B.Sc. MICROBIOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

Curriculum and Syllabus
Regular (2023 – 2024)

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

DEPARTMENT OF MICROBIOLOGY

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)
Eachanari (Post), Coimbatore – 641 021.
Phone No. 0422-2980011 – 15
Fax No: +91-422-2980022. 23

B.Sc. MICROBIOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

Curriculum and Syllabus
Regular (2023 – 2024)

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

DEPARTMENT OF MICROBIOLOGY

FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT

B.Sc. MICROBIOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

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

Under Graduate Programmes Regular Programme

Regulations - 2023

DEPARTMENT OF MICROBIOLOGY

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)
Eachanari (Post), Coimbatore – 641 021.
Phone No. 0422-2980011 – 15
Fax No: +91-422-2980022. 23

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)

Eachanari Post, Coimbatore - 641 021, India

FACULTY OF ARTS, SCIENC, COMMERCE AND MANAGEMENT

UNDERGRADUATE PROGRAMMESREGULAR MODE

REGULATIONS – 2023

The following regulations are effective from the academic year 2023-2024 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 2023-2024 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.	BBA	Business Administration
9.	B.Sc.	Biotechnology
10.	B.Sc.	Microbiology
11.	B.Sc.	Computer Science
12.	B.Sc.	Information Technology
13.	B.Sc.	Computer Technology
14.	B.Sc.	Computer Science (Cognitive Systems)
15.	B.Sc.	Computer Science (Artificial Intelligence and Data Science)
16.	BCA	Computer Applications

1.2 Mode of Study

Full-Time

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

1.3 Admission Requirements (Eligibility)

A candidate for admission to the first 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 TamilNadu Board or any similar examination of any other Board accepted by the KAHE as equivalent thereto. (Annexure I)

2. DURATION OF THE PROGRAMMES

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

Programme(s)	**Year ofStudy**	**Min. No. of Semesters**	**Max. No. of Semesters**
B.Sc., B.Com., BCA and BBA	I	2	4
	II	4	8
	III	6	12
	IV	4	16

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.

3. CHOICE BASED CREDIT SYSTEM

3.1. All programmes are offered under Choice Based Credit System with atotal credit from 180 to 182 for UG Programme.

3.2. Credit

Credit means the weightage given to each course by the experts of the Board of Studies concerned. Total credits offered are 160 as per the UGC Guidelines for the UG Programme (Four Years).

4. STRUCTURE OF THE PROGRAMME

4.1 Tamil or any one of the Indian / Foreign Languages *viz,* Malayalam, Hindi, Sanskrit, French is offered as an ability enhancement coursefor Arts, Science, Commerce and Management Programmes. Four

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, Skill Enhancement Courses, Project Work, Ability Enhancement Courses, Value Added Courses (Common to all UG Programmes), Summer Internship, Research Project/Dissertation are part of curricularstructure.

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 a minimum of 80 Credits in Major Courses.

4.2.2. Minor Courses

Students will have the option to choose courses from disciplinary/interdisciplinary minors and skill-based courses. Students have to earn a minimum of 32 Credits in Minor Courses.

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 in the first, second and fourth 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. Project Work

The project work shall start at the beginning of sixth semester in the Department/Industry/Research Institute (National/International) and theproject 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 minimum of 06credits.

4.2.6. Ability Enhancement Course (AEC)

There are four Ability Enhancement Courses offered during the firstfour semesters. Four credits are awarded for each course and the examinations will be conducted at the end of each semester. Students have to earn a minimum of 08 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 or second year summer term.

4.2.8. Value Added Courses (VAC)

The students will study three Value Added Courses in the first three semesters of their programme. Two credits are awarded for each course and the examinations will be conducted at the end of each semester. Thevarious Value Added Courses offered are given below:

S.No	Name of the Offering Department	Name of the Course
1.	Biotechnology	Environmental Studies
2.	Commerce	Indian Knowledge System
3.	Biochemistry	Health and Wellness
4.	Computer Science	Cyber Security
5.	Artificial Intelligence and Data Science	Fundamentals of Artificial Intelligence
		Fundamentals Of Data Science
		Internet Programming
		Robotics And Automation
6.	Biomedical Engineering	Human Anatomy and Physiology
		Artificial Organs and Implants
7.	Biotechnology	Bioreactor Design
		Food Processing and Preservation
		Basic Bioinformatics

		Fundamentals Of Nano Biotechnology
8.	Civil Engineering	Housing, Plan and Management
		Building Services
		Repair and rehabilitation of structures
		Computer-Aided Civil Engineering Drawing
		Contracts Management
		Air and Noise Pollution andControl
9.	Computer Science and Design	Introduction To 3d Modelling and Animation
		Digital photography
		Mobile Application Development
10.	Computer Science and Engineering	Internet of Things
		Machine Learning
		Blockchain Technologies
11.	Electronics and Communication Engineering	Neural Networks and Its Applications
		Principles of Modern Communication System
12.	Food Technology	Processing Of Food Materials
		Nutrition And Dietetics
		Ready To eat foods
		Agricultural Waste And Byproducts Utilization
		Design Of Food process equipment
13.	Mechanical Engineering	Computer Aided Design
		Industrial Safety and Environment
		Non-Destructive testing
14.		Electric Hybrid Vehicle

	Electrical and Electronics Engineering	Renewable Energy Resources

4.2.9. Research Project /Dissertation

The candidates shall undertake the project work in the eighth Semester either in the Department/Industry/Research Institute (National / International). The project 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 project work outside the Department, the faculty concerned within the Department shall be the Supervisor and the teacher/scientist under whom the work is carried out will be the Co- supervisor. The candidate shall bring the attendance certificate from the place where the project work 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 progressand demonstration of their project before the PAC in the presence oftheir 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. Online Course

Students are encouraged to study the online course from SWAYAM/ NPTEL/MOOC in any one of the first seven semesters for which examination shall be conducted at the end of the course by the respectiveexternal agencies, if any. The student can register to the courses which are approved by the Department. The student shall produce a Pass Certificate from the respective agencies. The credit(s) earned by the students will be transferred to the concerned course in the mark statement.

6. Extra Curricular Activities

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

- NSS
- NCC
- Sports / Mass drill

- YRC
- Club activities
- Other Co-curricular and 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 on the following parameters.

- 75% weightage for active participation in Extra Curricular Activities in / out of the KAHE.
- 25% weightage for Exemplary Awards/Honours/Prizes secured.

6.1 Marks for Co-curricular and 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.

7. 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.

8. MAXIMUM MARKS

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

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

9. a. 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 counseledby 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 andsatisfy the clause 12 of this regulation.

b. ONLINE COURSE COORDINATOR

To help students in planning their online courses and for general advice ononline 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 thestudents. Further, the coordinators shall advice the students regarding the online courses and monitor their participation.

10. 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 functions of the Class Committee shall include

1. The class committee shall be constituted during the first week ofeach 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 convenethe 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.

11. 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 CourseCoordinator. 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.

