics and biosafety, trademarks, copyrights, and patenting.

COURSE OUTCOMES (CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Label the knowledge on filling and submission of copyrights and related property rights.	Remember
CO2	Outline knowledge in developing new pilot scale / large scale industries and associated formalities.	Understand
CO3	Identify the importance of patenting /copyrights/Trade marks	Apply
CO4	Impart knowledge on bio-entrepreneurship skills	Analyze
CO5	File trademark, copyright and patenting through the portal	Create

UNIT-I INTELLECTUAL PROPERTY RIGHTS: 8 HOURS

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

UNIT-II BIO-ENTREPRENEURSHIP: 8 HOURS

Selection of a product, line, design and development processes, economics on material and energy requirement, stock the product and release the same for making etc. The basic regulations of excise: Demand for a given product, the feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc.

UNIT –III BIOETHICS: 8 HOURS

Introduction. Animal Rights. General issues related to the 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 BIOSAFETY: 4 HOURS

Introduction; Background; Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels; Recommended Biosafety Levels, Cartagena protocol on biosafety.

UNIT-V PATENT APPLICATION: **8 HOURS**

Rules governing patents. 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, copyright. Traditional Knowledge.

TOTAL: 36 HOURS

TEXT BOOK:

1. David H. Holt. (2016). Entrepreneurship: New Venture Creation. 1st edition ISBN: 9789332568730.
2. Gupta, C.B., Khanka, S.S. (2017). Entrepreneurship and Small Business Management. 7th edition Sultan Chand & Sons.
3. Pandey, N., Dharni, K. (2014) Intellectual Property Rights. PHI Learning PVT. LTD. New Delhi.
4. Sateesh, M.K. (2010). Bioethics and Biosafety, I. K. International Pvt Ltd.
5. Sree Krishna, V. (2007) Bioethics and Biosafety in Biotechnology. New age international publishers.

REFERENCE BOOK:

1. Goel, D. & Parashar, S. (2013). *IPR, Biosafety and Bioethics* (1st ed.). Pearson Publishers, London, United Kingdom.
2. Llewelyn, D. & Aplin, T. (2019). Intellectual Property: Patents, Copyrights, Trademarks & Allied Rights (9th ed.). Sweet & Maxwell Publishers, London, United Kingdom.
3. Balasubramaniam, S. (2017). India: Traditional Knowledge and Patent Issues: An Overview of Turmeric, Basmati, Neem Cases.

CO, PO, PSO Mapping

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

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

SEMESTER III

24BTU311 **MOLECULAR BIOLOGY – PRACTICAL** **4H–2C**

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

PREREQUISITE: Student should be familiar with organization and replication of DNA.

COURSE OBJECTIVES (CO)

- To emphasize the basic knowledge about the organization of DNA
- To obtain adequate knowledge on the replication of DNA and gene regulations
- To gain information about the DNA damage and repair mechanisms

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Achieve basic knowledge about the organization of DNA	Remember
CO2	Acquire an in-depth knowledge of replication of DNA	Understand
CO3	Gain an insight into the most significant molecular and cell-based methods used today for DNA damage and repair mechanisms	Apply
CO4	Assess the mechanisms behind gene regulations	Analyze
CO5	Perform the experiments for isolation, purification and visualize the chromosomal DNA & Plasmid DNA from various sources	Evaluate

Practicals **48 HOURS**

1. Isolation of chromosomal DNA from plants
2. Isolation of chromosomal DNA from bacterial cells
3. Isolation of Plasmid DNA by alkaline lysis method
4. Agarose gel electrophoresis of genomic DNA & plasmid DNA
5. Preparation of restriction enzyme digests of DNA samples
6. Extraction and separation of protein from bacterial cells-SDS page
7. Demonstration of AMES test or reverse mutation for carcinogenicity

TOTAL:48 HOURS

TEXT BOOK:

1. Griffiths AJF, Wessler SR, Lewontin RC, and Carroll SB. (2015). Introduction to Genetic Analysis. 11th edition W. H. Freeman & Co.
2. Klug WS, Cummings MR, and Spencer CA. (2018). Concepts of Genetics. 12th edition. Benjamin Cummings.
3. Russell PJ. (2016). Genetics- A Molecular Approach. 5th edition. Benjamin Cummings.
4. Carson, S., H. Miller, M. Srougi, D. Scott Witherow (2019). Molecular Biology Techniques 4th Edition – A Classroom Laboratory Manual. Academic Press.
5. Chaitanya KV (2013). Cell and Molecular biology laboratory manual. PHI learning private limited, New Delhi.

CO, PO, PSO Mapping

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

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

SEMESTER III

24BTU312 **GENERAL MICROBIOLOGY – PRACTICAL** **4H–2C**

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

End Semester Exam: 3Hours

PREREQUISITE: Student should be familiar with structural organization, morphology and reproduction of microbes.

COURSE OBJECTIVES (CO)

- To acquire knowledge about the structural organization, morphology and reproduction of microbes
- To know the principles and advancements in various microscopic techniques
- To learn the basic knowledge of the major microbiological techniques practiced in the laboratory

COURSE OUTCOMES (CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Label the knowledge on fundamentals and historical perspective of Microorganisms	Remember
CO2	Acquire basic knowledge on isolation, subculture and maintenance of microbes	Understand
CO3	Analyze the structure of microbes on different types of microscopes	Analyze
CO4	Develop the skills to prepare media for microbial growth in the laboratory	Apply
CO5	Assess the microbial metabolism, growth and disease caused by microorganisms	Analyze

Practicals **48 HOURS**

1. Preparation of media & sterilization methods
2. Methods of isolation of bacteria from different sources
3. Enumeration of microorganism – total & viable count
4. Basic staining methods
5. Biochemical characterization of isolated microbes
6. Determination of bacterial motility by hanging drop method
7. Antibiotic sensitivity of microbes

TOTAL: 48 HOURS

TEXT BOOK:

1. Cappuccino, J.H. and Sherman, N. (2014). Microbiology – A Lab Manual (10th Ed), The Benjamin Publishing Company, Singapore.
2. Goering R, Dockrell H, Zuckerman M, and Wakelin D. (2012). Mims' Medical Microbiology. 5th ed. Elsevier.
3. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott, Harley and Klein's Microbiology. 9th ed. McGraw Hill Higher Education.

CO, PO, PSO Mapping

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

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

SEMESTER III

24VAC301 **INDIAN KNOWLEDGE SYSTEM** **2H–1C**

Instruction Hours/week: L: 2 T:0 P:0 **Marks:** Internal: **100** External: **00** Total: **100**

End Semester Exam: 3 Hours

PREREQUISITE: Not required

COURSE OBJECTIVES:

- To understand the Indian knowledge systems about the origin, evolution, and ontological approach
- To comprehend the Indian knowledge approaches concerning time and language
- To obtain key knowledge on life and mind of the Indian knowledge system

COURSE OUTCOMES:

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

COs	Course Outcomes	Blooms Level
CO1	Understand the rich heritage that resides in our traditions.	Understand
CO2	Apply the Indian knowledge in modern life styles	Apply
CO3	Analyze the importance of philosophical concepts	Analyze
CO4	Evaluate the origin of Indian knowledge and practices	Evaluate
CO5	Assess the role of Women in ancient and modern India.	Analyze

UNIT I TRADITION **5 HOURS**

Conception and Constitution of Knowledge in Indian Tradition, The Oral Tradition, Knowledge Maintenance and Renewal Mechanisms, Nature and Character of Knowledge, Models and Methods of Indian Knowledge Systems, Nature and Conception of Reality, Means of Knowledge of Reality –Uniqueness of Indian Ontology and Epistemology.

UNIT II TIME AND LANGUAGE **5 HOURS**

– Time – Concept of Kala, Cycles of Time, Measurement of Time, Knowledge of Time – the Science of Light. Language – Philosophy of Word and Meaning, The Sphota Doctrine, Sadhu and Asadhu words, Levels of Speech, Silence as the eternal language.

UNIT III ENVIRONMENT AND MANAGEMENT **5 HOURS**

– Environment – Concept of Nature in Indian Tradition, Panchbhutas – Elements of Nature, Concept of Rta, Sacred Environment, Panchvati. Management – Indian conception of Economy and Management, Insights from Arthashastra, Management by Consciousness.

UNIT IV LIFE AND MIND **5 HOURS**

– The Science of Life – History and Basic Principles of Ayurveda, Prana, Ojas and Tejas, Health, Balance and Routine in Ayurveda. The Science of Mind – Origin, Nature and Evolution of Yoga, Types and Schools of Yoga, Yoga Darshana.

UNIT V TORCH BEARERS **4 HOURS**

– Ancient – Sankara, Nanak, Tulsi, Caitanya. Modern – Dayananda, Ramakrishna, Sri Aurobindo, Ananda Coomaraswamy. Women's Empowerment in India: Ancient Period to Modern Time Period.

TOTAL:24 HOURS

TEXT BOOK:

1. B. Mahadevan, Vinayak Rajat Bhat, and Nagendra Pavana R.N. (2022). *Introduction to Indian Knowledge System: Concepts and Applications* (1st ed.). PHI Publishers, New Delhi, India.

WEBSITES

1. https://iks.iitgn.ac.in/wp-content/uploads/2016/01/Indian-Knowledge-Systems-Kapil-Kapoor.pdf
2. https://www.sanskritimagazine.com/india/traditional-knowledge-systems-of-india/

CO, PO, PSO Mapping

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

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

24BTU303 COMMUNITY ENGAGEMENT AND SOCIAL RESPONSIBILITY 2H-2C

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

PRE-REQUISITE: Not required

COURSE OBJECTIVES (CO):

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

COURSE OUTCOMES (COs):

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

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

UNIT I INTRODUCTION AND PRINCIPLES 7 HOURS

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

UNIT II RURAL DEVELOPMENT 7 HOURS

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

UNIT III COMMUNITY AND RESEARCH 6 HOURS

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

UNIT IV: AWARENESS PROGRAMME ON DISEASE MANAGEMENT 2 HOURS

Creation of awareness programme about disease management and Control.

UNIT V : PLANTATION 2 HOURS

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

TOTAL: 24 HOURS

TEXT BOOK:

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

WEBSITES:

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

CO, PO, PSO Mapping

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

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

SEMESTER III

24BTU391	**INTERNSHIP PROGRAMME**	**2 C**

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

நான்காம் பருவம்

24LSUT401 தமிழர் நாகரிகமும் பண்பாடும் 4H - 3C

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

End Semester Exam: 3 Hours

பாடத்திட்டப் பொதுநோக்கம்

- வரலாற்றுக்கு முற்பட்ட தமிழகத்தின் சிறப்பை அறியச்செய்தல்.
- தமிழின் தொன்மையை மாணர்களுக்கு எடுத்துரைத்தல்.
- பழந்தமிழர் வாழ்க்கை முறையை உணர்த்துதல்.

பாடத்திட்டப் பயன்விளைவு

- தமிழ்மொழி வரலாறு குறித்த தெளிந்த அறிவு பெற்றிருத்தல்.
- தமிழரின் மரபு சார்ந்த மொழியின் செல்வாக்கை அறிதல்.
- பழந்தமிழ் இலக்கியங்களின்வழி பண்பாடு கலாச்சாரம் போன்றவற்றை அறிதல்.
- ஐவகை நிலஅமைப்பு, வாழ்வியல் ஒழுக்கலாறுகளைப் பெற்றிருத்தல்.
- இலக்கியங்களின்வழி கலைகளின் வளர்ச்சி மற்றும் அமைப்பு முறையை அறிதல்.

அலகு – I வரலாற்றுக்கு முற்பட்ட தமிழகமும் சங்ககால வரலாறும்

வரலாறும் நிலஅமைப்பும் – வரலாற்றின் செல்வாக்கு – பல்வேறு காலங்களில் வரலாறு உண்டாக்கிய நாட்டுப் பிரிவுகள் - பழைய கற்காலம் – புதிய கற்காலம் – இரும்புக் காலம்.

அலகு – 2 தமிழின் தொன்மை

தமிழ் தோன்றிய இடம் – குமரிக்கண்டத் தமிழ் நாடுகள் – தமிழ் என்னும் பெயர் வரலாறு – திராவிட மொழிக்குடும்பம் – தமிழ்மொழிச் சிறப்பு – தமிழுக்குத் தமிழ் நாட்டவர் செய்ய வேண்டியவை – தமிழுக்கு வெளிநாட்டிற் செய்ய வேண்டியவை.

அலகு – 3 தமிழர் வாழ்வியல்

ஐவகை நிலங்கள் – களவு வாழ்க்கை – கற்பு வாழ்க்கை – அரசர் கடமை – கல்வி நிலை – தொழில் நிலை – ஆடவர் நிலை – பெண்டிர் நிலை.

அலகு – 4 கட்டடக்கலையும் தமிழர் பண்பாடும்

கட்டடக்கலை தோற்றுவாய் – முதற்கலை – கட்டடக்கலையின் பழைமை – புதிய கற்காலம் – சங்ககாலம் – கோயில்கள் – அரண்மனைகள் – கோட்டைகள் – வீடுகள் – நீர்ப்பாசனக் கட்டடக்கலை – தமிழர் கட்டடக் கலையின் தனிச்சிறப்பு.

அலகு – 5 ஆற்றங்கரை நாகரிகம்

ஆறும் நாகரிகமும் – ஆறுகளின் தோற்றமும் நீளமும் – காவிரிக்கரை நாகரிகம் – இலக்கியச் சிறப்பு – கலைச்சிறப்பு – வைகைக்கரை நாகரிகம் - இலக்கியச் சிறப்பு – கலைச்சிறப்பு , நொய்யல்கரை நாகரிகம்.

Total: 48 Hours

பார்வை நூல்கள்

1. முனைவர் அரங்க இராமலிங்கம் (பதிப்பாசிரியர்), தமிழர் நாகரிகமும் தமிழ் மொழிவரலாறும் (தொகுதி -1, 6, 2, 5, 10), வர்த்தமானன் பதிப்பகம், தியாகராயநகர், சென்னை-17.
2. கே.கே.பிள்ளை, தமிழக வரலாறு மக்களும் பண்பாடும், உலகத்தமிழ் ஆராய்ச்சி நிறுவனம் தரமணி, சென்னை-13.
3. நா.வானமாமலை, தமிழர் வரலாறும் பண்பாடும், நியூசெஞ்சுரி புக்ஹவுஸ், சென்னை -98.

இணையதளம்

1. www.tvu.org.in
2. www.maduraitamilproject.com

இதழ்கள்

1. International Research Journal of Indian Literature, irjil.in
2. International Tamil Research Journal, iorpress.in

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	**2.6**	**2.6**	**2.8**	**-**	**-**	**-**	**-**	**-**	-	-	-	-	-	-	-	-	-

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

24LAUH401/24LUH401 HINDI-PAPER- IV 4H-3C

(Modern Poetry, One Act, Essay, Translation)

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

End Semester Exam: 3 Hours

PREREQUISITE: Not Required

COURSE OBJECTIVES(CO):

- Develop an interest in the appreciation of short stories
- Comprehend the grammatical structures and sentence making
- Understand the language and developing English to Hindi translation skill

COURSE OUTCOMES(COs):

- Learning the literacy knowledge of Hindi specially reading and writing .
- Learning the literary knowledge specially reading and understanding of Hindi short Stories
- Learning the history of Hindi literature.
- The ability to translate from Hindi to English and from English to Hindi will be improved.
- Develop a skill in spoken Hindi.

UNIT-I a) Poetry – Lakshmanan ke Bare Me

b) Bharath ka Bhagya

c) Essay – Dhokha

d) Translation – Lesson – 1 to 3

UNIT-II a) Poetry – Soorpanakha Ki Visheshatha

b) Bahu Ki Vida

c) Essay – Jabaan

d) Translation– Lesson – 4 to 6

UNIT-III a) Poetry– Kavya Ke AdharPar

b) Reed Ki Haddi

c) Essay – Kya Janvar Bhee Sochthi Hai

d) translation– Lesson – 7 to 9

UNIT-IV a) Khanda Kavya Ke Adhar Par Panchavati

b) Rajputhni Ka Badhala

c) Essay – Shradha-Bhakthi

d) Translation– Lesson – 10 to 12

UNIT-V a) Kavya Ke Adhar Par Prakruthik Varnan

b) Bheem Aur Raakshas

c) Essay – Adhunik Nari

d) Translation – Lesson –13 to 15

REFERENCE BOOKS:

1.Poetry : Panchavati

Writer : Mythili Sharan Guptha

Publisher : Bharathiya Sahithya Sangrah

Kanpur – 208002, Uttar Pradesh

2.One Act Play : Adarsh Akanki

Publisher : D.B.Hindi Prachar Sabha

T. Nagar,Chennai – 600017, Tamil Nadu

3.Essay : Nibandh Nishchay

Editor : Dr.Sharadh Ranjan

Publisher : Hindi Sahithya Sammelan Prayag

12.Sammelan Marg, Illahabadh

4.Translation : Anuvadh Abhyas – III

Publisher : D.B.Hindi Prachar Sabha

T.Nagar, Chennai – 600017, Tamil Nadu

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	**3**	**2.6**	**2.6**	**-**	**-**	**-**	**-**	**-**	-	-	-	-	-	-	-	-	-

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

Semester IV

24LAUM401/24LUM401 MALAYALAM IV 4H-3C

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

End Semester Exam: 3 Hours

PREREQUISITE: Not required

COURSE OBJECTIVE(CO):

- Knowledge of contemporary drama contents of Malayalam literature
- Learn Screen play and its techniques. The ability to read drama and expresscriticism about it and the ability to express social thoughts will improve
- There will also be litigation messages in Malayalam and news on speech techniques

COURSE OUTCOME(COs):

- Get a basic knowledge of drama
- Can read and critique Screenplay
- Create interest in art literature courses
- The hope of writing a Drama or a Screen Play
- The idea of creating new works and critique knowledge willimprove.