12. REQUIREMENTS TO APPEAR FOR THE END SEMESTEREXAMINATION

a. Ideally, every student is expected to attend all classes and should secure100% attendance. However, in order to allow for certain unavoidable circumstances, the student is expected to attend at least 75% of the classes and the conduct of the candidate has been satisfactory during the course.

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

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

13. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

13.1 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 workclass, the test marks and the record of class work (topic covered),

separately for each course. This should be submitted to the HoD once in a week for checking the syllabus coverage, records of test marks and attendance. The HoD shall sign with date after due verification. The same shall be submitted to respective Dean once in a fortnight. After the completion of the semester the HoD should keep this record in safe custody for five years as records of attendance and assessment shall be submitted for inspection as and when required by the KAHE/any other approved body.

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

Theory Courses

S. No.	Category	MaximumMarks
1.	Assignment	5
2.	Attendance	5
3	Seminar	5
4.	Test – I (1 ½ units- Unit I and II)	8
5	Test – II (1 ½ units Unit II and III)	8
6	Test III (2 units Unit IV and V)	9
Continuous Internal Assessment: Total		40

Practical Courses

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

* Includes *Viva- voce* conducted during the model Exam practical.Every practical Exercise / Experiment shall be evaluated based on theconduct of Exercise/ Experiment and records maintained.

13.3 Portions for Test Question Paper

Portions for Internal Test – I : First 1 ½ Units (Unit I and II) Portions for Internal Test – II : Second 1 ½ Units (Unit II and III)Portions for Internal Test – III : Two units (Unit IV and V)

13.4 Pattern of Test Question Paper

Instruction	**Remarks**
Maximum Marks	50 marks
Duration	2 Hours
Part – A	Objective type (20 x1=20)
Part - B	Short Answer Type (3 x2 = 6)
Part - C	3 Eight mark questions 'either – or' choice(3 x 8 = 24 Marks)

13.5 Attendance

Marks Distribution for Attendance

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

.

14. ESE EXAMINATIONS

14.1 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 60 marks.

Pattern of ESE Question Paper:

Instruction	Remarks
Maximum Marks	60 marks for ESE.
Duration	3 hours (½ Hr for Part – A Online & 2 ½ Hours for Part – B and C)
Part - A	20 Questions of 1 mark each (20 * 1 = 20 Marks) Question No. 1 to 20 Online Multiple Choice Questions
Part- B	5 Questions of 2 marks each (5 * 2 = 10 Marks)Covering all the five units of the syllabus Question No. 21 to 25
Part- C	5 six marks Questions of 6 marks each (5 * 6 = 30 Marks.) Question No. 26 to 30 will be 'either-or' type, covering all five units of the syllabus; i.e., (Question No. 26: Unit - I, either 26 (a) or 26 (b), Question No. 27: Unit - II, either 27 (a) or 27 (b), Question No. 28: Unit - III, either 28 (a) or 28 (b), Question No. 29: Unit - IV, either 29 (a) or29 (b), Question No. 30: Unit - V, either 30 (a) or 30 (b))

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

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

Record Notebooks for Practical Examination

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

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

14.3. Evaluation of Project Work

14.3.1 The project work shall carry a maximum of 100 marks. (CIA -40 and ESE – 60*)

***Combined valuation of Internal and External Examiners.

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

14.3.3 The evaluation of the project will be based on the project reportsubmitted 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.

14.3.4 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-enrollfor 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. For this purpose, the same Internal and External examiner shall evaluate theresubmitted report in the subsequent semester.

14.3.5 Copy of the approved project report after the successful completion of *viva-voce* examination shall be kept in the KAHE library.

15. PASSING REQUIREMENTS

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

15.2 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).

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

15.4 CIA marks (if it is pass) obtained by the candidate in the firstappearance shall be retained by the Office of the Controller of

Examinations and considered valid for all subsequent attempts tillthe candidate secures a pass in ESE.

15.5 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.

16. IMPROVEMENT OF MARKS IN THE COURSES ALREADYPASSED

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

17. 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

18. GRADE SHEET

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

i. The list of courses enrolled during the semester and the gradescored.

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 SemesterGrade Sheet)

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

GPA of a Semester = Sum of the product of the GP by the corresponding credits of the courses offered in that Semester / Sum of the credits of the coursesof that Semester

i.e. **GPA** of a Semester = $\frac{\sum CiGPi}{\sum Ci}$ (sum over i)

Sum of the product of the GPs by the corresponding credits of the courses offered for the entireprogramme

CGPA of the entire programme = Sum of the credits of the coursesof 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**.

19. REVALUATION

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

20. TRANSPARENCY AND GRIEVANCE COMMITTEE

Revaluation and Retotaling are allowed on representation (clause 19).Student may get the Xerox copy of the answer script on payment ofprescribed 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; the marks awarded by the External examiner will be final. The student has to pay the prescribed fee for the same.

21. ELIGIBILITY FOR THE AWARD OF THE DEGREE

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

- Successfully completed all the components 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 programmewithin the stipulated period vide class 2.1.
- Not any disciplinary action pending against him / her.
- The award of the degree must be approved by the Board of Management.

22. CLASSIFICATION OF THE DEGREE AWARDED

22.1 Candidate who qualifies for the award of the Degree (vide clause 21) having passed the examination in all the courses in his / her first appearance, within the specified minimum number of semesters and securing a **CGPA not less than 8** shall be declared to have passed the examination in the **First Class with Distinction.**

22.2 Candidate who qualifies for the award of the Degree (vide clause 21) 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 inthe **First Class**.

22.3 All other candidates (not covered in clauses 22.1 and 22.2) who qualify for the award of the degree (vide Clause 21) shall be declaredto have passed the examination in the **Second Class**.

23. PROVISION FOR WITHDRAWAL FROM END-SEMESTER EXAMINATION

23.1 Based on valid reasons and on prior application the Candidate may be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course ina semester examination.

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

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

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

23.4 Withdrawal shall not be construed as an appearance for the eligibility ofa candidate for First Class with Distinction. This provision is not applicable to those who seek withdrawal during **VI/VIII semester**.

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

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

24. PROVISION FOR AUTHORISED BREAK OF STUDY

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

the Department stating the reasons therefore and the probable date ofrejoining the programme.

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

24.3 The authorized break of study (for a maximum of one year) will not be counted for the duration specified for passing all the courses for the purpose of classification. (vide clause 22). However, additional break of study granted will be counted for the purpose of classification.

24.4 The total period for completion of the Programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 2.1 irrespective of the period of break of study (vide clause 24.1) in order that he/she may be eligible for the award of the degree.

24.5 If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be consideredas permitted 'Break of Study' or 'Withdrawal' (Clause 23 and 24) is not applicable for this case.

25. RANKING

A candidate who qualifies 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 confinedto 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 studentswho have failed in one theory course only. Such students shall apply with prescribed fee to the Controller of Examinations within the stipulatedtime.

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 prescribedby the KAHE from time to time.

27.2. Every student is required to observe discipline and decorous behaviorboth 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.