Unit No.	PART I – MALAYALAM IV	Hours
I	Screen Play - Perumthachan	10
II	Screenplay - Perumthachan	10
III	Drama - Saketham	10
IV	Drama - Saketham	09
V	Drama - Saaketham	09
	TOTAL	48

TEXT BOOKS:

1. Perumthachan – M.T.VasudevanNair,DC Books
2. Saketham – C.N.SreekandanNair,DC Books

REFERENCE BOOKS:

1.MalayalaNatakaSahithyaCharithram. G Sankara Pillai (Kerala SahithyaAkademi, Trissur) 2. Malayala Nataka Sahithya Charithram, Vayala Vasudevan Pillai (Kerala Sahithya Akademi Thrissur).
3. Natakam- OruPatanam (C.J. SmarakaPrasanga Samithi, Koothattukulam)
Natakaroopacharcha, Kattumadam Narayanan (NBS, Kottayam)
4.Chalachithrasameeksha–Vijayakrishanan.
5. Cinemayude Paadangal-VisakalanavumVeekshanavum – Jose-K.Manual.

CO, PO, PSO Mapping

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

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

Semester IV

24LAUS401/24LUS401	**SANSKRIT IV** (Lyrics, Grammar and Translation)	**4H-3C**

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

End Semester Exam: 3 Hours

PREREQUISITE: Not required

COURSE OBJECTIVES(CO):

- The fundamental objective of the curriculum is to impart effective science education at the undergraduate level, exposing them to recent trends and developments in the subject.
- Creating scientific temper is another major objective of this curriculum.
- Another major thrust given here is to develop an environmental concern in all activities ofthe students. 'Go green', the motto of the syllabus emphasizes the urgent need to conserve nature without destruction of natural resources.

COURSE OUTCOMES(COs) :

- **Critical Thinking** :Take informed actions after identifying the assumptions that frame students' thinking and actions.
- **Problem Solving**: Understand and solve problems of relevance to society to meet the specified needs using the knowledge, skills and attitudes acquired.
- **Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **Effective Citizenship**: Demonstrate empathetic social concern and equity centered national development.
- **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.

UNIT I

Introduction to Sanskrit Lyrics and erotic literature.

UNIT II

Devotional Literature, Important works

UNIT III

Krishnakarnamrita of Leelasuka (Second Section only)

UNIT IV

Grammar – Past tense, Declension of personal pronouns

UNIT V

Simple sentences from Sanskrit Self Teacher

TEXT BOOK:

Krishnakarnamrita of LeelasukaSri Ramakrishna Mud Mylapore, Chennai.

TOTAL: 48 HOURS

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	**2.6**	**2.6**	**2.8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

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

Semester IV

24LAUF401/24LUF401 FRENCH IV 4H-3C

(Comprehension,Tradusion, Reduction,Une act)

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

End Semester Exam: 3 Hours

PREREQUISITE: Not Required

COURSE OBJECTIVES (CO):

- To provide the students with an ability to build and enrich their communication skills.
- To help them think and write imaginatively and critically.
- To strengthen their professional skills.
-

COURSE OUTCOMES (COS):

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

COs	Course Outcomes	Blooms Level
CO1	Make the students proficient communicators in French.	Apply
CO2	Develop learners' ability to understand French.	Understand
CO3	Understand the nuances of listening, speaking and readingFrench.	Understand
CO4	Prepare the learners to face situations with confidence and to seek employment in the modern globalized world.	Apply
CO5	Build the students' ability to listen and to speak French better.	Apply

Unite – I
a) Leçon – On fait le ménage !
b) Communication - Protester et réagir
c) Grammaire - Le présent progressif, Les pronoms possessifs
La phrase négative (3)
d) Lexique –• Le logement,La maison,Les pièces
e) Culture – Paris et ses symboles

Unite – II
a) Leçon – À propos de logement
b) Communication - Exprimer l'intérêt et l'indifférence
c) Grammaire - Quelques adjectifs et pronoms indéfinis
Les verbes lire, rompre et se plaindre
d) Lexique – Meubles et équipement,Les tâches ménagères
e) Culture - Les fêtes et les traditions en France

Unite – III
a) Leçon – Tous en forme ! Accidents et catastrophes
b) Communication - Raconter au passé
c) Grammaire - Le passé composé et l'imparfait
Le passé récent, L'expression de la durée,
d) Lexique – Le corps humain : l'extérieur,Le corps humain : l'intérieur Les maladies et les remèdes
e) Culture - La longue histoire de la Francophonie

Unite – IV

a) Leçon – Faire ses études à l'étranger

b) Communication -• Exprimer la peur et rassurer
c) Grammaire - Les adjectifs et les pronoms ,indéfi nis : rien, personne, aucun Les verbes dire, courir et mourir
d) Lexique – Les accidents,Les catastrophes naturelles
e) Culture - Les jeux de la Francophonie .

Unite – V a) Leçon – Bon voyage !La méte
b) Communication - Exprimer son opinion, Parler de la météo
c) Grammaire -• Les pronoms démonstratifs neutres
Le futur simple, Situer dans le temps
d) Lexique – Le système scolaire,Les formalités pour partir à l'étranger • La météo
e) Culture- Le français hors de France

TOTAL: 48 HOURS

REFERENCE BOOKS:

- Cocton Marie –Noëlle , Duplex Dorothée, Heu Elodie , Kasazian Emilie, Ripaud Delphine, **Saison 1- Méthode de francais**, Didier, paris.2015.
- Cocton Marie – Noëlle, Dupleix, Heu Elodie, Kasazian Emilie ,Ripaud Deldphin**, Saison 1 –**
- **Cahier d'activites ,** Dider ,Paris , 2015
- Anne Akyüz,Bernadette Bazelle- Shahmael,JoëlleBonenfant, Marie- Françoise Gliemenn,Les **exercices de grammaire,Hachette FLE,** Paris,2005
- Christian Beaulieu, **Je pratique**, **Exercises de grammaire A**1, Dider,Paris,2015
- Nathalie BIE, philippe SANTINAN,Gra**mmaire pour adolescents-250 exercises, CLE International , Paris , 2005**

WEBSITES :

- http:// enseigner.tv5 monde.com/
- bonjourdumonde.com /exercises/contenu/le – francais-du- tourisme.html
- http://www.bonjurdefrance.com/
- https://www.lepointdufle.net/

CO, PO, PSO Mapping

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

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

Semester IV

24ENU401	**ENGLISH IV**	**3H-3C**

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

End Semester Exam: 3 Hours

PREREQUISITE: Not required

COURSE OBJECTIVES(CO):

- To provide the students with an ability to build and enrich their communication skills.
- To help them think and write imaginatively and critically.
- To strengthen their professional skills.

Course Outcomes (COs):

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

COs	Course Outcomes	Blooms Level
CO1	Make the students proficient communicators in English.	Apply
CO2	Develop learners' ability to understand English.	Understand
CO3	Understand the nuances of listening, speaking and reading English.	Understand
CO4	Prepare the learners to face situations with confidence and toseek employment in the modern globalized world.	Apply
CO5	build the students' ability to listen and to speak English better.	Apply

UNIT-I **8 HOURS**

Concept of Communication- Barriers to Communication- Body Language-Personality Development-Etiquette and Manners-Soft Skills

UNIT- II **7 HOURS**

Listening Comprehension-Reading Comprehension-Paragraph Writing-Precis Writing-Collocation

UNIT-III **7 HOURS**

Writing-Writing Resume and Covering Letter- Types of Letter Writing-Writing MoU- Dicto Composition--Term Paper-Book Reviews

UNIT- IV **7 HOURS**

Speaking-Interview Skills-Preparing Welcome address and Vote of Thanks-Compering -

UNIT-V **7 HOURS**

Punctuation Marks- Figures of Speech

TOTAL: 36 HOURS

TEXT BOOK:

1. Board of Editors (2024). *Proficiency in Communication II*, Karpagam Academy of Higher Education

REFERENCE BOOKS:

1.Martin's, St (2013). *Oxford Handbook of Writing: Handbook of Writing*. Cambridge University Press.

2. Wren & Martin, *(*2008). *High School English Grammar & Composition*, S. Chand & Company Ltd, Board of Editors,

3. Krashen, Stephen D (1982). *Principles and Practice in Second Language Acquisition*. New York: Pergamon Press.

WEB SITES:

1. https://www.skillsbuilder.org/blog/top-5-speaking-skills-for-success-in-interviews
2. https://www.coursera.org/articles/interviewing-skills

CO, PO, PSO Mapping

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

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

SEMESTER IV

24BTU401 **GENETICS** **5H–4C**

Instruction Hours/week:L:5 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3Hours

PREREQUISITE: Student should be familiar with basic concepts of heredity in different living organisms.

COURSE OBJECTIVES(CO)

- To deliver the basic concepts of heredity in different living organisms
- To gain knowledge about the genome-level organization in various living organisms
- To obtain the knowledge about transmission of genetic information across generations at the individual and population level

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Acquire knowledge about the central theories and methodologies traditional, molecular and population genetics.	Remember
CO2	Acquire information on sex- linked inheritance and associated diseases.	Understand
CO3	Understand the role of genetics in breeding and natural selection.	Apply
CO4	Compare the principles of inheritance as formulated by Mendel.	Analyze
CO5	Assess the Hardy-Weinberg Law in analyzing population genetics for gene frequency, sex linkage, equilibrium, and heterozygote frequency.	Evaluate

UNIT-I INTRODUCTION TO GENETICS: 12 HOURS

Historical developments in the field of genetics. Organisms suitable for genetic experimentation and their genetic significance. Pre-Mendelian genetic concepts: Preformation, Epigenesis, Chromosomal Theory of inheritance. Heredity and Environment: Concepts of Phenotype, Genotype, Heredity, variation, Pure lines and Inbred lines. Biography of Mendel and his experiment on pea plants,

UNIT- II MENDELIAN GENETICS: 12 HOURS

Law of Segregation and Law of Independent assortment – monohybrid, di-hybrid cross, test cross, back cross and reciprocal cross. Concepts of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy, multiple alleles, pseudo-allele, essential and lethal genes, penetrance, and expressivity. Application of Mendel's principles-The Punnett square method, Pedigree analysis.

UNIT-III CHROMOSOME AND GENOMIC ORGANIZATION: 12 HOURS

Eukaryotic nuclear genome nucleotide sequence composition –unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, repetitive transposed sequences- SINEs & LINEs. Genetic organization of prokaryotic and viral genome. Structure and features of bacterial and eukaryotic chromosome, chromosome morphology, concept of euchromatin and heterochromatin. concept of cistron, exons, introns, genetic code, gene function.

UNIT-IV SEX DETERMINATION, SEX-LINKED DISEASE AND DISORDERS: 12 HOURS

Chromosomal theory of sex determinations: XX-XY, XX-XO, ZO-ZZ, ZZ-ZW; Mechanisms of Sex determination, Genic balance theory in Drosophila; Gynandromorphs; Chromosomal and Genetic mutations: Variations in chromosome structure - deletion, duplication, inversion and translocation, causes of mutations. Sex linkage, Sex-linked disease, and disorder: Hemophilia, muscular dystrophy, down syndrome, turner syndrome, Fragile-X-syndrome; Sex-linked inheritance.

UNIT-V GENETIC LINKAGE AND POPULATION GENETICS: 12 HOURS

Linkage and Recombination of genes in a chromosome crossing over. Extra chromosomal inheritance: Rules of extranuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting. Evolution and population genetics: In breeding and outbreeding, Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, systems of mating, evolutionary genetics, and natural selection.

TOTAL:60 HOURS

TEXT BOOK:

1. Gardner EJ, Simmons MJ, and Snustad DP. (2006). Principles of Genetics. 8th edition. John Wiley & Sons.
2. Griffiths AJF, Wessler SR, Lewontin RC, and Carroll SB. (2015). Introduction to Genetic Analysis. 11th edition W. H. Freeman & Co.
3. Leland Hartwell, Michael L. Goldberg, Janice Fischer, Leroy Hood (2017). Genetics: From genes to genomes. 6th edition. McGraw-Hill Publishers.
4. Russell PJ. (2016). Genetics- A Molecular Approach. 5th edition. Benjamin Cummings.
5. Snustad DP, and Simmons MJ. (2009). Principles of Genetics. 5th edition. John Wiley and Sons nc. USA

CO, PO, PSO Mapping

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

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

SEMESTER IV

24BTU402 **RECOMBINANT DNA TECHNOLOGY** **5H–4C**

Instruction Hours/week: L:5 T:0 P:0 **Marks:** Internal: 40 External: 60 Total: **100**

End Semester Exam: 3 Hours

PREREQUISITE: Student should be familiar with structural organization, morphology and reproduction of microbes.

COURSE OBJECTIVES(CO)

- To learn the procedure for isolation of nucleic acids and proteins
- To learn the strategies for gene transfer in plants and animals
- To acquaint the students to utilize versatile tools and techniques employed in recombinant DNA technology

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Define the fundamental techniques for isolation of nucleic acids and proteins	Remember
CO2	Designate the strategies for gene transfer in plants and animals	Understand
CO3	Apply the procedures for plasmid preparations for gene inserting	Apply
CO4	Assess cloning strategies and techniques used to probe DNA for the specific gene of interest	Analyze
CO5	Conceptualize PCR technique in medical and forensic science	Create

UNIT-I INTRODUCTION TO R-DNA TECHNOLOGY: 15 HOURS

Basic tools and applications – isolation and purification of nucleic acids, Enzymes used in cloning - restriction enzymes, ligases, polymerases, kinases, phosphatases. Expression vectors and cloning vector, Artificial vectors, Gene recombination and gene transfer – transformation, transfection, microinjection, electroporation, ultrasonication.

UNIT-II SELECTION AND SCREENING OF RECOMBINANT CLONES: 15 HOURS

Probes – radio labeled and non-radio-labeled, guessmer and degenerate probes. Sequence-dependent and independent screening, Southern / Northern / Western blot, dot blot and zoo blot. Southern and northern hybridization, colony and plaque hybridization, *in situ* chromosomal hybridization, chromosome walking, Genome mapping, DNA fingerprinting, DNA footprinting, Polymerase chain reaction (PCR), RT- (Reverse transcription) PCR.

UNIT-III EXPRESSION AND CHARACTERIZATION OF CLONED DNA: 10 HOURS

Optimization of protein expression in heterologous systems, Synthesis and purification of proteins from cloned genes – Fusion proteins, *In vitro* translation systems. Preparation and comparison of Genomic and cDNA library. GFP and RFP.

UNIT-IV RANDOM AND SITE-DIRECTED MUTAGENESIS: 10 HOURS

Primer extension and PCR based methods of site directed mutagenesis, random mutagenesis, Gene shuffling, production of chimeric proteins, Protein engineering concepts (any two) and applications.

UNIT-V APPLICATIONS OF GENETIC ENGINEERING: 10 HOURS

In plants: use of *Agrobacterium tumefaciens* and *A. rhizogenes*, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors. In animals: Production and applications of transgenic mice, role of embryonic stem cells in gene targeting in mice, Therapeutic products - blood proteins, human hormones, immune modulators and vaccines (one example each). Q PCR, Ethical, legal and social issues, Human Genome Project.