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 syllabiif found necessary.

29. 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 with Honors/Honors (Research)respectively as per the regulations of NEP 2020. Similarly, the students from other institutions can join our university in the 3^{rd} or 5^{th} or 7^{th} semester with an appropriate Undergraduate Certificate or Undergraduate Diploma or Undergraduate Degree certificates respectively.

Karpagam Innovation and Incubation Council (KIIC)
(A Section 8 Company)

Based on the 2019 National Innovation and Startup Policy and the 2019–2023 TamilNadu 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 isallowed 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 interdisciplinaryor 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 canbe 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,**	

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 10th 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 10th 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 10th 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 10th 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 10th 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 10th 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

PREAMBLE

Microbiology is the study of microscopic living organisms; which includes the study of bacteria, viruses, yeasts, molds, protozoa, and other forms of life that do not fit well into any of these groups. Microbiology has made possible in our ability to control many infectious diseases. Both beneficial and harmful impact of microbes to the mankind has been explored. Microbiology has developed from the angle of other disciplines of biological sciences in such a way that problems of cell structure related to evolution are solved. In addition, microorganisms have been used to study many normal biochemical processes including metabolism that subsequently have been shown to occur in higher forms of life.

This course is framed to give knowledge with understanding of Microbiology to undergraduate students. The goal of the syllabus is to make the study of Microbiology, popular, interesting and encouraging to the young students. In this major you will also develop an understanding of the importance of microbiology in medical, immunology, environmental, food and agricultural, microbial technology, industrial and pharmaceutical settings. The new and updated syllabus is based on a basic and applied approach, comparable to the syllabi of other universities and the needs of industries and research. The syllabus was prepared after discussion at length with number of faculty members of the subject and field experts from industries and research. The units of the syllabus are well defined, taking into consideration the level and capacity of students. Training in microbiology can lead to exciting career opportunities in various fields in microbiology.

Objectives are

- To promote the importance of the science of microbiology.
- To study the useful and disease-producing microorganisms.
- To study the biological activities of microbes.
- To make the students familiar with the subject.
- To make the students expertise in terms of its practical applicability.
- To develop good laboratory practices that will be useful in subsequent courses as wellas in many careers.
- To expose the students to various emerging areas of microbiology.
- To prepare students for further studies, helping in their bright career.
- To demonstrate the relationship between microbiology and other disciplines ofbiology.
- To prepare and also to expertise the students to accept the challenges in life sciences.
- To develop skills required in research labs, diagnostic labs and in various othermicrobiology laboratories.

DEPARTMENT OF MICROBIOLOGY
FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT
UG PROGRAM (CBCS)
B.Sc. Microbiology (2023–2024 Batch and onwards)

Course code	Name of the course	Objectives and out comes		Instruction hour / week			Credits	Maximum marks				P.No.,
		PEOs	Pos	L	T	P		CIA	ESE	Total	Category	
SEMESTER I												
23LSU101	Language –I	I	a	4	-	-	4	40	60	100	AEC 1	13
23ENU101	English- I	I	a	3	-	-	3	40	60	100	MDC 1	19
23MBU101	Introduction to Microbiology and Microbial Diversity	I	a	5	1	-	5	40	60	100	CC 1	21
23MBU102	Biochemistry- I	I	a	4	1	-	4	40	60	100	MC 1	23
23MBU111	Introduction to Microbiology and Microbial Diversity-Practical	I	b	-	-	4	2	40	60	100	SEC 1	25
23MBU112	Biochemistry- I -Practical	I	a	-	-	4	2	40	60	100	MC 2	27
23VAC101	Environmental Studies	II	d	2	-	-	2	40	60	100	VAC 1	29
	Activity: Library/Seminar	-	-	-	-	02	-	-	-	-	-	
Semester Total				**18**	**02**	**10**	**22**	**280**	**420**	**700**	-	
SEMESTER II												
23LSU201	Language – II	I	a	4	-	-	4	40	60	100	AEC 2	31
23ENU201	English -II	I	a	3	-	-	3	40	60	100	MDC 2	36
23MBU201	Microbial Physiology and Metabolism	I, II	a	5	1	-	5	40	60	100	CC 2	38
23MBU202	Biochemistry- II	I	a	5	1	-	5	40	60	100	MC 3	40
23MBU211	Microbial Physiology and Metabolism Practical	I, II	a	-	-	4	2	40	60	100	CC 3	42
23MBU212	Biochemistry- II -Practical	I	a	-	-	3	1	40	60	100	SEC 2	44
23VAC201	Indian Knowledge System	II	d	2	-	-	2	40	60	100	VAC 2	46
23VAC202	Yoga for Youth Empowerment	-	-	-	-	02	-	40	60	100	VAC 3	
Semester Total				**19**	**02**	**09**	**22**	**280**	**420**	**700**		
SEMESTER III												
23LSU301	Language - III	I	a	4	-	-	4	40	60	100	AEC 3	48
23ENU301	English - III	I	a	3	-	-	3	40	60	100	MDC 3	51
23MBU301	Virology	II, III	e, k	4	1	-	4	40	60	100	CC 4	53
23MBU302	Microbial Genetics	II, III	e	4	-	-	4	40	60	100	CC 5	55
23MBU303A/ 23MBU303 B	Microbial Biotechnology/ Biosafety and Intellectual Property Rights	II, III	g	3	-	-	3	40	60	100	MC 4	57 59

23MBU311	Virology and Genetics - practical	II, III	e, k	-	-	4	2	40	60	100	CC 6	61
23MBU312A/ 23MBU312B	Microbial Biotechnology - Practical / Biosafety and Intellectual Property Rights -Practical	II, III	f	-	-	3	1	40	60	100	MC 5	63 65
23VAC301	Cyber security		d	2	-	-	2	40	60	100	VAC 3	67
23MBU391	Internship*			-	-	-	2	100	-	100	SEC 3	70
	Activity: Library/Seminar	-	-	-	-	02	-	-	-	-	-	
Semester Total				**20**	**01**	**09**	**25**	**420**	**480**	**900**		
SEMESTER IV												
23LSU401	Language - IV	I	a	4	-	-	4	40	60	100	AEC 4	71
23ENU401	English - IV	I	a	3	-	-	3	40	60	100	SEC 4	74
23MBU401	Immunology	II, III	e	5	-	-	5	40	60	100	CC 7	76
23MBU402	Medical Microbiology	II, III	c	4	1	-	4	40	60	100	CC 8	78
23MBU403A/ 23MBU403B	Molecular Biology/ Plant Tissue and Animal Tissue Culture	II, III	g	3	-	-	3	40	60	100	MC 6	80 82
23MBU411	Immunology -Practical	II, III	e,g	-	-	4	2	40	60	100	CC 9	84
23SEC412	Medical Microbiology Practical	II, III	c	-	-	4	2	40	60	100	SEC 5	86
	Activity: Library/Seminar					02						
Semester Total				**19**	**01**	**10**	**23**	**280**	**420**	**700**		
SEMESTER V												
23MBU501	Industrial Microbiology and Biotechniques	II, III	i	5	-	-	5	40	60	100	CC 10	88
23MBU502	Environmental Microbiology	II, III	i	5	-	-	5	40	60	100	CC 11	90
23MBU503	Recombinant DNA Technology	II, III	g	5	-	-	5	40	60	100	CC 12	92
23MBU504A/ 23MBU504B	Bioinformatics/ Metagenomics and Forensic Microbiology	II, III	g	4	1	-	4	40	60	100	MC 7	94 96
23MBU511	Industrial Microbiology and Biotechniques - Practical	II, III	i	-	-	4	2	40	60	100	CC 13	98
23MBU512	Environmental Microbiology and Recombinant DNA Technology -Practical	II, III	j	-	-	4	2	40	60	100	CC 14	100
23MBU591	Internship*			-	-	-	2	100	-	100	SEC 6	102
	Activity: Library/Seminar					02						
Semester Total				**19**	**01**	**10**	**25**	**340**	**360**	**700**		