TOTAL:60 HOURS

TEXT BOOK:

1. Brown, T.A., (2016). *Gene Cloning and DNA Analysis* (7th ed.). Wiley-Blackwell.
2. Clark, D.P., & Pazdernik, N.J. (2009). *Biotechnology-Applying the Genetic Revolution*. USA: Elsevier Academic Press.
3. Glick, B.R., & Patten C. L. (2017). *Molecular Biotechnology- Principles and Applications of recombinant DNA*. (5th ed.). Washington: ASM Press.
4. Primrose, S.B., & Twyman, R.M. (2013). *Principles of Gene Manipulation and Genomics* (7th ed.). Wiley-Blackwell.

CO, PO, PSO Mapping

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

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

SEMESTER IV

24BTU403A **BASICS OF FORENSIC SCIENCE** **3H–3C**

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

End Semester Exam: 3Hours

PREREQUISITE: Not Required.

COURSE OBJECTIVES(CO)

- To give knowledge on molecular analysis in forensic science
- To acquire knowledge to assess DNA finger printing patterns
- To understand the basic methods for examine the different types of questioned documents

COURSE OUTCOMES (CO's)

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

COs	Course Outcomes	Blooms Level
CO1	List the competency in the collection, processing, analyses, and evaluation of evidence	Remember
CO2	Demonstrate ability in the principles of crime scene investigation, including the recognition, collection, identification, preservation, and documentation of physical evidence	Understand
CO3	Develop an understanding of the scientific method and the use of problem-solving within the field of forensic science	Apply
CO4	Examine the role of the forensic scientist and physical evidence within the criminal justice system	Analyze
CO5	Determine the ability to document and orally describe crime scenes, physical evidence, and scientific processes	Evaluate

UNIT- I INTRODUCTION AND PRINCIPLES OF FORENSIC SCIENCE: 8 HOURS

Forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, causes of crime, role of modus operand in criminal investigation. Crime – types and characteristics – crime scene management. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths. Criminal justice system. Role of mobile forensic science laboratory in crime scene investigation.

UNIT-II CLASSIFICATION OF FIRE ARMS AND EXPLOSIVES: 7 HOURS

Introduction to internal, external and terminal ballistics. Chemical evidence for explosives. General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of various ink samples.

UNIT-III TOXICOLOGY AND PHYSICAL EVIDENCE: 7 HOURS

Role of the toxicologist, significance of toxicological findings, Physical evidence types, significance, collection, preservation, packing and forwarding different evidences, Blood stain pattern analysis, Detection of blood group, Identification of blood stains, Fundamental principles of fingerprinting, classification of fingerprints.

UNIT-IV DNA FINGER PRINTING: 7 HOURS

Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Investigation Tools, eDiscovery, Evidence Preservation, Search and Seizure of Computers. Types and applications in criminal investigation, Automated fingerprint identification system.

UNIT-V APPLICATION OF FORENSIC SCIENCE: 7 HOURS

Cyber Crime, Introduction to Cyber security and recent techniques. development of fingerprint as science for personal identification. Recent Advanced techniques used in forensic science (Lie detection, Voice identification, Narco Analysis, Brain fingerprinting).

TOTAL: 36 HOURS

TEXT BOOK:

1. Bernard J. Glick, Jack J. Pasternak, & Cheryl L. Patten. (2010). *Molecular Biotechnology- Principles and Applications of recombinant DNA* (4th ed.). Washington: ASM Press.
2. Bhasin, M.K., & Nath S. (2002). *Role of Forensic Science in the New Millennium*. Delhi: University of Delhi.
3. Eckert, W.G., & Wright, R.K. (1997). *An Introduction to Forensic Sciences* (2nd ed.). CRC Press, Boca Raton (1997).
4. James, S.H., & Nordby J.J. (2005). *Forensic Science: An Introduction to Scientific and Investigative Techniques* (2nd ed.). CRC Press, BocaRaton.

REFERANCE BOOK:

1. Nabar BS,(2013) *Forensic Science in Crime Investigation*, Asia Law House (3rd ed.), Telangana, India
2. Nanda, B.B., & Tiwari, R.K. (2001). *Forensic Science in India: A Vision for the Twenty First Century*. New Delhi: Select Publishers.
3. Saferstein R., (2015). *Criminalistics: An Introduction to Forensic Science* (11th ed.). New Jersey: Prentice Hall.

CO, PO, PSO Mapping

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

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

SEMESTER IV

24BTU403B **EVOLUTIONARY BIOLOGY** **3H–3C**

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

End Semester Exam: 3 Hours

PREREQUISITE: Student should be familiar with basic concepts of heredity in different living organisms.

COURSE OBJECTIVES(CO)

- To give a detailed explanation of key concepts of population genetics in terms of Hardy-Weinberg Law, genetic drift, and types of Natural Selection
- To provide adequate knowledge about Micro-evolutionary changes, Speciation and Adaptive Radiation
- To give a detailed outline of Extinctions and their types

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Relate knowledge of key concepts of population genetics	Remember
CO2	Extend the information about the concepts of evolution	Understand
CO3	Utilize the Concept of Hardy-Weinberg Law	Apply
CO4	Analyze the phylogenetic tree used for experimental study	Analyze
CO5	Assess the salient features of the neutral Theory of molecular evolution.	Evaluate

UNIT- I HISTORICAL REVIEW OF EVOLUTIONARY CONCEPT: **7 HOURS**

Pre-Darwinian ideas -Lamarckism – Merits and demerits. Darwinism – Merits and demerits, post-Darwinian era – Modern synthetic theory; and the theory of population genetics leading to Neo-Darwinism.

UNIT- II LIFE'S BEGINNINGS: **7 HOURS**

Chemogeny – An overview of pre-biotic conditions and events; experimental proofs to abiotic origin of micro- and macro-molecules. Current concept of chemogeny – RNA first hypothesis. Biogeny – Cellular evolution based on proto-cell models (coacervates and proteinoid micro-spheres). Endosymbiotic theory – Evolution of Eukaryotes from Prokaryotes. Genome evolution. Anaerobic metabolism. Origin of photosynthesis and aerobic metabolism. Micro, Macro and Mega evolution. Co- evolution.

UNIT-III EVIDENCES OF EVOLUTION: **7 HOURS**

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)

UNIT-IV BIOCHEMICAL AND MOLECULAR EVOLUTION: **8 HOURS**

Gene evolution, Evolution of gene families, molecular drive, Amino acid sequence divergence in proteins, Nucleotide sequence divergence in DNA, Molecular clocks, Ancient DNA. Biochemical and genomic evolution: The evolutionary history of proteins and the concept of molecular clock. Outline of organization of prokaryotic and eukaryotic genomes. The "C- Value paradox". Evolutionary history of neural integration. Evolution of the endocrine system – Hormones and Evolution. Role of environment in regulating evolution.

UNIT-V FORCES OF EVOLUTION – QUALITATIVE STUDIES BASED ON FIELD OBSERVATIONS: 7 HOURS

Natural selection as a guiding force – Its attributes and action Basic characteristics of natural selection. Coloration, camouflage and mimicry, Co-adaptation and co-evolution, Man-made causes of change – Industrial melanism; brief mention of drug, pesticide, antibiotic in various organisms. Modes of selection, Polymorphism, Heterosis and Balanced lethal systems. Genetic Drift (Sewall Wright effect) as a stochastic/random force – Its attributes and action. Basic characteristics of drift; selection vs. drift, Bottleneck effect. Founder principle.

TOTAL: 36 HOURS

TEXT BOOK:

1. Ridley, M. (2014). *Evolution* (3rd ed.). Blackwell.
2. Hall, B. K., & Hallgrimson, B. (2018). *Strickberger's Evolution* (4th ed.). Jones and Barlett
3. Zimmer, C., & Emlen, D. J. (2013). *Evolution: Making Sense of Life*. Roberts & Co.
4. Evolution: A Very Short Introduction 2017 Brian Charlesworth, Deborah Charlesworth – Oxford University Press London

WEBSITES

1. http://172.16.25.76/login/index.php
2. https://nptel.ac.in/content/storage2/courses/122103039/pdf/mod2.p

CO, PO, PSO Mapping

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

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

24BTU411 GENETICS AND RECOMBINANT DNA TECHNOLOGY - PRACTICAL 4H–2C

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

End Semester Exam: 3 Hours

PREREQUISITE: Student should be familiar with DNA and RNA

.

COURSE OBJECTIVES(CO)

- To familiarize with practical knowledge in isolation and analysis of genetic material
- To perform basic molecular biology techniques including DNA and RNA isolation from microbes, plants and animals
- To obtain key concepts of different blotting techniques

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Recall recombinant DNA techniques including restriction and digestion, ligation, transformation and PCR	Remember
CO2	Carry out DNA and RNA isolation from microbes, plants and animals	Apply
CO3	Demonstrate various blotting techniques	Understand
CO4	Analyze genetic model system used in research	Analyze
CO5	Assess the different stages in cell division.	Evaluate

Genetics Practical's **24 HOURS**

1. Permanent and temporary mount of mitosis
2. Permanent and temporary mount of meiosis
3. Genetic study of model organisms and their significance
   a) Bacteria: *E. coli*
   b) *Saccharomyces* sp.
   c) Drosophila melanogaster
   d) Arabidopsis thaliana
4. Study of polyploidy in onion root tip by colchicine treatment

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

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

TOTAL:48 HOURS

TEXT BOOK:

1. Green, M.R. &Sambrook, J. (2012). *Molecular Cloning: A Laboratory anual*. (4th ed.). Cold Spring Harbor Laboratory Press, New York, United States.
2. Greene, J.J.&Rao, V.B. (2001). *Recombinant DNA Principles and Methodologies.* (2nd ed.) 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.* (1st ed.).Academic Press Publishers, New York, United States.

CO, PO, PSO Mapping

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

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

SEMESTER IV

24BTU412A **BASICS OF FORENSIC SCIENCE - PRACTICAL** **4H–2C**

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

End Semester Exam: 3Hours

PREREQUISITE: Student should be familiar with instrumental handling.

COURSE OBJECTIVES(CO)

- To give practical knowledge on molecular analysis in forensic science
- To perform DNA finger-printing, handle the evidence left out at the crime scene
- To get knowledge on the lifting of footprints from the crime scene, examine the different types of questioned documents

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Relate the Laboratory skills to participate in the career needs of Forensic community	Remember
CO2	Become trained in the laboratory skills of different division of Forensic Science	Understand
CO3	Be able to work with different R&D organizations	Apply
CO4	Classify the role of the forensic scientist and physical evidence within the criminal justice system	Analyze
CO5	Develop the ability to document and orally describe crime scenes, physical evidence, and scientific processes	Create

Practicals **48 hours**

1. Documentation of crime scene by photography, sketching and field notes
2. a. Simulation of a crime scene for training
   b. To lift footprints from the crime scene
3. Case studies to depict different types of injuries and death
4. Separation of nitro compounds (explosives)/ ink samples by thin-layer chromatography
5. Investigate the method for developing fingerprints by Iodine crystals
6. PCR amplification on target DNA and DNA profiling
7. Study of different searching methods at the scene of the crime.

TOTAL: 48 HOURS

TEXT BOOK:

1. Tilstone, W.J., Hastrup, M.L., & Hald, C. (2013). *Fisher's Techniques of Crime Scene Investigation*. CRC Press.
2. Bernard J. Glick, Jack J. Pasternak, & Cheryl L. Patten. (2010). *Molecular Biotechnology- Principles and Applications of recombinant DNA* (4th ed.). Washington: ASM Press.
3. Bhasin, M.K., & Nath S. (2002). *Role of Forensic Science in the New Millennium.* Delhi: University of Delhi.
4. Eckert, W.G., & Wright, R.K. (1997). *An Introduction to Forensic Sciences* (2nd ed.). CRC Press, Boca Raton (1997).
5. James, S.H., & Nordby J.J. (2005). *Forensic Science: An Introduction to Scientific and Investigative Techniques* (2nd ed.). CRC Press, Boca Raton.
6. Nanda, B.B., & Tiwari, R.K. (2001*). Forensic Science in India: A Vision for the Twenty First Century*. New Delhi: Select Publishers.
7. Saferstein R. (2004). *Criminalistics: An Introduction to Forensic Science* (8th ed.). New Jersey: Prentice Hall.

CO, PO, PSO Mapping

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

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

SEMESTER IV

24BTU412B **EVOLUTIONARY BIOLOGY- PRACTICAL** **4H–2C**

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

End Semester Exam: 3Hours

PREREQUISITE: Student should be familiar with instrumental handling.

COURSE OBJECTIVES(CO)

- To obtain practical concepts of variations
- To practically learn about adaptive strategies
- To attain knowledge on Neo-Darwinian concepts

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Relate knowledge of key concepts of population genetics	Remember
CO2	Extend the information about the concepts of evolution	Understand
CO3	Utilize the Concept of Hardy-Weinberg Law	Apply
CO4	Analyze the phylogenetic tree used for experimental study	Analyze
CO5	Assess the salient features of the neutral Theory of molecular evolution.	Evaluate

Practicals **48 hours**

1) Variations
   a. Sampling of human height, weight and BMI for continuous variation.
   b. Sampling for discrete characteristics (dominant *vs* recessive) for discontinuous variations e.g hitch-hiker's thumb, dexterity, tongue rolling, ear lobe (data categorization into 16 groups based on the combination of 4 traits; assigning each subject to the respective group).
2) Selection Exemplifying Adaptive strategies (Colouration, Mimetic form, Co-adaptation and co- evolution; Adaptations to aquatic, fossorial and arboreal modes of life) using Specimens.
3) Neo-Darwinian Studies
   a. Calculations of genotypic, phenotypic and allelic frequencies from the data provided
   b. Simulation experiments using coloured beads/playing cards to understand the effects of Selection and Genetic drift on gene frequencies
4) Phylogeny.

TOTAL: 48 HOURS

TEXT BOOK

1. Barton, Briggs, Eisen, Goldstein, & Patel, (2007). *Evolution*. Cold Spring Harbor Laboratory Press.
2. Hall, B. K., & Hallgrimson, B. (2013). *Strickberger's Evolution* (4th ed.). Jones and Barlett
3. Ridley, M. (2014). *Evolution* (3rd ed.). Blackwell.
4. Zimmer, C., & Emlen, D. J. (2013). *Evolution: Making Sense of Life*. Roberts & Co.

CO, PO, PSO Mapping

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

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

SEMESTER IV

24VAC401 UNIVERSAL HUMAN VALUES 2H–1C

Instruction Hours/week: L:2 T:0 P:0 **Marks:** Internal: **100** External: **00** Total: **100**

End Semester Exam: 3Hours

PREREQUISITE: Not Required

COURSE OBJECTIVES (CO):

- To develop the holistic perspective based on self-exploration about themselves, family, society and nature/existence.
- To understand harmony in themselves, family, society and nature/existence.
- To strengthen the self-reflection.
- To develop the commitment and courage to act.

COURSE OUTCOMES (COs):

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

COs	Course Outcomes	Blooms Level
CO1	Become more aware of themselves and their surroundings (family, society, nature).	Understand
CO2	Be more responsible in life.	Apply
CO3	Deal with problems with sustainable solutions, while keeping human relationship and human nature in mind.	Analyze
CO4	Develop consciousness of themselves through the control of mind.	Evaluate
CO5	Nuture human to live with mutual happiness and prosperity with rest of nature	Analyze

UNIT I INTRODUCTION 4 HOURS

Purpose and motivation for the course, recapitulation from universal human values I. Self-exploration-what is it? – its content and process; 'Natural Acceptance' and Experiential Validation- as a process for self-exploration. Continuous Happiness and prosperity. A look at basic human Aspiration. Right understanding, Relationship and physical Facilities-the basic requirements for fulfillment of aspirations of every human being with their correct priority. Understanding Happiness and prosperity correctly- A critical appraisal of the current scenario. Method of fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT II UNDERSTANDING HARMONY IN THE HUMAN BEING – HARMONY IN MYSELF 4 HOURS

Understanding human being as a co-existence of the sentiment 'I' and the material 'Body'. Understanding the needs of self ('I') and 'Body' – sukh and Suvidha. Understanding the body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and helth; correct appraisal of physical needs, meaning of prosperity in detail. Programs to ensure Sanyam and health.

UNIT III UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY-HARMONY IN HUMANHUMAN RELATIONSHIP 6 HOURS

Understanding values in human-human relationship; meaning of justice (nine universal values in relationship) and program for its fulfillment to ensure mutual happiness; Trust and respect as the foundational values of relation, Understanding the meaning of trust; Difference between intention and competence understanding the meaning of respect, Difference between respect and differentiation; the other salient values in relationship. understanding harmony in the family and society (society being an extension of family): Resolution, prosperity, fearlessness and coexistence as comprehensive human goals. Visualizing a universal harmonious order in society- undivided society, universal order- from family to world family.

UNIT IV UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE- WHOLE EXISTENCE AS CO- EXISTENCE 4 HOURS

Understanding harmony in the nature, Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self-regulation in nature. Understanding existence as co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence.

UNIT V IMPLICATION OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS 6 HOURS

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a) Ability to utilize the professional competence for augmenting universal human order b) Ability to identify the scope and characteristics of people-friendly and ecofriendly production systems, c) Ability to identify and develop appropriate technologies and management patters for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations.

TOTAL: 24 HOURS

TEXT BOOKS:

1. Gaur,R.R, Sangal,R and Bagaria,G.P,(2010). *A foundation course in Human Values and professional Ethics*, Excel books, New Delhi.
2. Schumacher. E.F, *Small is Beautiful: Economics as If People Mattered*,Perennial Library.
3. Cecile Andrews, (2006). *Slow is Beautiful*, New Society Publishers.

REFERENCE BOOKS:

1. Joseph Cornelius Kumaruppa,(Digitized 30 Oct 2019). *The Economy of Permanence*.
2. Mahatma Gandhi, (1983). *The Story of My Experiments with Truth*.
3. Maulana Abul Kalam Azad, (2017). *India Wins Freedom*, Create Space Independent Publishing Platform.
4. Romain Rolland, (1952). *The Life of Vivekananda and the Universal Gospel*, Advaita ashrama.

WEB SITES:

1. http://www.arvindguptatoys.com/arvindgupta/gandhiexperiments.pdf
2. http://www.sanipanhwar.com/India%20Wins%20Freedom%20%20Maulana%20Abul%20Kalam%20Azad
3. https://estudantedavedanta.net/The-Life-Of-Vivekananda-And-The-Universal-Gospel.pdf

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	-	-	2	1	-	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	
CO3	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	3	-	-	-	-	-	-	-	-	-	-	3	2	-
Average	-	-	**2**	**2**	**2**		**3**	-	-	-	-	-	-	-	**3**	**2.5**	-

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

SEMESTER V

24BTU501 **PLANT BIOTECHNOLOGY** **5H–4C**

Instruction Hours/week: L:5 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3Hours

PREREQUISITE: Student should be familiar with plant culture media.

COURSE OBJECTIVES(CO)

- To cognize and get knowledge on plant tissue culture
- To give knowledge about various methods of gene transfer and gene expression in plants
- To introduce biotechnological methods for the production of transgenic plant

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Choose the growth conditions required to culture the plants in *in vitro c*onditions	Remember
CO2	Inculcate the deep information of genetic engineering of plants	Understand
CO3	Assess the secondary metabolite products through cell suspension culture	Evaluate
CO4	Analysis the gene transfer methods and its mechanism for the development of transgenic plants	Analyze
CO5	Develop plant-based enzyme-engineered edible vaccines	Apply

UNIT – I INTRODUCTION: **12 HOURS**

Principles of Plant Breeding: Nutritional requirement by plants. Important conventional methods of breeding – self, cross pollinated and vegetatively propagated crops. Non-conventional methods. Polyploidy, Genetic variability.

UNIT-II MICROPROPAGATION: **12 HOURS**

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: **12 HOURS**

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

UNIT-IV PLANT GENETIC ENGINEERING: **12 HOURS**

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: 12 HOURS

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

TOTAL:60 HOURS

TEXT BOOK:

1. Slater, A., Scott, N.W., & Fowler, M. R. (2008). *Plant Biotechnology.* Oxford: Oxford University Press.
2. Ignacimuthu, S. (2004). *Plant Biotechnology.* New Delhi: Oxford and IBH Publishing House.
3. Chawla, H.S. (2002). *Introduction to Plant Biotechnology.* New Delhi: Oxford and IBHP Publishing Co. Pvt. Ltd.
4. Kumar,U. (2008). *Plant Biotechnology and Biodiversity Conservation.* Jodhpur: Agrobios.
5. Stewart, N.C. (2016). *Plant Biotechnology and Genetics.* 2nd 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.

CO, PO, PSO Mapping

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

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

SEMESTER V

24BTU502 **ANIMAL BIOTECHNOLOGY** **5H–4C**

Instruction Hours/week: L:5 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3Hours

PREREQUISITE: Student should be familiar with animal culture media.

COURSE OBJECTIVES(CO)

- 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

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Name the growth conditions required to culture the animal in *in vitro* conditions	Remember
CO2	Inculcate the deep information of genetic engineering of animal	Understand
CO3	Make use of strong knowledge on transgenic animal	Apply
CO4	Implement and analyze the gene transfer methods to develop transgenic animal	Analyze
CO5	Influence animal-based growth hormone	Evaluate

UNIT I ANIMAL CELLS: **12 HOURS**

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

UNIT II CELL CULTURE: **12 HOURS**

Disaggregation of tissue, primary culture, established culture; Suspension culture, organ culture and tissue engineering, feeder layers, 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: **12 HOURS**

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

UNIT IV EMBRYOLOGY: **12 HOURS**

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

UNIT V TRANSGENICS: **12 HOURS**

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

TOTAL:60 HOURS

TEXT BOOK:

1. Ranga, M. M. (2007). Animal Biotechnology. (3rd ed.). Jodhpur: Agrobios.
2. Freshney, R.I. (2000). Animal Cell Culture: A Practical Approach (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.

CO, PO, PSO Mapping

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

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

SEMESTER V

24BTU503 **IMMUNOLOGY** **5H–4C**

Instruction Hours/week: L:5 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3Hours

PREREQUISITE: Student should be familiar with types of immune cells and systems.

COURSE OBJECTIVES(CO)

- To understand the basic concepts of immunology
- To expose students to use these principles of the immune system to combat infections
- To gain the information about the auto-immune diseases

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Relate the knowledge about the various cells and organs involved in the immune system	Remember
CO2	Understand the molecular mechanisms of antigen-antibody interactions	Understand
CO3	Apply the theoretical basis for various immunological techniques	Apply
CO4	Analyze which cell types and organs present in the immune response	Analyze
CO5	Asses basic techniques for identifying antigen-antibody interactions	Evaluate

UNIT-I IMMUNE SYSTEM: **12 HOURS**

An overview, components of mammalian immune system, Antigens- Essential features of Ag, haptens, Carrier molecule, Immunological valence, Antigenic determinants. Adjuvants: Freund's complete and incomplete. Antibodies - Molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses, T lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells).

UNIT-II REGULATION OF IMMUNOGLOBULIN GENE EXPRESSION: **12 HOURS**

T-cell receptors, genome rearrangements during B- lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination. Clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity.

UNIT-III HYPERSENSITIVITY REACTIONS (HS): **12 HOURS**

Type I: Allergies and anaphylaxis; Type II: Antibody mediated HS reactions; Mechanism and pathogenicity; Type III: Immune complex mediated HS reactions: Mechanism & pathogenicity; Type IV: Delayed type (or) cell-mediated HS reactions; Mechanisms and pathogenicity. Type V: Stimulatory HS reactions. Mechanism and pathogenesis.

UNIT-IV MAJOR HISTOCOMPATIBILITY COMPLEXES: **12 HOURS**

Class I & class II MHC antigens, antigen processing. Immunity to infection – immunity to different organisms, pathogen defense strategies: avoidance, resistance and tolerance. Autoimmune diseases with special reference to Hashimoto's thyroiditis, Multiple sclerosis and Systemic Lupus Erythematosus**,** Immunodeficiency diseases (AIDS).

UNIT-V VACCINES & VACCINATION: **12 HOURS**

Cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization Introduction to immunodiagnostics – RIA, ELISA, Immunoblotting, Immunofluorescence.

TOTAL:60 HOURS

TEXT BOOK:

1. Goldsby, R.A., Kindt, T.J., Osborne, B.A. (2007). *Kuby's Immunology* (6th ed.). New York: W.H. Freeman and Company.
2. Hayat, M. (2017) Immunology, (1st ed) Academic Press, New Jersey, USA.
3. Murphy, K., Travers, P., & Walport, M. (2008). *Janeway's Immunobiology* (7th ed.). New York: Garland Science Publishers.
4. Owen, J., Punt, J. and Stranford, S. (2012) Immunology, Seventh Edition, W.H. Freeman and Company Publishers, New York.
5. Peakman, M., & Vergani, D. (2009). *Basic and Clinical Immunology* (2nd ed.). Edinberg: Churchill Livingstone Publishers.
6. Prescott, L.M., Harley, J.P. and Klein, D.A. (2010) Microbiology, Eight Edition, The McGraw Hill Companies Publishers, New York.
7. Richard, C., & Geiffrey, S. (2009). *Immunology* (6th ed.). Wiley Blackwell Publication.
8. Roitt, I., Brostoff, J. and Male, D. (2012). Essential Immunology, Twelfth Edition, Wiley Blackwell Publishers, New York.
9. William E. Paul (2012) Fundamental Immunology (7th ed), Lippincott Williams and Wilkins.

CO, PO, PSO Mapping

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

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

SEMESTER V

24BTU504A **MICROBIAL BIOTECHNOLOGY** **5H–4C**

Instruction Hours/week: L:5 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

PREREQUISITE: Student should be familiar with microbes and their metabolic pathways.

COURSE OBJECTIVES(CO)

- 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 and waste utilization of sewage

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Critically evaluate the role of microorganisms in specific biotechnological processes.	Evaluate
CO2	Explain the complex processes behind the development of genetically manipulated organisms.	Understand
CO3	Apply the knowledge of microalgae in pharmaceutical industries	Apply
CO4	Recall the technologies of genetics of antimicrobial metabolite production	Remember
CO5	Analyze the utilization of waste material for commercially important compounds	Analyze

UNIT– I INTRODUCTION: **12 HOURS**

History and scope of Microbial biotechnology, General concepts of microbial biotechnology. Classification of microbes using genome mapping**:** DNA and RNA present as genetic material in microbes. Types and division of microbes according to their genetic organization. Classification of microbes according to genotyping. Microscope and its types: Phase contrast microscope, Electron microscope, SEM, TEM; Microscopic examination of microorganisms.

UNIT– II METABOLISM IN MICROBES: **12 HOURS**

Microbial growth kinetics- Microbial growth in response to temperature, pH, solute and water activity, oxygen, pressure and radiation. Enzymes and their regulation, Microbial metabolism energy production, utilization of energy and biosynthesis. Role of ATP in metabolism.

UNIT – III MICROBIAL BIOTECHNOLOGY IPR & ETHICS: **12 HOURS**

Biosafety issues in biotechnology – risk assessment and risk management – safety protocols: risk groups – biosafety levels – biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulations – types of biosafety containment - GM crops and GMO's - benefits and risks – ethical aspects of genetic testing – ethical aspects relating to use of genetic information and bio-warfare. Ethical implications of cloning - Reproductive cloning, therapeutic cloning; Ethical, legal and socioeconomic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research. Biotechnology and biopiracy.

UNIT– IV MICROBIAL BIOCONVERSION **12 HOURS**

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: **12 HOURS**

Waste water treatment, 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: Mineral recovery and removal of heavy metals from aqueous effluents.

TOTAL:60 HOURS

TEXT BOOK:

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 Biotechnology: 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.
5. Michael Pelczar JR, E.C.S. Chan, Noel R. Krieg: Microbiology, Mc Graw Hill, 6th Edition.
6. Foster WM, Food Microbiology, CBS publishers, 2018 Edition

CO, PO, PSO Mapping

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

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

SEMESTER V

24BTU504B **MARINE BIOTECHNOLOGY** **5H–4C**

Instruction Hours/week: L:5 T:1 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

PREREQUISITE: Student should be familiar with marine organisms and their metabolic pathways.

COURSE OBJECTIVES(CO)

- To provide an in-depth knowledge of marine organism and their metabolic pathways and products that can be used in biotechnology.
- To develop marine hydro-colloids from marine organisms for industrial application.
- To provide knowledge about genetic engineering and marine organisms for various applications.

COURSE OUTCOMES(CO's)

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

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

UNIT I BIOTECHNOLOGY IN MARINE SCIENCES: **12 HOURS**

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

UNIT II MARINE HYDROCOLLOIDS **12 HOURS**

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

UNIT III AQUACULTURE BIOTECHNOLOGY **12 HOURS**

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

UNIT IV PRODUCTION OF TRANSGENIC FISHES **12 HOURS**

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

UNIT V PHARMACEUTICALS FROM MARINE REALMS **12 HOURS**

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

TOTAL: 60 HOURS

TEXT BOOK:

1. Aquaculture: Principles and Practices - T.V.R. Pillay -1990
2. Steven M. Colegate and Russel J. Molyneux. 2008. Bioactive Natural Products (II Ed.). CRC Press.
3. Aquaculture: The farming and husbandry of Freshwater & Marine organisms by J.Bardach, Ryther J.Mclarhey.W. 1972.
4. Advances in Fisheries Technology and biotechnology for increased profitability - Ed. Michael N. Voigt, J. Richard Botta. Technomic Publishing Co. Inc.(1990)
5. Biotechnology in the Marine Science- Proceedings of the first Annual MIT Sea Grant Lecture and Seminar - Colwell R.R. 1982.
6. New Developments in Marine Biotechnology Ed. LeGal and H.O.Halvorson Plenum press 1998.

CO, PO, PSO Mapping

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

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

24BTU511 **PLANT AND ANIMAL BIOTECHNOLOGY- PRACTICAL** **4H–2C**

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

End Semester Exam: 3 Hours

PREREQUISITE: Student should be familiar with cell culture techniques.

COURSE OBJECTIVES(CO)

- To provide practical knowledge about the culture the plant and animal cells under *in vitro* condition and for application purposes
- To get proficiency in handling the contamination-free plant and animal tissue culture techniques
- To acquire hands on training in plant and animal tissue culture Techniques

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Relate the principles, technical requirement, scientific and commercial applications in plant and animal biotechnology	Remember
CO2	Demonstrate plant and animal tissue/cell culture experiments	Understand
CO3	Develop basic gene transfer technologies in plants	Apply
CO4	Categorize problems associated with plant and animal tissue culture	Analyze
CO5	Construct strong knowledge in routine practices of plant and animal tissue culture	Create

Practical

Plant Tissue Culture Techniques **24 HOURS**

1. Media preparation and sterilization
2. *In vitro* germination of seeds and micropropagation
3. Callus induction
4. Synthetic seed production
5. Lab visit to Greenhouse unit

Animal Biotechnology **24 HOURS**

1. Preparation and filter-sterilization of animal tissue culture medium
2. Quantification of viable and non-viable cells by trypan blue dye exclusion method
3. Cryopreservation and revival of cell lines
4. Visit the animal house and study animal handling

TOTAL: 48 HOURS

TEXT BOOK:

1. Bhojwani, S.S., & Razdan, (2004). *Plant Tissue Culture and Practice*.
2. Brown, T.A., (2006). *Gene Cloning and DNA Analysis* (5th ed.). Oxford: UK, Blackwell Publishing.
3. Butler, M. (2003). *Animal cell culture and technology: The basics* (2nd ed.). Taylor & Francis Publishers, Abingdon, United Kingdom.
4. Gardner, E.J., Simmonns, M.J., & Snustad, D.P. (2008). (8th ed.). *Principles of Genetics*. India: Wiley.
5. Raven, P.H., Johnson, G.B., Losos, J.B., & Singer, S.R. (2005). *Biology*. Tata MC Graw Hill.
6. Reinert, J., & Bajaj, Y.P.S. (1997). *Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture*. Narosa Publishing House.

CO, PO, PSO Mapping

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

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

SEMESTER V

24BTU512 **IMMUNOLOGY- PRACTICAL** **4H–2C**

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

End Semester Exam: 3 Hours

PREREQUISITE: Student should be familiar with immune systems.

COURSE OBJECTIVES(CO)

- To understand the basic concepts of immunology
- To train the students to use these principles of the immune system to combat infections
- To gain the information about the autoimmune diseases

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Understand the basic concepts of immunology.	Understand
CO2	Identify the cellular and molecular basis of immune responsiveness	Remember
CO3	Demonstrate Hemagglutination assay	Apply
CO4	Distinguish with the various immunological techniques	Analyze
CO5	Evaluate the serum separated from blood sample	Evaluate

Practicals **48 HOURS**

1. Differential leucocytes count
2. Total leucocytes count
3. Total RBC count
4. Haemagglutination assay
5. Haemagglutination inhibition assay
6. Separation of serum fromblood
7. Double immunodiffusion test using specific antibody andantigen
8. ELISA
9. Immuno blotting

TOTAL:48 HOURS

TEXT BOOK:

1. Abbas, A.K., Lichtman, A.H., & Pillai, S. (2011). *Cellular and Molecular Immunology* (7th ed.). Philadelphia: Saunders Publication.
2. Delves, P., Martin, S., Burton, D., & Roitt, I.M. (2017). *Roitt's Essential Immunology* (13th ed.). Wiley-lackwell Scientific Publication, Oxford
3. Goldsby, R.A., Kindt, T.J., Osborne, B.A. (2013). *Kuby's Immunology* (7th ed.). New York: W.H. Freeman and Company.
4. Murphy, K., Travers, P., Walport, M. (2017). *Janeway's Immunobiology* (9th ed.). New York: Garland Science Publishers.
5. Peakman, M. & Vergani, D. (2009). *Basic and Clinical Immunology* (2nd ed.). Edinberg: Churchill Livingstone Publishers.
6. Richard, C., & Geiffrey, S. (2009). *Immunology* (6th ed.). Wiley Blackwell Publication.