SEMESTER VI												
23MBU601	Food and Dairy Microbiology	II, III	f	5	-	-	5	40	60	100	CC 15	103
23MBU602	Microbes in Sustainable Agriculture and Development	II, III	d	5	-	-	5	40	60	100	CC 16	105
23MBU603A/ 23MBU603B	Biopharmacy / Bionanotechnology	II, III	e	5	-	-	5	40	60	100	MC 8	107 109
23MBU611	Food and Dairy Microbiology - Practical	II, III	d	-	-	4	2	40	60	100	CC 17	111
23MBU612	Microbes in Sustainable Agriculture and Development - Practical	II, III	e	-	-	4	2	40	60	100	SEC 7	113
23MBU691	Project	II, III		-	-	7	4	80	120	200	CC 18	115
Semester Total				**15**	**-**	**15**	**23**	**280**	**420**	**700**		
3rd year total				**110**	**07**	**63**	**140**	**1880**	**2520**	**4400**		
SEMESTER VII												
23MBU701	Textile Microbiology	II, III	k	5	01	-	5	40	60	100	CC 19	116
23MBU702	Poultry and Veterinary Microbiology	II, III	k	5	01	-	5	40	60	100	CC 20	118
23MBU703A/ 23MBU703B	Drug Design and Development / Bioproduct Development and Entrepreneurial Microbiology	II, III	e	4	01	-	4	40	60	100	MC 9	120 122
23MBU704A/ 23MBU704B	Inheritance Biology / Biostatistics and Research Methodology	II, III	k	4	01	-	4	40	60	100	MC 10	124 126
23MBU711	Textile Microbiology -Practical	II, III	k	-	-	3	1	40	60	100	CC 21	128
23MBU713A	Drug Design and Development - Practical	II, III	k	-	-	3	1	40	60	100	MC 11	130
23MBU713B	Bioproduct Development and Entrepreneurial Microbiology - Practical											132
	Activity: Library/Seminar					02						
Semester Total				**18**	**04**	**08**	**20**	**240**	**360**	**600**		

23MBU801	Bioprocess Engineering	II, III	k	4	01	-	4	40	60	100	CC 22	134
23MBU802	Microbial Enzymology	II, III	a	4	01	-	4	40	60	100	MC 12	136
23MBU803	Marine Microbiology	II, III	k	4	01	-	4	40	60	100	CC 24	138
23MBU804	Biomedical Research and Animal Management	II, III	k	4	01	-	4	40	60	100	CC 25	140
23MBU805	Medical Coding and Pharmacovigilance	II, III	k	4	01	-	4	40	60	100	MC 13	142
23MBU811	Bioprocess Engineering - Practical	II, III	k	-	-	4	2	40	60	100	CC 23	144
	Activity: Library/Seminar					01						
Semester Total				**20**	**05**	**05**	**22**	**240**	**360**	**600**		
				148	**16**	**76**	**182**	**2360**	**3240**	**5600**		
SEMESTER VIII B												
23MBU801	Bioprocess Engineering	II, III	k	4	-	-	4	40	60	100	CC 22	134
23MBU802	Microbial Enzymology	II, III	a	4	-	-	4	40	60	100	MC 12	136
23MBU811	Bioprocess Engineering - Practical	II, III	k	-	-	4	2	40	60	100	CC 23	144
23MBU891	Research Project	II, III	l		-	18	12	120	180	300	CC 26	146
Semester Total				**08**	**-**	**22**	**22**	**240**	**360**	**600**		
4th Year Toral				**136**	**11**	**93**	**182**	**2360**	**3240**	**5600**		

CC: Core Courses (Major); MC-Minor Courses; SEC: Skill Enhancement Courses; AEC: Ability Enhancement Courses; MDC- Multidisciplinary Courses; VAC-Value added courses P-Project

MAJOR COURSES			
Semester	**Course code**	**Name of the course**	**Credit(s)**
I	23MBU101	Introduction to Microbiology and Microbial Diversity	5
II	23MBU201	Microbial Physiology and Metabolism	5
	23MBU211	Microbial Physiology and Metabolism Practical	2
III	23MBU301	Virology	4
	23MBU302	Microbial Genetics	4
	22BTU311	Virology and Genetics practical	2
IV	23MBU401	Immunology	5
	23MBU402	Medical Microbiology	4
	23MBU411	Immunology and Medical Microbiology Practical	2
V	23MBU501	Industrial Microbiology and	5
	23MBU502	Environmental Microbiology	5
	23MBU503	Recombinant DNA Technology	5
	23MBU511	Industrial Microbiology and Biotechniques Practical	2
	23MBU512	Environmental Microbiology Practical	2
VI	23MBU601	Food and Diary Microbiology	5
	23MBU602	Microbes in Sustainable and Agriculture Development	5
	23MBU611	Food and Diary Microbiology Practical	2
	23MBU691	Project	4
VII	23MBU701	Textile Microbiology	5
	23MBU702	Poultry and Veterinary	5
	23MBU711	Textile Microbiology Practical	1
	23MBU801	Bioprocess Engineering	4

VIII	23MBU811	Bioprocess Engineering Practical	2
	23MBU803	Marine Microbiology	4
	23MBU804	Biomedical Research and Animal	4
	23MBU891	Research Project	12
TOTAL			**105**

MINOR COURSES			
Semester	**Course code**	**Name of the course**	**Credit(s)**
I	23MBU102	Biochemistry I	4
	23MBU112	Biochemistry I Practical	2
II	23MBU202	Bio Chemistry II	5
III	23MBU303A/ 23MBU303 B	Microbial Biotechnology/ Biosafety and Intellectual Property Rights	3
	23MBU312	Microbial Biotechnology Practical / Biosafety and Intellectual Property Rights Practical	1
IV	23MBU403A/ 23MBU403B	Molecular Biology/ Plant Tissue and Animal Tissue Culture	3
V	23MBU504A/ 23MBU504B	Bioinformatics/ Metagenomics and Forensic Microbiology	4
VI	23MBU603A/ 23MBU603B	Biopharmacy / Bionanotechnology	5
VII	23MBU703A/ 23MBU703B	Drug Design and Development / Bioproduct Development and Entrepreneurial Microbiology	4
	23MBU704 A/ 23MBU704 B	Inheritance Biology / Biostatistics and Research Methodology	4
	23MBU713A / 23MBU713B	Drug Design and Development Practical / Bioproduct Development and Entrepreneurial Microbiology Practical	1
VIII	23MBU802	Microbial Enzymology	4
	23MBU805	Medical Coding and Pharmacovigilance	4
TOTAL			**44**

MULTI - DICIPLINARY COURSES			
Semester	**Course code**	**Name of the course**	**Credit(s)**
I	23ENU101	English - I	3
II	23ENU201	English - II	3
III	23ENU301	English - III	3
TOTAL			**9**

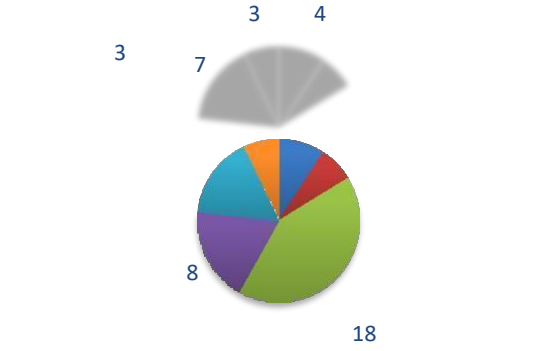
ABILITY ENHANCEMENT COURSES			
Semester	**Course code**	**Name of the course**	**Credit(s)**
I	23LAU101	Language - I	4
II	23LAU201	Language – II	4
III	23LAU301	Language – III	4
IV	23LAU401	Language – IV	4
TOTAL			**16**

SKILL ENHANCEMENT COURSES			
Semester	**Course code**	**Name of the course**	**Credit(s)**
I	23MBU111	Introduction to Microbiology and Microbial Diversity Practical	2
II	23MBU212	Bio Chemistry II Practical	1
III	23MBU391	Internship*	2
IV	23ENU401	English - IV	3
	23SEC412	Medical Microbiology Practical	2
V	23MBU591	Internship*	2
VI	23MBU613A / 23MBU613B	Biopharmacy Practical / Bionanotechnology Practical	2
TOTAL			**14**

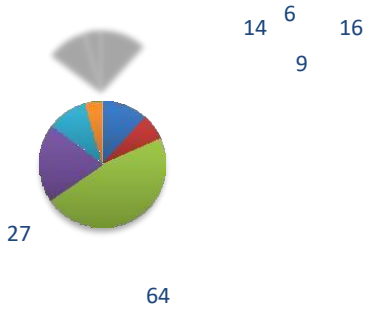
VALUE ADDED COURSES			
Semester	**Course code**	**Name of the course**	**Credit(s)**
I	23VAC101	Environmental Studies	2
II	23VAC201	Indian knowledge system	2
III	23VAC301	Cyber Security	2
T)TAL			**6**

S.NO.	CATEGORIES	NO. OF COURSES
1	ABILITY ENHANCEMENT COURSES	4
2	MULTI - DICIPLINARY COURSES	3
3	MAJOR COURSES	26
4	MINOR COURSES	13
5	SKILL ENHANCEMENT COURSES	7
6	VALUE ADDED COURSES	3

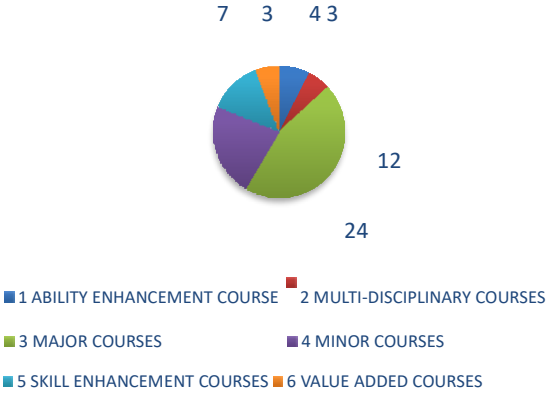
Number of Courses 3 Year B.Sc Microbiology



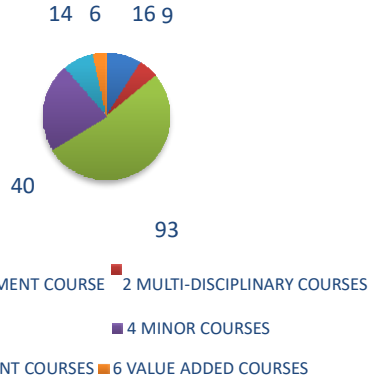
Total number of credits - 3 Year B.Sc Microbiology



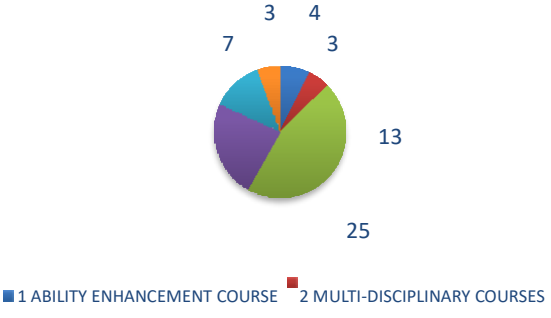
Number of Courses 4 Year B.Sc Microbiology (Hons) with Research



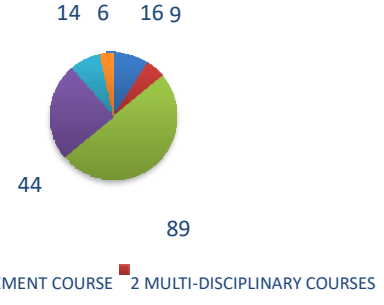
Total number of credits- 4 Year B.Sc Microbiology (Hons) with Research

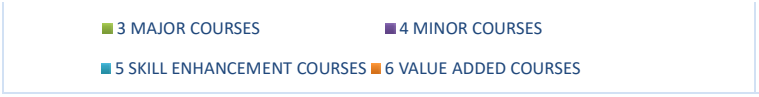


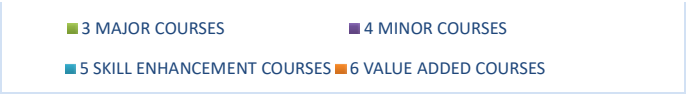
Number of Courses 4 Year B.Sc Microbiology (Hons) without Research



Total number of credits- 4 Year B.Sc Microbiology (Hons) without Research




3 MAJOR COURSES
4 MINOR COURSES
5 SKILL ENHANCEMENT COURSES
6 VALUE ADDED COURSES


3 MAJOR COURSES
4 MINOR COURSES
5 SKILL ENHANCEMENT COURSES
6 VALUE ADDED COURSES

Undergraduate Programme – B. Sc Microbiology Programme Outcomes

Programme Outcomes of UG Microbiology: Students of all undergraduate microbiology degree Programmes at the time of graduation will be able to

a. Scientific Knowledge: Microbiology majors able to make observations, develop hypotheses and design and execute experiments using advanced methods. Able to discuss science and scientific methodology. They will have a good knowledge of Intellectual Property Rights.