CO, PO, PSO Mapping

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

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

SEMESTER V

24BTU591	**INTERNSHIP PROGRAMME**	**2C**

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

SEMESTER V

ACTIVITY: LIBRARY/SEMINAR **2H**

Instruction Hours/week: L:0 T:0 P:2

SEMESTER VI

24BTU601 **BIOPROCESS TECHNOLOGY** **5H–4C**

Instruction Hours/week: L: 5 T:0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

PREREQUISITE: Student should be familiar industrially important microbes.

COURSE OBJECTIVES (CO)

- To learn the procedure for isolation and screening of industrially important microbes
- To derive industrially important products from microbes
- To acquire knowledge on downstream processing

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Gain overall knowledge on industrial application of Microbes.	Remember
CO2	Obtain information about the application of industrially important Microbes.	Understand
CO3	Develop the screening, extraction and purification of enzymes.	Apply
CO4	Take part in designing of bioreactors for large-scale production of desired products.	Analyze
CO5	Choose and optimize media for maximum production of microbial metabolites.	Create

UNIT-I INTRODUCTION TO BIOPROCESS TECHNOLOGY: **12 HOURS**

Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology. Types of microbial culture and its growth kinetics– Batch, Fed batch and Continuous culture. Types of fermentation- submerge and solid state; aerobic and anaerobic fermentation.

UNIT-II DESIGN OF BIOPROCESS VESSELS: **12 HOURS**

Significance of Impeller, Baffles, Sparger; Types of culture production vessels- Airlift; Stirred tank; Cyclone Column; trickled bed; Packed Tower and their application in production processes. Principles of upstream processing – Media preparation, Inoculum development and sterilization.

UNIT-III BIOREACTOR CONTROL AND MONITORING: **12 HOURS**

Types of sensors. pH, temperature, O2, CO2 and pressure control and monitoring. Bioprocess measurement and control system with special reference to computer aided process control.

UNIT-IV DOWNSTREAM PROCESSING: **12 HOURS**

Sedimentation, Filtration, Centrifugation, Cell disruption, Chromatography, liquid- liquid extraction, product recovery, purification, drying, and crystallization. Effluent treatment, sludge process, waste disposal, Bioenergy from waste.

UNIT- V APPLICATION OF BIOPROCESS TECHNOLOGY: **12 HOURS**

Microbial production of ethanol, amylase, lactic acid, citric acid and Single Cell Proteins (algal mediated and fungal mediated). Microbial Health care products, Applications in food industry, pharma industry, agriculture, fuels, chemicals etc, Fermentation economics. IPR and Microbial Process.

TOTAL: 60 HOURS

TEXT BOOK:

1. Casida, LE. (1991). *Industrial Microbiology*. (1st ed.). Wiley Eastern Limited.
2. Crueger, W., & Crueger, A. (2017). *Biotechnology: A textbook of Industrial Microbiology* (3rd ed.). Medtech.
3. Patel, A.H. (1996). *Industrial Microbiology*. (1st ed.). Macmillan India Limited.
4. Patel, A.H. (2011). *Industrial Microbiology*. (2nd ed.). Laxmi Publications
5. Srivastava M. L. (2008). F*ermentation technology*. Narosa Publications.
6. Liu. S, Bioprocess Engineering; kinetics, biosystems, sustainability and reactor design, Elsevier, 2016.
7. Octave Levenspiel, Chemical Reaction Engineering, Wiley, 2016.

CO, PO, PSO Mapping

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

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

SEMESTER VI

24BTU602 ENVIRONMENTAL BIOTECHNOLOGY 5H–4C

Instruction Hours/week: L:5 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

PREREQUISITE: Student should be familiar with environmental important organisms.

COURSE OBJECTIVES(CO)

- To obtain the basic concepts of Bioremediation
- To ascertain the knowledge about Waste management treatment strategies
- To gain knowledge about the biotechnological measures for restoring the environment

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Define the principles & concepts of bioremediation	Remember
CO2	Utilize the knowledge on Waste management treatment strategies	Apply
CO3	Know about the environmental significance for the detection of pollutants	Understand
CO4	Compare the pathways regulating biofertilizers and bioleaching	Analyze
CO5	Know the importance of biofuels and genetically modified organisms	Evaluate

UNIT-I BIOREMEDIATION: 12 HOURS

Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes. Phyto-remediation. Degradation of pesticides and other toxic chemicals by micro-organisms- degradation aromatic and chlorinates hydrocarbons and petroleum products and xenobiotics

UNIT- II WASTE MANAGEMENT: 12 HOURS

Treatment of municipal waste and Industrial effluents. Basic aspects of Solid waste management (an introduction), Aerobic and anaerobic treatments of SWM, Composting, Vermicomposting, Biogas production, Treatment of Hazardous waste, treatment strategies of PCBP, Biomedical wastes, Types of biomedical waste, Hazards caused by Biomedical waste, Treatment strategies of Biomedical waste.

UNIT- III BIO-FERTILIZERS AND BIOLEACHING: 12 HOURS

Bio-fertilizers Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM). Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium), Heavy metal pollution.

UNIT-IV FUELS: 12 HOURS

Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas. Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol

UNIT- V GMO's: 12 HOURS

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. Bioleaching.

TOTAL:60 HOURS

TEXT BOOK:

1. Santra, S.C. (2011). *Environmental Science* (3rd ed.). New Central Book Agency.
2. Pradipta Kumar Mohapatra, (2007). *Environmental Biotechnology*. I.K. International Publishing House.
3. Hans-Joachim Jordening, & Jesef Winter, (Eds.). (2005). *Environmental Biotechnology*: Concepts and Applications. Wiley-VCH.
4. Metcalf, & Eddy, (2003). *Waste Water Engineering: Treatment and Reuse* (4th ed.). Tata McGraw hill.
5. Purohit, S.S. (2003). *Agricultural Biotechnology* (2nd ed.). Updesh Purohit.
6. Alicia, L., Ragout De Spencer, & John Spencer, F.T. (Eds.). (2004).*Environmental Microbiology: Methods and Protocols*. Humana Press.
7. Milton Wainwright, (1999). *Introduction to Environmental Biotechnology*. Springer.
8. Gilbert Masters, (2007). *Principles of Environmental Engineering* (3rd ed.). Prentice Hall.
9. Metcalf, & Eddy. (2002). *Wastewater Engineering* (4th ed.). McGraw-Hill Higher Education.

CO, PO, PSO Mapping

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

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

SEMESTER VI

24BTU603A **GENOMICS AND PROTEOMICS** **4H–3C**

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

End Semester Exam: 3Hours

PREREQUISITE: Student should be familiar with genome and sequencing techniques.

COURSE OBJECTIVES(CO)

- To import the basic and recent developments in the field of genome sequencing, genome mapping, proteomic data analysis
- To develop the knowledge on gene sequencing methods
- To know the structure and interactions of proteins

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Have a clear understanding on the application of genetic markers in genome mapping	Remember
CO2	Application of 2D technique to analyze the structure of protein	Apply
CO3	Analyze the genomic and proteomic data	Analyze
CO4	To acquire knowledge and understanding of fundamentals of genomics and proteomics	Understand
CO5	Discuss how biological systems information relating to genes, proteins and cellular structures can be used to model living cells, and even to create new synthetic cells	Apply

UNIT-I INTRODUCTION TO GENOMICS: **10 HOURS**

Genes, Pseudogenes – Gene structure – Human genome project - Genome sequencing methods –manual and automated strategies - Maxam and Gilbert method; Sangers method; Pyrosequencing. Shotgun and Hierarchical (clone contig) methods – Computer tools for sequencing projects: Next Generation Sequencing (NGS) Genome sequence assembly software. Pharmacogenomics

UNIT-II MANAGING AND DISTRIBUTING GENOME DATA: **10 HOURS**

Web based servers and software for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Organism-specific databases – FlyBase and OMIM; CRISPR cas9 technology.

UNIT-III GENOMIC MAPPING: **8 HOURS**

Genetic markers – RFLP, VNTR, mini and micro satellites, STS, SNPs, ESTs. Genome maps; Mapping techniques; Physical and genetic mapping; FISH and Restriction mappings; Map resources; Practical uses genomemaps.

UNIT-IV INTRODUCTION TO PROTEIN STRUCTURES: **10 HOURS**

Proteins – protein diversity – Protein folds – Primary structures – Edman degradation – Secondary structures and their unique features – Tertiary structures - Physical interactions stabilizing proteins - Short-range interactions, electrostatic forces, van der Waal interactions, hydrogen bonds, Hydrophobic interactions. Structural characterization of proteins - Sedimentation analysis, Gel filtration, Native PAGE and SDS-PAGE.

UNIT-V INTRODUCTION TO PROTEOMICS: **10 HOURS**

Analysis of proteomes - 2D-PAGE - Sample preparation, solubilization, reduction, resolution - Reproducibility of 2D-PAGE. Mass spectrometry-based methods for protein identification - ESI-MS and its applications; *De novo* sequencing using mass spectrometric data. Three dimensional structure database – PDB, CATH and SCOP. Protein Microarray. Cancer and genomic microarray.

TOTAL: 48 HOURS

TEXT BOOK:

1. Bhat S., (2008). Genomics, Bioscience Publishing, NewDelhi,
2. Devarajan Thangadurai, Jeyabalan Sangeetha, (2015). Genomics and Proteomics: Principles, Technologies, and Applications. CRC Press, Tylor& FrancisGroup
3. Glick, B.R., & Patten C. L. (2017). *Molecular Biotechnology- Principles and Applications of recombinant DNA*. (5th ed.). Washington: ASMPress.
4. Lesk A.M., (2014). Introduction to Bioinformatics, (4th ed.). Oxford University Press, UK.
5. Primrose, S.B., &Twyman, R.M. (2013). *Principles of Gene Manipulation and Genomics* (7th ed.). Wiley-Blackwell.
6. Tamarin, R. H. (2017). *Principles of Genetics* (7th ed.). McGraw Hill Education.
7. Timothy P., (2007). Proteomics, SPRINGER.

CO, PO, PSO Mapping

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

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

SEMESTER VI

24BTU603B **BIOINFORMATICS** **4H–3C**

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

End Semester Exam: 3Hours

PREREQUISITE: Student should be familiar with genome and biological databases

COURSE OBJECTIVES(CO)

- To give knowledge on bioinformatics and its application
- To offer knowledge on biological databases
- To understand and analyze the protein/nucleotide sequences and to predict its 3D structure

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Define the relationship between sequence - structure - function of genes	Remember
CO2	Demonstrate the algorithms required to compare sequences and require to know the phylogenetic relationship between the gene sequences	Understand
CO3	To adapt knowledge on building 3D structures of genes	Create
CO4	Construct and use the main databases at the NCBI and EBI resources	Apply
CO5	Compare the difference between databases, tools, repositories and be able to use each one to extract specific information	Evaluate

UNIT-I INTRODUCTION AND ROLE OF BIOINFORMATICS: 10 HOURS

Introduction to Bioinformatics – History, scope and Milestones. Bioinformatics in molecular biology: Data Generation-Generation of large scale molecular biology data (Genome sequencing and protein sequencing). Genome sequencing project and its application.

UNIT-II BIOLOGICAL DATABASES: 10 HOURS

Sequence databases, Nucleic acid sequence databases – Primary (GenBank, EMBL, DDBJ), Secondary (UniGene, SGD, EMI Genomes, Genome Biology), Protein sequence database – Primary (PIR, SWISS-PROT), Secondary (PROSITE, Pfam), Structural databases (PDB, PDBSUM, SCOP, CATH), Generic model organism database (ANISEED), Genome online database (GOLD), Bibliographic databases – PubMed, PloS, SCOPUS and WOS.

UNIT-III SEQUENCE ALIGNMENT AND PHYLOGENY ANALYSIS: 8 HOURS

Outline of sequence Assembly – Mutation/Substitution Matrices – Pairwise Alignments. Introduction to BLAST and FASTA, Multiple Sequence Alignment, Phylogenetic Analysis.

UNIT-IV GENOME ANALYSIS: 10 HOURS

Genome annotation; Genome annotation tools; DEG, Gene Ontology, Detecting open reading frames – primer designing and property predictions – 2D PAGE data analysis – Microarray data analysis – SAGE.

UNIT-V *IN-SILICO* STRUCTURE PREDICTION AND ANALYSIS TOOLS: 10 HOURS

Predicting protein tertiary structure – Homology modelling, fold recognition and Ab-initio methods. Merits and limitations – Molecular visualization tools. Structural analysis – ERRAT, VERIFY 3D, Molecular docking and Cheminformatics.

TOTAL:48 HOURS

TEXT BOOK:

1. Shaik, N.A., Hakeem, K.R., Banaganapalli, B. and Elango, R. eds., 2019. *Essentials of Bioinformatics, Volume II: In Silico Life Sciences: Medicine*. Springer Nature.
2. Shanker, A. ed., 2018. *Bioinformatics: Sequences, Structures, Phylogeny*. Springer Ghosh, Z. & Bibekanand M. (2008). *Bioinformatics: Principles and Applications*. Oxford UniversityPress.
3. Pevsner, J. (2009). *Bioinformatics and Functional Genomics* (2nd ed.).Wiley-Blackwell.
4. Campbell, A.M., & Heyer, L.J. (2006). *Discovering Genomics, Proteomics and Bioinformatics* (2nd ed.). Benjamin Cummings.
5. Syed Ibrahim.K., GuruSubramanian, G., Zothansarga, yadav, R.P., Senthil Kumar N., Pandian, S.K., Borah., P., Mohan S., 2017. Bioinformatics- A student's companion.

CO, PO, PSO Mapping

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

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

SEMESTER VI

24BTU611 BIOPROCESS TECHNOLOGY, ENVIRONMENTAL BIOTECHNOLOGY – PRACTICAL 4H–2C

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

End Semester Exam: 3Hours

PREREQUISITE: Student should be familiar with industrial important microbes.

COURSE OBJECTIVES(CO)

- To learn the procedure for isolation, screening of industrial important microbes
- To obtain practical knowledge to solve the environmental problems
- To ascertain the knowledge about wastewater treatment

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Define environmental problems	Remember
CO2	Illustrate waste water treatment through biotechnological methods	Understand
CO3	Estimate the Biological Oxygen Demand	Create
CO4	Measure Chemical Oxygen Demand	Evaluate
CO5	Produce biofertilizers from waste products	Apply

PRACTICALS

BIOPROCESS TECHNOLOGY **24 HOURS**

1. Isolation and screening of industrially important microorganism from natural resources
2. Bacterial growth curve
3. Production and analysis of ethanol
4. Production and analysis of amylase
5. Production and analysis of lactic acid

ENVIRONMENTAL BIOTECHNOLOGY **24 HOURS**

1. Estimation of total dissolved solids (TDS)/ TSS of water sample
2. Estimation of BOD of water sample
3. Estimation of COD of water sample
4. Examination of bacterial load in water sample by MPN method

TOTAL:48 HOURS

TEXT BOOK:

1. Ghosh, S.K., & Singh, R. (2003). *Social forestry and forest management.* Global Vision Publishing House
2. Joseph, B. (2005). *Environmental studies.* Tata Mc Graw Hill.
3. Michael Allabay, (2000). *Basics of environmental science* (2nd ed.). Routledge Press.
4. Mohapatra, P.K., (2007). *Textbook of environmental biotechnology.* IK publication. Rana, S.V.S., (2013). *Environmental pollution –health*

CO, PO, PSO Mapping

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

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

SEMESTER VI

24BTU612A **GENOMICS AND PROTEOMICS - PRACTICAL** **3H–1C**

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

End Semester Exam: 3Hours

PREREQUISITE: Student should be familiar with computer internet and gene analysis tools.

COURSE OBJECTIVES(CO)

- To practically import the basic and recent developments in the field of genome sequencing, genome mapping, proteomic data analysis
- To develop the steps to retrieve knowledge on gene sequencing methods
- To view the structure in 3D form and understand the functional group interactions of proteins

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Have a clear understanding on the application of genetic markers in genome mapping	Remember
CO2	Application of 2D technique to analyze the structure of protein	Apply
CO3	Analyze the genomic and proteomic data	Analyze
CO4	To acquire knowledge and understanding of fundamentals of genomics and proteomics	Understand
CO5	Discuss how biological systems information relating to genes, proteins and cellular structures can be used to model living cells, and even to create new synthetic cells	Apply

Practicals **36 HOURS**

1. Use of NCBI and UniProt databases.
2. Use of OMIM database.
3. Detection of Open Reading Frames using ORF Finder.
4. Proteomics 2D PAGE database.
5. Software for Protein localization.
6. Predicting Secondary structures of proteins.
7. Hydropathy plots of proteins.
8. Three-dimensional protein structure prediction and visualization tools.

TOTAL: 36 HOURS

TEXT BOOK:

1. Charles Markoff, (2016). Functional Genomics and Proteomics.
2. Devarajan Thangadurai, Jeyabalan Sangeetha, (2015). Genomics and Proteomics: Principles, Technologies, and Applications. CRC Press, Tylor& FrancisGroup
3. Glick, B.R., & Patten C. L. (2017). *Molecular Biotechnology- Principles and Applications of recombinant DNA.* (5th ed.). Washington: ASMPress.
4. Pevsner, J. (2009). *Bioinformatics and Functional Genomics* (2nd ed.) John Wiley & Sons.

CO, PO, PSO Mapping

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

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

SEMESTER VI

24BTU612B **BIOINFORMATICS- PRACTICAL** **3H–1C**

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

PREREQUISITE: Student should be familiar with computer internet and bioinformatics tools.

COURSE OBJECTIVES(CO)

- To get practical knowledge on Bioinformatics and its application
- To retrieve the knowledge by assessing biological databases
- To understand and to analyze protein/nucleotide sequences and to predict its 3D structure

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Recall the relationship between sequence - structure - function of genes	Remember
CO2	Construct the nucleotide sequences in GenBank	Analyze
CO3	Perform genome annotation	Understand
CO4	Compare the nucleotide sequences and perform the phylogenetic analysis	Evaluate
CO5	Get hands on experience in homology modelling	Apply

Practicals **36 HOURS**

1. Sequence information resource
2. Understanding and use of various web resources: EMBL, Genbank, Entrez,Unigene, Protein information resource (PIR)
3. Understanding and using: PDB, Swissprot, TREMBL
4. Using various BLAST and interpretation of results
5. Retrieval of information from nucleotide databases
6. Sequence alignment using BLAST
7. Multiple sequence alignment using Clustal W
8. Homology Modelling
9. Molecular Docking Studies
10. Genome Annotation tools

TOTAL: 36 HOURS

TEXT BOOK:

1. Campbell, A. M., & Heyer, L.J. (2006). *Discovering Genomics, Proteomics and Bioinformatics* (2nd ed.). Benjamin Cummings.
2. Ghosh, Z., & Bibekanand M. (2008). *Bioinformatics: Principles and Applications*. Oxford University Press.
3. Mohammed, I., & Mohammed R.G. (2015). *Bioinformatics Practical Manual*. ACM, Digital Library, Create Space Independent Publishing Platform. USA.
4. Pevsner, J. (2009). *Bioinformatics and Functional Genomics* (2nd ed.).Wiley-Blackwell.

CO, PO, PSO Mapping

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

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

SEMESTER VI

24BTU691	**MINOR PROJECT**	**9H–6C**

Instruction Hours/week: L:0 T:0 P:9 **Marks:** Internal: 80 External: 120 Total: **200**

24EAU601 **NATIONAL SERVICE SCHEME** **0H-2C**

Instruction Hours/week: L:0 T:0 P:0 **Marks:** Internal**:100** External**:00 T**otal**:100**
End Semester Exam:3 Hours

I YEAR

Orientation – NSS origin – motto – symbol – NSS administration at different levels – programme planning – Rural Projects – Urban projects – Government schemes – Career guidance – Self help groups – Environment protection – Use of natural energy – Conventional energy resources – Soil and Water conservation – Community health programmes – Women and child welfare – Education for all.

II YEAR

Popularization of agro techniques – Self employment opportunities – Animal health, Dairy and Poultry farming – Road safety – Training on First aid and emergency cell. Popularization of small savings – communal harmony and National integration – Care of Senior citizens – Personality development – meditation, Yoga Art of living – Activities on the preservation of National monuments, cultural heritage and folklore – special camp activities

PRACTICAL SCHEDULE

Semester-I

1. Orientation of NSS volunteers and programme coordinator and Programme officers.
2. Origin of NSS in India and its development
3. NSS motto, symbol and NSS awards
4. Organizational set up of NSS at Central, State University and college levels.
5. Programme planning – Theme of the year – planning implementation at PC, PO and NSS volunteer level.
6. Visit to selected village - gathering basic data on socio economic status.
7. Participatory rural appraisal – studying the needs of the target group.
8. Visit of urban slum and gathering data on socio economic status.
9. Self involvement and methods of creating rapport with the target group.
10. Awareness campaign on welfare schemes of the central and state government.
11. Formation career guidance group with NSS volunteers and students welfare unit
12. Cycle rally on environmental protection.

13. Campus development activities – clean environment campaign, formation of plastic free zones.
14. Campus development,
15. Tree planting maintenance and greening
16. Campus cleaning.
17. FINAL EXAMINATION.

Semester - II

1. Motivation of rural and urban youth for formation of SHG (Self Help Groups) in collaboration with Government machineries and NGOs.
2. Campaign on ill effects of plastics in the adjoining campus areas – Villages / urban areas.
3. Campaign on *Parthenium* eradication.
4. Cycle rally on air pollution – Vehicle exhaust and other means.
5. Popularization of biogas and smokeless chulah.
6. Demonstration on the use of wind energy and solar energy.
7. Demonstration of water harvesting techniques.
8. Demonstration on soil conservation techniques wherever possible.
9. Campaign on Community health programmes of central and state Government – involving Health department officials.
10. AIDS awareness campaign ; campaign on diabetes and healthy food habits and drug abuse
11. Planing formation of blood donors club – involving NGOs.
12. Campaign on gender equality and women empowerment.
13. Campaign on child health care – immunization, food habits and child labour abolition.

III Semester

1. Conducting field days with KVK to popularize improved agro techniques.
2. Conducing seminar / workshop in a nearby village to motivate the youth on agribusiness (involving DEE, KVK, NGO and local agripreneurs).

3–5 Campaign on self employment opportunities like Apiculture, mushroom cultivation, Food processing and value addition, production of biocontrol agents and biofertilizers, nursery techniques, seed production, tissue culture, vermicompost, manufacture of small gadgets and agricultural implements as per local needs and feasibility.

6. Animal health care campaign – Dairy and poultry farming - Forage production techniques and silage making.
7. Training the NSS volunteers on road safety measures in involving traffic wardens and RTO.
8. Training NSS volunteers on First AID and emergency call involving NGOs and organizations like St. John's Ambulance, Red Cross, etc.,

9. Organizing Road safety rally.
10. Motivating NSS Volunteers on small savings concept and conveying the message to the public through them.
12. Observation of National integration and communal harmony. 14 – 16 : Campus development and greening activities
4. Examination.

Semester-IV

1 – 3 : Visit to orphanages and old age homes to look after their needs.
4. Personality development programmes – Building up self confidence in youth.
5 – 7 : Teaching NSS volunteers on mediation Yoga and art of healthy living with trained teachers
8 – 9 : Visit of nearby National Monument / Places of tourist importance and campaign on cleanliness and preservation.
10–11 : Exploration of hidden talents of village youth and public on folklore, traditional art, sports, martial arts and cultural heritage.
12–13. Campus improvement activities
14–16 : Visit to special camp village and pre camp planning.
5. Examination

- Besides the above NSS volunteers will attend work during important occasions like Convocation, Farmers day, Sports meet and other University / College functions. NSS Volunteers will attend one special camp in the selected village for a duration of 10 days and undertake various activities based on the need of that village people.
- For all out door regular activities villages / slums nearby the campus may be selected to avoid transport cost (Cyclable distance)
- Special camp activity may be carried out in a village situated within a radius of 15 – 20 KM.

EVALUATION

A. Regular activities	Marks(60)
I Semester	15
II Semester	15
III Semester	15
IV Semester	15

* (Written test 10 marks and attendance 5 marks) 80% attendance compulsory

B. Special camping activities	Marks(40)
a. Attendance in daily activities(marks During special camp)	30
b. Special camp activity report	5
Viva - voce on the 7th day(special camp)	5

SEMESTER VII

24BTU701 **PHARMACEUTICAL BIOTECHNOLOGY** **6H–4C**

Instruction Hours/week: L:6 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3Hours

PREREQUISITE: Students should have basic knowledge about medicines and diseases

COURSE OBJECTIVES(CO)

- 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 physical and chemical properties of drugs with drug safety and effectiveness

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Define different pharmaceutical parameters of current biotechnology products	Remember
CO2	Compare the parameters related to stability and formulation of biotechnology- derived drugs	Understand
CO3	Deliberate quality control procedures related to biotechnology products	Analyze
CO4	Apply the knowledge of physicochemical properties of drugs in novel drug designing	Apply
CO5	Develop novel formulation methods for better delivery of biotechnology derived drugs	Create

Unit 1 – INTRODUCTION **15 HOURS**

Introduction, History of pharmaceuticals, origin of Medicines – Medicines of Ancient civilization, Isolation and synthesis of compounds, Development of Anti-Infective agents- Discovery of antiseptics and vaccines, Improvement in drug administration, new classes of pharmaceuticals, Transitions in drug discovery -Discovery of penicillin, Isolation of insulin, Identification of vitamins, Emergence of modern diseases and treatment, pharmaceutical industry in the modern era.

Unit II: DRUG DISCOVERY AND DEVELOPMENT: **15 HOURS**

Introduction, Stages in the drug discovery process, Therapeutic agents,
Recombinant proteins – Interferons, recombinant interferons, Manufacturing steps for interferon, Monoclonal antibody, Clinical applications. Routes of Drug administration.

Unit III: DRUG ABSORPTION, DISTRIBUTION AND ELIMINATION PHARMACOKINETICS: **15 HOURS**

Drug absorption- Biologic factors, Drug Distribution – Compartments- Protein Binding. Drug biotransformation. Drug Elimination. Pharmacokinetics – Order of Kinetics – Drug safety and Effectiveness- Drug Interactions.

Unit IV: FORMULATIONS AND ACTIVE PHARMACEUTICAL INGREDIENTS: **15 HOURS**

Formulation of Biotechnological Products, Herbal formulation, Drug Encapsulation, Drug Delivery, Examples of some Biotechnological products in clinical development. Active pharmaceutical ingredients.

Unit V: REGULATIONS: **12 HOURS**

Role of FDA, ICH Guidelines, The Regulation of Pharmaceutical Biotechnological Products and Ethical Issues. Case studies – Different drug formulation, FDA approved drugs for various disease management.

TOTAL: 72 HOURS

TEXT BOOK:

1. Abraham, D.J. & Rotella, D.P. (2010). Burger's Medicinal Chemistry, Drug Discovery and Development (7th ed.). Wiley Publishers, New York, United States.
2. Banga, A.K. (2015). Therapeutic Peptides and Proteins: Formulation, Processing, and Delivery Systems (3rd ed.). CRC Press, Florida, United States.
3. Bhagavan, N.V. & Ha, C-E. (2015). Essential of Medical Biochemistry (2nd ed.). Academic Press Publishers, New York, United States. Crommelin, D.J.A., Sindelar, R. D. & Meibohm, B. (2019).
4. Pharmaceutical Biotechnology: Fundamentals and Applications (5th ed.). Springer Publishers, New York, United States. Golan, D.E., Armstrong, E.J., & Armstrong, A.W. (2016).

REFERENCE BOOK:

1. Principles of Pharmacology: The Pathophysiologic Basis of Drug Therapy (4th ed.). LWW Publishers, Pennsylvania, United States.
2. Rho, J.P. & Louie, S.G. (2003). Hand book of Pharmaceutical Biotechnology (1st ed.). CRC Press, Florida, United States.
3. Satoskar, R. S., Rage, N.N., Tripathi, R.K., & Bhandarkar, S. D. (2017). Pharmacology and Pharmacotherapeutics (25th ed.). Elsevier India Publishers, Chennai, India. 8. Sethi, P.D. (2008).
4. Quantitative Analysis of Drugs in Pharmaceutical Formulations (3rd ed.). CBS Publishers and Distributers, New Delhi, India.

CO, PO, PSO Mapping

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

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

SEMESTER VII

24BTU702 **NANO BIOTECHNOLOGY** **6H–4C**

Instruction Hours/week: L:6 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3Hours

PREREQUISITE: Students should have basic knowledge about nanomaterials and its applications

COURSE OBJECTIVES(CO)

- 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

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Define the role of bio nanotechnology as an interdisciplinary tool and to understand how to use these new tools in solving biological problems	Remember
CO2	Distinguish the interactions and relationship between molecular dynamics, nanoscale physics and macroscopic system behavior	Analyze
CO3	Explain basic principles of characterization tools in nanobiotechnology	Understand
CO4	Develop nanocarriers for crop improvement	Evaluate
CO5	Implement eco-friendly nanoparticles in wastewater treatment	Apply

Unit I: INTRODUCTION TO NANOTECHNOLOGY: **15 HOURS**

History and Scope of Nanotechnology. Applications of Nanotechnology. Various types of nanostructured materials. Approaches of nanoparticles synthesis- Top down and bottom up approach. Synthesis of metal/metal oxide nanoparticles –physical, chemical and biological sources. Nanocomposite, Polymers, Carbon Nanotubes, Quantum Dots

Unit II: CHARACTERIZATION OF NANOSTRUCTURE MATERIALS: **15 HOURS**

UV-Visible Spectroscopy; Fourier Transform Infra-Red Spectroscopy (FTIR); Transmission Electron Microscopy (TEM); Scanning Electron Microscopy (SEM); Dynamic Light Scattering (DLS); Zeta Potential; X-ray Diffraction

Unit III: BIOMEDICAL APPLICATIONS OF NANOTECHNOLOGY: **15 HOURS**

Drug Delivery; Antimicrobial activity; Anticancer activity; Liposomes; Niosomes; Chemotherapeutic agent; Photothermal therapy; Diagnosing agent; Wound Healing and Nanozyme. Nanotechnology in Defense.

Unit IV: ENVIRONMENTAL APPLICATIONS OF NANOTECHNOLOGY: **15 HOURS**

Nanofertilzier, Nanopesticides, Nanoinsecticides, Plant Growth Promoter; Impact of nanoparticles on shoot germination and growth; Disease resistance; Plant yield and Quality. Nano based adsorption for waste water treatment.

Unit V: NANOTECHNOLOGY IN FOOD PROCESSING AND TECHNOLOGY: **12 HOURS**

Post harvest technology - Food Packaging; Food Quality and Traits; Development of nano kit for insect repellents.
Case studies: Nano technology in industrial sectors.

TOTAL: 72 HOURS

TEXT BOOK:

1. Claudio Nicolini, Nanobiotechnology & Nanobiosciences Pan Stanford Publishing Pte. Ltd, 2009.
2. C.M. Niemeyer and C.A. Mirkin, Nanobiotechnology, Concepts, Applications and perspectives, WILEY VCH, Verlag Gmb H&Co, 2004.
3. S. David Goodsell, Bionanotechnology, Lessons from Nature, Wiley-Liss, Inc, 2004.
4. Melgardt M.deVilliers, Pornanong Aramwit, Glen S.Kwon, Nanotechnology in Drug Delivery, Springer- American Association of Pharmaceutical Scientists Press 2009.
5. Robert A. Freitas Jr. Nanomedicine, Volume I:Basic Capabilities, Landes Bioscience,1999.

CO, PO, PSO Mapping

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

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

SEMESTER VII

24BTU703A **PLANT PHYSIOLOGY** **6H–4C**

Instruction Hours/week: L:6 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3Hours

PREREQUISITE: Students should have basic knowledge about plants

COURSE OBJECTIVES(CO)

- To understand the physiological conditions of the plants and metabolism
- To understand the basic concepts of Photosystems and their importance in plant growth
- To acquire adequate knowledge on plant development, biochemistry, and their metabolism

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Find adequate knowledge on plant physiology and its importance	Remember
CO2	Understand the molecular mechanisms of macro and micro nutrients in plant growth	Understand
CO3	Experiment with the basic and applied knowledge of plant growth, development and metabolism	Apply
CO4	Estimate the plant water relations	Evaluate
CO5	Compare the mechanism of various metabolic processes in plants	Analyze

UNIT I PLANT-WATER RELATIONS: **15 HOURS**

Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation. Mineral nutrition: Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.