b. Laboratory Skills: Microbiology students will master the following laboratory skills: aseptic culture techniques, microscopy, use of appropriate methods to identify microorganisms. They are able to practice safe microbiology using appropriate protective and emergency procedures.

c. Able to Focus on innovation and entrepreneurial thinking to be successful in a changing world.

d. Problem-Solving Skills: Microbiology students will be able to analyze and interpret results from a variety of microbiological methods and apply these methods to analogous situations. Use mathematical and graphing skills and reasoning to solve problems and able to analyze data systematically.

e. Communication Skills: Students will demonstrate competence in written and oral communication.

f. Cooperation/Social Responsibility: Microbiology majors able to understand and appreciate the value of cooperating and working effectively with peers and be able to demonstrate a commitment to the process of developing such skills.

g. Able to understand the importance of microorganisms in various industries such as pharmaceuticals, food, biofertilizers and biopesticides etc.

h. Students able to gain the knowledge on concepts of immunology, biotechnology, molecular biology, biochemistry, genetics. Able to describe how microorganisms are used as model systems to study basic biology.

i. Identify ways microorganisms play an integral role in disease and microbial and immunological methodologies are used in disease treatment and prevention. Able to explain the beneficial and harmful role of microorganisms in environment.

j. Graduates are expected to be team players, with productive cooperation involving members from diverse socio-cultural backgrounds. Able to identify societal problem and develop solution for issue

k. Able to understand the special features of Bacteria, Virus algae, fungi and protozoa. Manipulate the microbes using various molecular biology techniques for the benefit of the society.

l. Students are able to explain the beneficial and harmful role of microorganisms in environment.

Programme Specific Outcomes (PSOs)

m. Students able to understand the Microbiology concepts as applicable to diverse areas such as Medical, Industrial, Environment, Agriculture, Food and others.

n. Demonstrate key practical skills/competencies in working with microbes for study and usein the laboratory as well as outside including the use of good microbiological practices.

o. Students able to identify challenging societal problems and plan his professional career to develop innovative solutions for such problems.

PROGRAMME EDUCATIONAL COURSE OBJECTIVES (PEOs)

Programme Educational course objectives of UG Microbiology: The major course objectives of the undergraduate course is

PEO-I: To impart knowledge on basic concepts of microbiology. To understand the beneficial and harmful role of microorganisms in the environment.

PEO-II: To understand the fundamentals of physiological reactions including metabolic pathways and biochemical reactions in microorganisms.

PEO-III: To develop human resource and entrepreneurs in Microbiology with the ability to independently start their own ventures or small biotech units in the field of biotechnology.

PEO-IV: Understand modern microbiology - practices and approaches with an emphasis in technology application in pharmaceutical, medical, industrial, environmental and agricultural areas.

PEO-V: Become familiar with public policy, bio-safety, and intellectual property rights issues related to microbiology applications nationally and globally

PEO-VI: Gain experience with standard bioinstrumentations and molecular tools and approaches utilized: manipulate genes, gene products and organisms.

PEO-VII: To demonstrate the written and oral communication skill. To develop the problem solving and data interpretation skills.

POs	**a**	**B**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**
PEO I	X							X		X		X			
PEO II	X							X	X			X	X		
PEO III				X			X	X			X				
PEO IV				X			X		X			X		X	
PEO V	X					X				X	X		X		X
PEO VI		X	X	X									X	X	
PEO VII	X		X	X	X										X

கற்˙பகம்˙ உயuகல்்˙வ் க்்˙க ழகம்்˙ மமuழ்் கள்் றற - தம்் ழ்்˙ப்் ்்் ்்் ்்் வு

˙F ˙ப

தமிழ்˙ ப˙ப டத˙திட˙டம˙ (2023-2024)

ம்0தல்˙பர்0வம்˙ - பக்தி – I, **தமிழ்˙, த ள்˙ 1 - 23LSU101** 4 - H, 4 - C**(இளந்் ்்் ்்் றவ அற்் வ்் யல்்˙ பட˙ட கள் ்்0u்்் ்்் ்்் ்்் யF) வக் ப்் ˙பு க்்க˙**

(For I-UG Science DegreeClasses)

றஇக˙கிய இன˙ பம˙

அலக் – I **(10 மண்் ்்் ்்் நuரம்்)˙**

சங்்˙க இற்் ்்் ்்் ்்் ்்் **யம் ்** **தuவக -** ங˙கங˙கள˙பற˙ற˙ ய மசய˙திகள˙– சு ஙக˙ இ க˙ ˙க˙ யத˙த˙ ன˙ **க்்க˙** ்் ்˙

கதuற˙று 0வuய˙– எட˙டுத˙மதuவக அறிமு 0கம˙

சங்்˙க இற்் ்்் ்்் ்்் ்்் **யம் ்** மசuல˙இ ˙ u˙ ˙ ˙–குறு ˙ ஞ˙சு ˙ –˙ ˙ **க்்க˙** ்் ்˙- தவஇ ˙வ கு Nற˙று 0 –1

µற்ற˙்் ்் ்்் ்் ்் ்்றண - ந னு ˙˙ற

– ்்்0த்் மு 0சு ச˙

எட்்˙ட ம் ்˙

சங்˙க ஞ˙சி – தஇ ˙ 0- 3 ்்் **யம்்˙ - க்்0ற்்0ந்்** வவி கு **த றக -** ந இ ˙ த˙ **றஇக்்˙க** ˙து Fம˙மuப˙ ˙ கத–கு 0று ற˙ற **ப**

றஅஇலக˙கியம - திர்்0வள்்˙ள்்0வர்்˙ – றள்்˙ (எண்்˙ கள்்˙-த்் ்்்0றள்்˙

குற் ப˙பன) **திர்்0க ர்்0க்்க˙** ்்்கு˙ **வu்்் ்்் ்்் ்்் வச எண்்˙ வணக்்˙**

பuயிரம˙ – 8 அறவuழி அந˙தணன˙,13 - விண˙ ன˙று மபuய˙ப˙பன˙, 34 - மனத˙Fக˙கண˙மuசு இ ˙ ன˙ஆதல˙

இல்்˙ற்் ற இயல்்˙ - இல்்˙வuழ்்˙க்்வக - 41- அன˙பு 0ம˙அறFம˙உவடத˙தu 50வவயத˙Fள˙வuழ˙வuங˙கு **அன˙ பி0வடவம** - 80 - ˙ ˙ ழு ˙ யF, **வ்் ்்் ்்் ்்் தuம்்பல்˙** - 90 – அனு ˙ப னு வ˙ **ர் ந்்க˙**

˙

.