UNIT II TRANSLOCATION IN PHLOEM: **15 HOURS**

Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading Photosynthesis: Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration.

UNIT III RESPIRATION: **15 HOURS**

Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway. Nitrogen metabolism: Biological nitrogen fixation; Nitrate and ammonia assimilation.

UNIT –IV: MINERAL NUTRITION, ENZYMES **12 HOURS.**

Essential macro and micro mineral nutrients and their role in plants; symptoms of mineral deficiency. Absorption of mineral ions; passive and active processes. Characteristics, nomenclature and classification of Enzymes. Mechanism of enzyme action, enzyme kinetics.

UNITV PLANT GROWTH - DEVELOPMENT AND STRESS PHYSIOLOGY **15 HOURS.**

Growth and Development: Definition, phases and kinetics of growth. Physiological effects of Plant Growth Regulators (PGRs) - auxins, gibberellins, cytokinins, ABA, ethylene and brassinosteroids. Physiology of flowering: Photoperiodism, role of phytochrome in flowering. Seed germination and senescence; physiological changes.

TOTAL: 72 HOURS

TEXT BOOK:

1. Esau, K. (2009) *Anatomy of Seed Plants.* 3rd edition. Wiley Publishers.
2. Hopkins,W.G., & Huner, P.A. (2008). *Introduction to Plant Physiology*. John Wiley & Sons.
3. Taiz, L., & Zeiger, E. (2010). *Plant Physiology* (5th ed.). MA: USA, Sinauer Associates Inc.
4. Srivastava, H.S. and Shankar, N. (2008) Plant physiology and Biochemistry, First Edition, Rastogi Publications, Meerut.
5. Pandey, S.N. and Sinha, B.K.(2008) Plant Physiology, Fourth Edition, VIKAS publishing House Pvt Ltd, New Delhi.
6. Pandey B P (2014), *College Botany Volume 20,* S. Chand Publishing, New Delhi.

CO, PO, PSO Mapping

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

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

SEMESTER VII

24BTU703B **ANIMAL PHYSIOLOGY** **6H–4C**

Instruction Hours/week: L: 6 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3Hours

PREREQUISITE: Students should have basic knowledge about animals

COURSE OBJECTIVES(CO)

- To provide the students with an in-depth knowledge of the diversity in form, structure and habits of invertebrates and vertebrates
- To learn the basics of systematics and understand the hierarchy of different categories
- To learn the diagnostic characters of different phyla through brief studies of examples

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Label the origin and classification of animal kingdom	Remember
CO2	Build the origin of animals and how they differ from other living organisms	Create
CO3	Explain the relationship between animal diversity and evolutionary derived changes in animal body	Understand
CO4	Analyze the various modes of adaptations in animals	Analyze
CO5	Identify and classify with examples the invertebrates	Apply

UNIT- I INTRODUCTION TO ANIMAL KINGDOM: **15 HOURS**

Outline of classification of Non-Chordates up to subclasses. Coelomata, Acoelomata, Symmetries, Deutrostomes, Protostomes. International commission of zoological nomenclature. Protozoa: Locomotion, Reproduction, evolution of Sex, General features of *Paramecium* and *Plasmodium*. Pathogenic protozoans. General Characters and classification of Porifera, Coelenterata, Platyhelminthes and Reptilian.

UNIT II DIGESTION AND RESPIRATION: **15 HOURS**

Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice Respiration: Exchange of gases, Transport of O_2 and CO_2, Oxygen dissociation curve, Chloride shift.

UNIT III CIRCULATION AND EXCRETION: **15 HOURS**

Composition of blood, Plasma proteins & their role, blood cells, Hemopoiesis, Mechanism of coagulation of blood. Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat. Modes of excretion, Ornithine cycle, Mechanism of urine formation.

UNIT IV MUSCLE AND NERVOUS SYSTEM: **15 HOURS**

Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, mechanism of muscle contraction. Basic structure of neuron, mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters.

UNIT V ENDOCRINE COORDINATION: **12 HOURS**

Mechanism of action of hormones (insulin and steroids), Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.

TOTAL: 72 HOURS

TEXT BOOK:

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer (2002). *The Invertebrates: A New Synthesis* (3rd ed.). Blackwell Science.
2. Barrington, E.J.W. (1979). *Invertebrate Structure and Functions* (2nd ed.). E.L.B.S. and Nelson.
3. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
4. Kardong, K.V. (2005) Vertebrates Comparative Anatomy, Function and evolution. IV Edition. McGraw-Hill Higher Education.
5. Kent, G.C., & Carr, R.K. (2000). *Comparative Anatomy of the Vertebrates* (9th ed.). The McGraw- Hill Companies.
6. Myers, P., Espinosa, R., Parr, C. S., Jones, T., Hammond, G. S., & Dewey, T. A. (2006). The Animal Diversity Web. 12, 2.
7. Ruppert, Edward, E., Fox Richard, S. & Barnes Robert, D. (2009). *Invertebrate Zoology: A Functional Evolutionary Approach* (7th ed.). Thomson Brooks/Cole.
8. Young, J.Z. (2004). The life of vertebrates. III Edition. Oxford university press.

CO, PO, PSO Mapping

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

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

SEMESTER VII

24BTU704A **MOLECULAR DIAGNOSTICS** **6H–4C**

Instruction Hours/week: L:6T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3Hours

PREREQUISITE: Students should have basic knowledge about diseases and its diagnostic tools

COURSE OBJECTIVES(CO)

- To obtain basic concepts of molecules and its effect on human and other animals
- To determine the diagnostics tools for infectious diseases
- To recognize the importance of proper specimen collection and preparation for molecular detection

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Get hold of the knowledge on fundamentals of molecular diagnostic techniques	Remember
CO2	Summarize the concepts of infection, diagnosis and control assortment	Understand
CO3	Develop knowledge on the qualitative studies based on biomarker observations	Apply
CO4	Analyze the methodologies of laboratory diagnostics to relevant states of health	Analyze
CO5	Estimate the characteristics signs of clinical manifestations	Evaluate

UNIT-I INTRODUCTION AND HISTORY OF DIAGNOSTICS: **15 HOURS**

History of diagnostics, Age of molecular diagnostics, Significance, Scope, Rise of diagnostic industry in Indian and global scenario.

UNIT-II MOLECULAR METHODS IN CLINICAL MICROBIOLOGY: **15 HOURS**

Digital Droplet PCR – Next-Gen Sequencing, MALDI- TOF, Flow Cytometry, Medical Cytogenetics. Laser 22 Capture Microdissection (FFPE). Applications of Molecular Diagnostics for Genetic Diseases, Identification of Fetuses at Risk for Immune Cytopenic Disorders. Genetic Counselling Considerations in Molecular Diagnosis, Ethical, Social, and Legal Issues Related to Molecular Genetic Testing.

UNIT-III ENZYME IMMUNOASSAYS (EIA): **15 HOURS**

Introduction, concept of EIA, enzymes used in EIA. Solid phases used in EIA. Homogeneous and heterogeneous EIA. ELISA, FISH and Immunoblotting. Polyclonal or Monoclonal antibodies in EIA. Enzyme immunohistochemistry, cytochemistry, and its applications. IA in microbial diagnosis, merits, and demerits, Radioimmunoassay (RIA) and direct and indirect Fluoro-immunoassays (FIA).

UNIT-IV BIOMARKERS IN DISEASE DIAGNOSTICS: **15 HOURS**

FDA definition of disease biomarkers, Role of markers in Disease diagnosis. Approaches and methods in the identification of disease markers, predictive value, diagnostic value, emerging blood markers for sepsis, tumour and cancer markers, markers in inflammation and cytoskeletal disorders diagnosis. Flow cytometry.

UNIT-V DIAGNOSIS AND STANDARDIZATION: **12 HOURS**

Automation in microbial diagnosis, Rapid diagnostic approach, Purification and standardization of antigen and specific antibodies. Diagnostic immunology: agglutination reactions, precipitation reactions, complement fixation test (CFT), direct and indirect hemagglutination (HA and IHA), hemagglutination inhibition (HAI), Concepts and methods: idiotypes, anti-idiotypes, molecular mimicry and receptors.

TOTAL: 72 HOURS

TEXT BOOK:

1. Chang-Hui Shen (2019), Diagnostic Molecular Biology, Academic Press.
2. Claudio Carini, Mark Fidock, Alain van Gool (2019), Handbook of Biomarkers and Precision Medicine, CRC Press.
3. Aura Anfossi (2018), Rapid Test: Advances in Design, Format and Diagnostic Applications, BoD – Books on Demand.
4. Michael Ford (2019), Medical Microbiology: Fundamentals of Biomedical Science, Oxford University Press, 3rd edition.
5. Vishal S. Vaidya, Joseph V. Bonventre (2010), Biomarkers: In Medicine, Drug Discovery, and Environmental Health, John Wiley & Sons.

CO, PO, PSO Mapping

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

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

SEMESTER VII

24BTU704B **MEDICAL DEVICES** **6H–4C**

Instruction Hours/week: L:6 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3Hours

PREREQUISITE: Students should have basic knowledge about diseases and its diagnostic tools

COURSE OBJECTIVES(CO)

- Examine the broad scope of the medical devices and its quality assurance practices.
- Explain the basics of medical devices and process of development.
- Demonstrate the regulatory requirements for approval of medical devices.

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	List the fundamental concepts of electromagnetic radiation and acoustic waves for medical imaging.	Remember
CO2	Determine the critical parameters of electromagnetic radiation and acoustic waves for safe practice for diagnostic imaging	Evaluate
CO3	Identify the principal factors to modulate the generation of X-rays and design parameters of X-ray systems for different clinical applications.	Apply
CO4	Analyze the advanced X-ray modalities for imaging of static and dynamic anatomical structures of human.	Analyze
CO5	Compare the materials and design parameters for the production of Ultrasound waves for clinical applications	Understand

Unit I: BIOSENSORS: **15 HOURS**

Introduction: Principles, Characteristics of Ideal Biosensors, Basic measuring procedure, Components of biosensors, Advantages & Limitations. Opportunities and challenges of integrating sensors in a system platform.

Unit II: TRANSDUCERS: **15 HOURS**

Principles and applications of Calorimetric, Piezoelectric, semiconductor, and impedimetric based transducers; Biochemical Transducers: Electrode theory: electrode-tissue interface, metal-electrolyte interface, electrode-skin interface, electrode impedance, electrical conductivity of electrode jellies and creams.

Unit III: OPTICAL SENSORS: **15 HOURS**

Photo detectors, optical fiber sensors, indicator-mediated transducers; General principles of optical sensing, optical fiber temperature sensors; Pulse sensor: photoelectric pulse transducer, strain gauge pulse transducer.

Unit IV: BIO RECOGNITION SYSTEMS: **15 HOURS**

Enzymes; Oligonucleotides Nucleic Acids; Lipids (Langmuir-Blodgett bilayers, Phospholipids, Liposomes); Membrane receptors and transporters; Immunoreceptors; Chemoreceptors.

Unit V: FUNDAMENTALS AND APPLICATIONS: **12 HOURS**

Biosensors in clinical chemistry, Medicine and health care, Biosensors for veterinary, Agriculture and food, Low-cost biosensor for industrial processes for online monitoring, Biosensors for environmental monitoring.

TOTAL: 72 HOURS

TEXT BOOK:

1. Biosensors: Fundamentals and applications, Oxford, U.K: Oxford University Press by Turner, A.P.F., Karube, I. & Wilson, GS.
2. Bilitewski, U. Turner, A.P.F. 2000 Biosensors for environmental monitoring Harwood, Amsterdam.
3. Rogers, K.R. and Mascini, M. 2001. Biosensors for analytical monitoring EPA biosensors group.
4. Aboul – Enein, H. V., Stefan, R. and Van Staden, (1999) Chemiluminiscence- based biosensors – An overview crit Rev. Anal. Chem. 29, 323-331.
5. Pearson, J.E. Gill, A., and Vadgama, P. (2000) Analytical aspects of biosensors, Ann Clin Biochem 37, 119-145.
6. Biosensors: Fundamentals and applications, Oxford, U.K: Oxford University Press by Turner, A.P.F., Karube, I. & Wilson, GS.

CO, PO, PSO Mapping

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

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

SEMESTER VII

24BTU711 PHARMACEUTICAL, NANO BIOTECHNOLOGY- PRACTICAL 4H–2C

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

End Semester Exam: 3Hours

PREREQUISITE: Students should have basic knowledge about diseases, medicines and nanomaterials

COURSE OBJECTIVES(CO)

- To identify appropriate sources of drugs/medical information
- To understand and analyze novel techniques of production, purification and characterization of enzymes and pharmaceuticals.
- To provide basic concepts of synthesis and characterization of nanomaterials and its drug safety effectiveness

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Find basic and applied research in the field of biomedicine.	Remember
CO2	Outline novel techniques in drug discovery and the role of biotechnology in pharmaceutics.	Understand
CO3	Apply theoretical bases and practical applications of core pharmaceutical biotechnology subjects in concerned industries and organizations.	Apply
CO4	Discuss quality control procedures related to biotechnology products	Create
CO5	Analyze the basic principles and characterization tools in nanobiotechnology	Apply

LIST OF EXPERIMENTS:

Pharmaceutical Biotechnology Experiments **24 hours**

1. Antibiotic production from biological sources.
2. To perform antibiotic assay.
3. Determination of lethal concentration and Lethal dosage
4. Toxicity testing.
5. Drug formulation and encapsulation.

Nano Biotechnology Experiments **24 hours**

1. Synthesis of metal nanoparticles using plant extracts and characterization.
2. Synthesis and characterization of lipid-based nanoparticles for drug delivery.
3. Determination of antimicrobial properties of silver nanoparticles.
4. Functionalization of nanoparticles with proteins.
5. Characterization of nanoparticles

TOTAL: 48 HOURS

TEXT BOOK:

1. Nanomaterials Chemistry by Rao C. N., A. Muller, A. K. Cheetham, WileyVCH , 2007.
2. Nanomaterials and Nanochemistry by Brechignac C., P. Houdy, M. Lahmani, Springer publication, 2007.
3. Nanoscale materials in chemistry by Kenneth J. Klabunde, Wiley Interscience Publications,2001.
4. Nanochemistry by Sergeev G.B., Elseiver publication,2006.
5. Nanostructures and Nanomaterials, synthesis, properties and applications by Guozhong Cao, Imperial College Press, 2004.
6. Nanomaterials – Handbook by Yury Gogotsi, CRC Press, Taylor & Francis group, 2006. NSC.

CO, PO, PSO Mapping

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

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

SEMESTER VII

24BTU712A **MOLECULAR DIAGNOSTICS – PRACTICAL** **3H–1C**

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

End Semester Exam: 3Hours

PREREQUISITE: Students should have basic knowledge about diseases and its diagnostic tools

COURSE OBJECTIVES(CO)

- To obtain the basic concepts of Identification of pathogenic bacteria
- To ascertain the diagnostics tools for infectious diseases - RFLP, RAPD
- To achieve a complete knowledge about molecular diagnostics techniques on microbial infection

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Get hold of the knowledge on fundamentals of molecular diagnostic techniques	Remember
CO2	Explain on the concepts of infection, diagnosis and control assortment	Understand
CO3	Agree the qualitative studies based on biomarker observations	Evaluate
CO4	Develop methodologies of laboratory diagnostics to relevant states of health	Apply
CO5	Analyze the concept of disease management	Analyze

LIST OF EXPERIMENTS **36 HOURS**

1. Perform/demonstrate RAPD analysis
2. Kirby-Bauer method (disc-diffusion method) to study antibiotic sensitivity of a bacterial culture
3. A kit-based detection of a microbial infection (Widal test)
4. Study of Electron micrographs (any four)
5. Perform any one immuno diagnostic test (Typhoid, Malaria, Dengue)
6. Molecular detection of bacteria from spoiled food sample by multiplex PCR

TOTAL:36 HOURS

TEXT BOOK:

1. Bruce Alberts (2014), Molecular Biology of cell, W. W. Norton & Company, 6th edition.
2. Chang-Hui Shen (2019), Diagnostic Molecular Biology, Academic Press.
3. Claudio Carini, Mark Fidock, Alain van Gool (2019), Handbook of Biomarkers and Precision Medicine, CRC Press.
4. Goering, R., Dockrell, H., Zuckerman, M., & Wakelin, D. (2007). *Mims' Medical Microbiology* (4th ed.). Elsevier.
5. Laura Anfossi (2018), Rapid Test: Advances in Design, Format and Diagnostic Applications, BOD – Books on Demand.
6. Michael Ford (2019), Medical Microbiology: Fundamentals of Biomedical Science, Oxford University Press, 3rd edition.
7. Vishal S. Vaidya, Joseph V. Bonventre (2010), Biomarkers: In Medicine, Drug Discovery, and Environmental Health, John Wiley & Sons.
8. Willey, J.M., Sherwood, L.M., & Woolverton, C.J. (2008). *Prescott, Harley and Klein's Microbiology* (7th ed.). McGraw Hill Higher Education.

CO, PO, PSO Mapping

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

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

SEMESTER VII

24BTU712B **MEDICAL DEVICES- PRACTICAL** **3H–1C**

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

End Semester Exam: 3Hours

PREREQUISITE: Students should have basic knowledge about diseases and its diagnostic devices

COURSE OBJECTIVES(CO)

- To obtain the basic concepts of Identification of pathogenic bacteria
- To ascertain the diagnostics tools for infectious diseases - RFLP, RAPD
- To achieve a complete knowledge about molecular diagnostics techniques on microbial infection

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Get knowledge on fundamentals of molecular diagnostic techniques	Understand
CO2	Apply the concepts of infection, diagnosis and control assortment	Apply
CO3	Agree the qualitative studies based on biomarker observations	Evaluate
CO4	Apply methodologies of laboratory diagnostics to relevant states of health	Apply
CO5	Relate the various characteristics signs of clinical manifestations	Remember

List of Practical **36 hours**

1. Performance and practice of ECG
2. Performance and practice of EEG
3. Performance and practice of Blood pressure monitor
4. Performance and practice of Digital stethoscope
5. Performance and practice of Thermometer
6. Performance and practice of glucometer
7. Demonstration of Hemodialysis delivery system

TOTAL:36 HOURS

TEXT BOOK:

1. Gail Baura, Medical Device Technologies: A Systems Based Overview Using Engineering, Elsevier science,2002.
2. Martin Culjat, Rahul Singh, Hua Lee Medical Devices: Surgical and Image-Guided Technologies, John Wiley and Sons,Reinaldo perez, Design of medical electronic device, Elsevier science, 2002.
3. Richard C, Fries, Handbook of Medical Device Design,Marcel DekkerAG,2nd edition 2005.
4. Anthony Y. K,Chan, Biomedical device technology: principles and design,Charles Thomas, 2008.
5. Theodore R,Kucklick, The Medical Device Ramp-D Handbook, Taylor andFrancis Group LLC, 3rd edition 2013.
6. David Prutchi, Michael Norris,Design and Development of Medical Electronic Instrumentation: A Practical perspective of the design, construction and test of medical devices,John Wiley and Sons, 2005

CO, PO, PSO Mapping

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

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

SEMESTER VII

ACTIVITY: LIBRARY/SEMINAR **1H**

Instruction Hours/week: L:0 T:0 P:1

SEMESTER VIIIA & B

24BTU801 **FOOD BIOTECHNOLOGY** **5H–4C**

Instruction Hours/week: L:5 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3Hours

PREREQUISITE: Students should have basic knowledge about food and microbes.

COURSE OBJECTIVES(CO)

- 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

COURSE OUTCOMES(CO's)

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

Cos	Course Outcomes	Blooms Level
CO1	Recall the beneficial role of microorganisms in fermented foods and food processing	Remember
CO2	Understand the significance and activities of microorganisms in food and role of intrinsic and extrinsic factors on growth and survival of microorganisms in foods	Understand
CO3	Apply the various technological aspects of fermented products such as beer and wine in larger scale production	Apply
CO4	Categorize the spoilage mechanisms in foods and identify methods to control deterioration and spoilage	Analyze
CO5	Create ways to control microorganisms in foods and thus know the principles involving various methods of food preservation	Create

Unit – I INTRODUCTION: **12 HOURS**

History and scope of food biotechnology, nutritive value of food, characterization and role of important microbes in food biotechnology – bacteria, fungi and yeast, Development and formulation of probiotic foods.

Unit – II FOOD MICROBIOLOGY: **12 HOURS**

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

Unit – III FERMENTED FOODS: **12 HOURS**

Origin, scope and development, nutritive value and preservation of fermented foods - 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: 12 **HOURS**

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

Unit – V FOOD ADULTERATION AND FOOD SAFETY: 12 HOURS

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 - Adulteration detection systems and sensors, Ethical issues concerning GM foods; testing for GM foods; current guidelines for the production, release and movement of GM foods. Food safety - HACCP System to food protection, FSSAI guidelines.

TOTAL:60 HOURS

TEXT BOOK:

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.

CO, PO, PSO Mapping

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

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

SEMESTER VIIIA & B

24BTU802 RESEARCH METHODOLOGY 5H–4C

Instruction Hours/week: L:5 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3Hours

PREREQUISITE: Students should have basic knowledge about hypothesis and statistical tools.

COURSE OBJECTIVES(CO)

- To impart the knowledge on Identification of research requirements
- To apply the state of art knowledge for dissertation writing
- To become familiarize with experiment design

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Define principles of formulation of objectives and hypothesis	Remember
CO2	Explain Guidelines for review of literature	Understand
CO3	Get insight to Use of software for graphics	Apply
CO4	Correlate the results using biostatistics tool	Analyze
CO5	Explain the methods of teaching and learning	Evaluate

UNIT I –RESEARCH FORMULATION AND DESIGN 12 HOURS

Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.

UNIT II – DATA COLLECTION AND ANALYSIS 12 HOURS

Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statically package (Sigma STAT, SPSS for student t-test, ANOVA, etc.), hypothesis testing.

UNIT III – SOFT COMPUTING 12 HOURS

Computer and its role in research, Use of statistical software SPSS, GRETL etc. in research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.

UNIT IV –RESEARCH ETHICS, IPR AND SCHOLARY PUBLISHING 12 HOURS

Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing-IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability.

UNIT V –INTERPRETATION AND REPORT WRITING **12 HOURS**

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions.

TOTAL:60 HOURS

TEXT BOOK:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction toResearch Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New AgeInternational. 418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess EssPublications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic DogPublishing. 270p.
5. Wadehra, B.L. 2000. Law relating to patents, trade marks, copyright designs andgeographical indications. Universal Law Publishing.
6. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: AProcess of Inquiry, Allyn and Bacon.
7. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.

REFERENCE BOOK:

1. Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
2. Day, R.A., 1992.How to Write and Publish a Scientific Paper, CambridgeUniversity Press.
3. Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
4. Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design,Prentice Hall.
5. Satarkar, S.V., 2000. Intellectual property rights and Copy right. Ess EssPublications

WEBSITES:

1. https://theintactone.com/2018/02/26/br-u1-topic-2-formulation-of-the-research-p
2. https://leverageedu.com/blog/research-design/
3. https://www.questionpro.com/blog/data-collection/
4. https://en.wikipedia.org/wiki/Soft_computing

CO, PO, PSO Mapping

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

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

24BTU803 **MEDICAL BIOTECHNOLOGY** **5H–4C**

Instruction Hours/week: L:5 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3Hours

PREREQUISITE: Students should have basic knowledge about microbes and diseases.

COURSE OBJECTIVES(CO)

- To impart knowledge on micro-flora of human body, mode action, classification of microbes, function and biochemical reaction going on inside the microbial cell.
- To study the importance of microorganisms in diagnosis, monitoring and treatment of infectious diseases.
- To get knowledge about the bacteria and viruses that can cause infectious disease.

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	List the importance of microorganisms in diagnosis, monitoring and treatment of infectious diseases.	Remember
CO2	Get knowledge of bacteria and viruses that can cause infectious disease.	Understand
CO3	Examine the knowledge of prokaryotic genetics, taxonomy, growth conditions and virulence.	Analyze
CO4	Build knowledge of viruses and classification of viruses	Create
CO5	Utilize the knowledge about eukaryotic microorganisms and their role in infectious diseases	Apply

UNIT I: INTRODUCTION TO BIOTECHNOLOGY AND MEDICINE: 12 HOURS

Historical breakthroughs of Medicine 21st century, role of biotechnology in medicine, Development of Anti-Infective agents- Discovery of antiseptics and vaccines, Improvement in drug administration, new classes of drugs, Emergence of modern diseases and treatment, r-DNA technology, Vaccines, Monoclonal antibody therapy.

UNIT II MOLECULAR DIAGNOSTICS: **12 HOURS**

Importance of diagnosis- based diagnosis for infectious diseases (HIV, Hepatitis, Typhoid, Filariasis), Cancer and genetic disorders. Methods – Next-Generation Sequencing, MALDI-TOF, Flow Cytometry, Medical Cyto-genetics. Applications of Molecular Diagnostics for Genetic Diseases. Genetic Counselling Considerations in Molecular Diagnosis, Ethical, Social, and Legal Issues Related to Molecular Genetic Testing.

UNIT III CELL AND GENE MEDIATED THERAPY: **12 HOURS**

Introduction to stem cells-History of stem cell research-Classification of stem cells –Stem cell banking-applications of stem cells-importance of stem cells- regulations of stem cell research - Gene therapy; outline and methods.

UNIT IV ASSISTED REPRODUCTIVE TECHNIQUES: **12 HOURS**

Introduction-causes of infertility-methods; IVF-Intra uterine insemination- cryopreservation of germ cells.

UNIT V RECENT DEVELOPMENTS IN MEDICAL BIOTECHNOLOGY: **12 HOURS**

Pharming for human proteins and nutraceuticals. Tissue engineering and therapeutic cloning, Application of nanotechnology in biomedical sciences- green nanosubstance, gene delivery, drug delivery. Nanotechnology in replacing defective cells.

TOTAL: 60 HOURS

TEXT BOOK:

1. Fundamentals of medical biotechnology by Aparna Rajagopalan, Ukaaz publications.
2. Medical biotechnology by S.N.Jogdand, Himalaya publications
3. Medical Microbiology- Mackie and Mc Cartney
4. Jogdand, S. N. Medical Biotechnology, Himalaya Publishing house, Mumbai, 2005.
5. Click, B. R. and Pasternak. Molecular Biotechnology: Principle and applications of
6. recombinant DNA. ASM Press, 2010

WEBSITES:

1. https://www.toppr.com/guides/biology/biotechnology-principles-andprocess/tools-ofbiotechnology/
2. https://www.slideshare.net/aiswaryababunaishu/applications-of-medicalbiotechnology
3. https://byjus.com/biology/application-biotechnology-medicine/

CO, PO, PSO Mapping

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

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

SEMESTER VIIIA

24BTU804 **AGRICULTURE BIOTECHNOLOGY** **5H–4C**

Instruction Hours/week: L:5 T: 0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3Hours

PREREQUISITE: Students should have basic knowledge about plants and its culture techniques.

COURSE OBJECTIVES(CO)

- 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

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Demonstrate the techniques in plant tissue culture	Understand
CO2	Explain the genetic transformation techniques in plants	Evaluate
CO3	Define the role of transgenic plants in crop improvement	Remember
CO4	Produce stress resistant crops against microbes and insects	Create
CO5	Validate the applications of genetic transformation, metabolic engineering, production of pharmaceuticals and industrial products	Apply

UNIT – I PLANT TISSUE CULTURE AND ITS APPLICATIONS: 12 HOURS

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

UNIT –II GENETIC AND MOLECULAR BASIS: 12 HOURS

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

UNIT –III IMPROVEMENT OF CROP PLANTS: 12 HOURS

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

UNIT – IV STRESS RESISTANCE ON CROPS: 12 HOURS

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: 12 HOURS

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

TOTAL: 60 HOURS

TEXT BOOK:

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.

CO, PO, PSO Mapping

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

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

SEMESTER VIIIA

24BTU805 **STEM CELL BIOLOGY** **5H–4C**

Instruction Hours/week:L:5 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3Hours

PREREQUISITE: Students should have basic knowledge about stem cells

COURSE OBJECTIVES(CO)

- To learn the basic concepts of tissue engineering and regenerative medicine
- To attain strong knowledge in cellular fate process such as cell division and cell death
- To understand in vitro cell culture environment and maintenance

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Apply tissue engineered cells as therapeutic agents	Apply
CO2	Analyze the co-ordination of cellular fate processes in soluble signaling	Analyze
CO3	Discuss the basic tools used to study cell fate and cell functions	Create
CO4	Demonstrate the application of stem cells in tissue engineering and regenerative medicine	Understand
CO5	Illustrate the basic concepts of cell culture and critical components of bioreactor/tissue design	Understand

UNIT I INTRODUCTION TO STEM CELLS: **12 HOURS**

Definition, Classification, characteristics, Differentiation and dedifferentiation, Stem cell niche, stem cell Vs Somatic cells; Mechanism of pluripotency in stem cells.

UNIT II BASIC CULTURE PROCEDURES: **12 HOURS**

Isolation, culture methods, identification, stem cell markers, feeder layer; Different kinds of stem cells – A d u l t Stem cells, Embryonic stem cells, Embryonic Germ cells, Heamtopoietic stem cell, Neural stem cells, muscle and cardiac stem cells, Umbilical cord blood stem cells, cancer stem cells, Mesenchymal stem cells, Induced pluripotent Stem cells.

UNIT III THERAPEUTIC APPLICATIONS: **12 HOURS**

Stem cells and neurodegenerative disorders, stem cells and diabetes, stem cells and cardiac disorders, regeneration of epidermis, Success stories of stem cell therapy. Stem cell banking and ethical approaches on stem cells.

UNIT IV PRINCIPLES OF TISSUE ENGINEERING **12 HOURS**

History and scope, Basics of Tissue Engineering, Cell- ECM interaction, wound healing mechanism, Tissue Engineering Bioreactors, Models of Tissue Engineering, Biomaterials in Tissue Engineering.

UNIT V APPLICATION OF STEM CELLS **12 HOURS**

Bioartificial organs – source of cells, choosing the right scaffold material, mode of transplantation. Epidermal Tissue engineering, Bladder reconstruction, Skin equivalents, Liver reconstruction, Bone regeneration through tissue engineering, Tissue Engineering and future perspectives – commercial products.

TOTAL: 60 HOURS

TEXT BOOK:

1. Stem cells: Scientific progress and future research directions – NIH report. Available @ www.stemcells.nih.gov/index ;www.stembook.org.
2. Essentials of Stem cell Biology – Robert Lanza, John Gearhart, Brigid Hogan. (2009) Academic Press
3. Stem cell now- From the experiment that shook the world to the new politics of life.
4. 2005. Pearson Education, Pi Press.: Upper Saddle River, New Jersey, USA. 256p. ISBN: 0-131-73798-8
5. Stem cell now – A Brief Introduction to the Coming of Medical Revolution, Christopher Thomas Scott. (2006), Pi Press.: Upper Saddle River, New Jersey, USA.
6. Principles of Tissue Engineering (Fourth Edition), Academic Press, 2014, ISBN 9780123983589, https://doi.org/10.1016/B978-0-12-398358-9.00009-4.
7. Palsson, B., Hubbell, J.A., Plonsey, R., & Bronzino, J.D. (Eds.). (2003). Tissue Engineering (1st ed.). CRC Press. https://doi.org/10.1201/9780203011423

CO, PO, PSO Mapping

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

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

SEMESTER VIIIA & B

24BTU811 **FOOD BIOTECHNOLOGY PRACTICAL** **3H–1C**

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

End Semester Exam: 3Hours

PREREQUISITE: Students should have basic knowledge about food and fermentation.

COURSE OBJECTIVES(CO)

- 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

COURSE OUTCOMES(CO's)

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

COs	Course Outcomes	Blooms Level
CO1	List the beneficial role of microorganisms in fermented foods and food processing	Remember
CO2	Understand the significance and activities of microorganisms in food and role of intrinsic and extrinsic factors on growth and survival of microorganisms in foods	Understand
CO3	Learn the various technological aspects of fermented products such as beer and wine in larger scale production	Apply
CO4	Determine the spoilage mechanisms in foods and thus identify methods to control deterioration and spoilage	Evaluate
CO5	Discover the ways to control microorganisms in foods and thus know the principles involving various methods of food preservation	Analyze

Experiments: **36 hours**

1. Market Survey on Cereals, Legumes, Minor Millets, Oilseeds and their Products
2. Physicochemical Tests for Quality of Cereals, Legumes, and Oilseeds
3. Determination of Amylose in Rice
4. Extraction of Gluten from Cereals
5. Development of Simulated Milk and Milk Products from Soy
6. Preparation of Extruded Products from Pulses
7. Preparation of Peanut Butter

TOTAL: 36 HOURS

TEXT BOOK:

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.

CO, PO, PSO Mapping

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

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

SEMESTER VIII

ACTIVITY: LIBRARY/SEMINAR **2H**

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

End Semester Exam: 3Hours

SEMESTER VIII B

24BTU891	**RESEARCH PROJECT**	**19H–12C**

Instruction Hours/week: L:0 T:0 P:19 **Marks:** Internal: 120External: 180 Total: **100**

End Semester Exam: 3Hour