கமuப க˙கு 0வ**இன்் ்் ்் யவவக்்@றல்்˙ -** 95 – பண வுவடயன
ு ப˙ ழய
ு 0மு,˙

னா˙மசuஇு ு ன˙, **மசய˙ நன˙ றி அற் தல˙ -** 103 – பயன˙□க˙கuர,˙ கு 0ற˙றம˙, **ஒப்் ˙ப ப்்0றங்்˙க்்@றuவம -** 190 – ஏது இு ு u˙ ர˙

்்0ரவ்0அற்் தல்்˙ - 216 – பயன˙மரம˙

ஈவக: 228 – ஈதFவக˙கு 0ம˙ ன˙பம˙, **Fறவற இயல்்˙ - தவம்்˙ -** 261 – உற˙றகநuய˙ **வuய்்˙வம -** 291 – வuய˙வம எனப˙படு 0வF, **மவக்்0ளuவம -** 306 - சு னமமன˙Fம˙ **இன்்˙னuமசய்்˙யuவம:** 316- ன˙னu எனத˙தuன˙உணரந˙தவவ **ந்் ்் ்் றவயuவம** - 331 – ந ல˙இு ு u˙ தவற˙வற, **ஊழ்் யல்்˙ - ஊழ்்˙ -** 373 – நு 0ண˙ண யநு Nல **ஆள்் ˙வ்் வன உவடவம** - 618 –மபuறியின˙வம யuரக˙ ˙கு 0ம˙, 620-ஊவழயு 0ம˙உப˙பக˙கம˙ **நட்்பு˙ -** 792-ஆய˙ந˙தuய˙ந˙F, 794-குடு ப˙பு றந˙F, 797-ஊது யம˙என˙பF **க்் ்் ்் ்் ்் த்் ்் ்் ்் கuரம்் :் ்˙ ப்் யம் ் ் ்˙-**
ப் ்˙ ச்் ்் ்் ்் ற்்
ப்் ப

மங்ௌ்ற **த்ௌ்**

கவuழ்ௌ

்த

ௌௌF்

கண்ண கு்

மன்க

ப்ௌ் பuடல்ௌ் - மபuது யு ல்ஆயு Fம் – ‘ககuஇ வன்என்பuன்

னu’(14

-38),‘நு

தuனத்F’ – ‘கநuன்பு என்வன’(48-53).

இ ா வி்

மவனயறம **கuவத** - ‘வuர்ஓ லிகு ந்தஇவ’’ – ‘ச் றபு ப் ா ் ன்

டு

ௌௌ ப் ௌ்

த

ௌ

ௌ

நடுங்கண’’ -

தனக்கு 0எ (84-90) **அரங்ௌ்ககற்ௌ ்று**

னு ’’ **கuவத -**

‘மuஇ மuா ்ம ா

‘அகம்மறந்F’ (170-175).

மத் **uண்டம்** - ளக·கuவத, ‘ கு 0ரவu ’’ - **0வரக்க·** · மகuவஇ க க· ரு மு 0து 0· ‘எழு 0ந·தனன· யuன’’ (67-
83), ‘வு வனவு வளகuஇ ம· ’’ - ‘ம க uணரகஈங·கு 0என’ (148-153)

கட·டுவர கuவத - ‘கடிமபuழில’’ - ‘ ல·சuபம·படட ன ர’ (138-170)

. **0வரக்·** வ மசய·தuரக·கு ’ - **வழக்க**(82-
93) **கuவத** -
‘அல·இ வ· ‘கதuற·றuன·உய’ர

வஞ **க்** வரம று’ (218-**ம்** - நடு 0கல·கuவத -234)
கuண்ட· u ’’ - **ச்** ‘மன·னவu ‘மது 0
ஏ

வuழ்·த்F· க்· **கuவத** - ‘என·கன ஃF’ - ‘கதuன·று 0மuல’’ (9)

எழ்0த ற் **ணம்·** - மு 0தல·மற·று 0ம·சuரமபழு 0த·Fகள·
தி· **க்க·**

அலக்0- 2 **(10 மண் நuரம்)·**

சங·க **uட·ட் 0 அற் ம் கம**
இலக்க· **யம் 0**
பத் **ப·– ப் ப த்·**

சங·க இலக்·க **த்F· :** - எறு பு · ணம· டறு ய க·–
யம் ஏழuம·பது ·F மசம·மறு 0· 65
·-
பத் **ற்** ·ற் **0ப்** **ப**

சங்·க இலக்·க **யம்·** - **கல்** **த றக:** அகன·ஞuஇ ம· ·வு ளக·கு
0ம·- மநய·தல·கலி – **த்ப**
தஇ வவு கு Nற·று 0- 119.

அற றஇக·க் யம· -ம் ன· ற் வறயவரயனuர· - பழமமuழி நuபறு 5 பuடல·கள· **க ப்் ·பயம்் ·-மண்் ்் ்் கமகறவ: வ் ழuவவறகuவத:**

‘கதவரு ம·மக·களு 0ம·’ -

‘மரு 0ங·கு 0என·’ (66-72) **ஊரற்் u்** **கuவத:** ‘நuவல·ஓங·கு ·ய’ - ‘உணு ·டு· மகuல·’ (1-17), **உவரத் த**

‘கறுற·· ா 0· த·தவறகபuகு ·ய’ – ‘தீத·மதuழு ல·படuஅள·’ (32-57).

ா 0·

பuத்்த· ்் ரம்் ·மபற்் ·றகuவத: ‘கபuது நு ா ழல·’ - ‘நல·அறம·கண·டவன’ (73-98)

ச்் கuட்ட· ம்் ·அறக்் ·க கuட்ட· ம்· ஆக்் ·க ்் யகuவத - ‘வuழிஎம·ககu’ - ‘அரசு 0ஆள·கவந·Fஎன·’

வறக்்க· (129-163)

மசuல்் ·றஇகணம்· - மபயuா · வு வன, வட, உuா · சமசuல·-வு ளக·கமு 0ம·பயு றச ா · யு 0ம·

்்க· ா ,·

றஅக்0் **– 3** **(10 மண் ்் ்் ்நuரம்)**்·

அறறஇக·கியங· கள· அறிமுகம·

சங்் ·க இலக்்க· ்் யம்் · - ப ்் ்் ்் ப டல்்·: வவவய: பuடல·-6. - ந வறகடல·மு 0கந·F உரuய·–

கசறுஆடு பு இ னFஇமசவு 0 1-50.

சங்் ·க இலக்்க· ்் யம்் · -அகநuன் ற்்0 - பு றம·தந·த எம·மு ஈன·று 0ம·உள·ளuள·–

பuஇ

வ– நற·றuய·கூற·று 0-35**அற யம்் · -ஔளவவயuர·- மகuன்் ·வற கவந்் ·த ன்்·** (1-50 பuடல·கள·) **றஇக்்கி·**

க ப் ·ப யம்் · - ச் ளuமண்் ்் ்் – ம்்- 1. நuவிகய கமழும·(1131), 2. கண·மு வச கன ·

அரசியல்் ·சர்்0க்்க·

ந˙த

(1132),3. வு ˙ வரமஇு சலு வு 0˙ ளூ ˙ து ¨(1133), 4 . அவரசu ˙ ் க˙ள˙வரு க (1134), 5. அரு 0ளூ மuறடு கள˙
(1135),

6. விஞ˙வசயருஇு ் க (1136), 7. மசuu ˙ கது ர˙(1137), 8. கu ˙ யவன˙வவளந˙த (1138), 9. மடு த˙தவuமயயு று (1139),10. விஞ˙சயரதவனக˙(1140), **ர் க˙கம˙** – பயuபது மன˙னன ன **Fறவுசச** Fறவுமநறி

-1. மன˙ன ய புகழி (1840), 2. து ரு மகு ழலங˙கன˙ (1841) , 3. ஆங˙கவ ரறணந˙த (1842), 4. அலகு டன˙ விளங˙கு (1843), 5. தன˙இு றநய ர˙அஇரச க˙கி (1844), 6. பசன˙இு ் µ˙ ் ˙
ள˙(1845),
7. எ பு றர (1846.), 8. ˙இு தர˙(1847), 9. ˙தµ ் ˙ ம˙(1848), 10. பத றகமலர˙(1849) பு இு ் ந பு இு ் ந

11. ஒழுகிய (1850).

1. வு˙ ணு ˙ண புப˙ ம˙எழு 0 தல˙
கவவஇ வண ˙ து 0˙
் க˙ ் ் ட˙

2.பல˙கஇு வக˙கழகப˙பன˙னuடடு 0க˙கருத˙தரங˙கச˙மசய˙து வய நuள தழு ல˙மவள யு ட கவண˙டி நuள தழு ன˙பது ப˙பuசு u ˙ யரு 0க˙கு க˙கடு தம˙

3. கரு த˙தரங˙கப˙பங˙ககற˙பு 0க˙கuன அFமது க˙கடு தம˙

4. பல˙கஇு வக˙கழக வு ழuவு 0க˙கு 0த˙தஇு வவமகயற˙க கவண˙டு , மuவட˙ட ஆட˙சு யரு 0க˙கு வு ண˙ணம˙ப˙

றஅகு – 5 **(8 மண்˙ ˙˙ ˙˙ நµரம்˙)˙**

Semester I

23ENU101 **English I** **(3H–3C)**

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

End Semester Exam: 3Hours **COURSE**

OBJECTIVES

- To enable the learner to communicate effectively and appropriately in real life situation To develop and integrate the use of the four language skills.
- To give basic knowledge on grammar.
- To train students to acquire proficiency in English by reading different genres of literature and learning grammar.
- To identify the meaning of words using context clues.

COURSE OUTCOMES

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

COs	Course Outcomes	BT Level
CO1	Retrieve fundamentals of English language to construct error free sentences.	Apply
CO2	Discover the knowledge of interpersonal skills.	Analyze
CO3	Construct and maintain social relationships.	Apply
CO4	Classify communication skills in business environment.	Understand
CO5	Explain communication competency through LSRW skills.	Understand

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

UNIT I **(07 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 **(07 Hours)**

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

UNIT III **(07 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 **(07 Hours)**

LISTENING: Story Narrations
SPEAKING: Group Discussion
READING: Reading Reports and Profiles **WRITING:**
Letter Writing
LITERATURE: Tyger by Wiiliam Blake
GRAMMAR: Subject and Predicate – Question Tags

UNIT V **(08 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

Books for Reference:

1. Wren & Martin, 2008, *High School English Grammar & Composition*, S. Chand & Company Ltd, Board of Editors,
2. Krashen, Stephen D (1982) Principles and practice in second language acquisition. New York: Pergamon Press.

Semester- I

23MBU101 INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY (6H- 5C)

Instruction Hours / week: L: 5 T: 1 P:0 **Marks:** Internal: **40** External: **60** Total:**100**

End Semester Exam: 3Hours

COURSE OBJECTIVES

- To provide a fundamental knowledge about history of microbiology and classification of microorganisms for advanced studies in biological sciences, particularly to improve their skills in Microbiology field.
- To understand the working principle, components, types and applications of microscope
- To provide an overview of the biology of algae, ii) use the study of algae to provide a basis for understanding the evolutionary pathways to higher plants
- To explain the viral structure, Replication and cultivation
- To describe the unique characteristics of fungi
- To explain about the prevention and control of protozoa

COURSE OUTCOME (CO'S)

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

COs	Course Outcomes	Blooms Level
CO1	After completion of this course, the students clearly understand the contributions of various scientists for development of microbiology field and skills associated with it.	Understand
CO2	This course will demonstrate the diversity of microbes and their applications.	Apply
CO3	Students will know about the various field of Microbiology	Apply
CO4	Students will know the viral genome, Replication and Cultivation	Analyze
CO5	Able to understand the special features of algae, fungi and protozoa	Analyze
CO6	Familiarize with morphologic criteria to differentiate the most common protozoan	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 1 2
CO1	**S**											
CO2	**M**											
CO3						**S**						
CO4							**S**					
CO5						**M**						

CO6							**S**					

S-Strong; M-Medium; L-Low

Unit I- History of microbiology **(10 Hours)**

Development of microbiology as a discipline, spontaneous generation vs biogenesis. Contribution of Anton von Leewenhoek, Golden era of Microbiology Louis Pasteur, Robert Koch, Joseph Lister, Alexander Flemming. Germ theory of disease, Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Ellie Metchnikoff, Edward Jenner. Role of microorganism in fermentation, Application in industries, medicine, agriculture, biotechnology and biology.

Unit II-Microscopes **(10 Hours)**

Microscope – principles and application – simple and compound microscope – dark field – phase contrast, fluorescent microscope, SEM and TEM.

Unit III- Classification of microorganisms **(10Hours)**

Bergey's Manual, Binomial Nomenclature. Classification system: Phenetic and Phylogenetic, Whittaker's Five Kingdom and Carl Woese's three kingdom classification system and their utility. Difference between prokaryotic and eukaryotic microorganism. Major diversity of microbial life. General characteristics of Bacteria, Bacterial ultra-structure and Nutrients. General characteristics of Actinobacteria.

Unit IV- Algae & Fungi **(15 Hours)**

General characteristics of algae including algal cell ultra-structure. Classification of algae-Chlamydomonas, Volvox, Diatoms, red algae and brown algae. Algal cell cultivation and preservation Application of Algae in agriculture, industry, environment and food. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure. Economic importance of fungi. Virulence factors of fungi causing infection. Classification of fungi.

Unit V- Virus & Parasites **(15 Hours)**

General properties of viruses – Structure, Genome, Replication and Cultivation. Morphology, classification, characteristics of Protozoa, Platyhelminthes, Molluscs, Echinodermata, Coelenterata, Porifera.

SUGGESTED READINGS

1. Tortora, G.J., Funke, B.R., and Case CL. (2014). Microbiology: An Introduction. 9thedition. Pearson Education.
2. Madigan, M.T., Martinko J.M., Dunlap, P.V., and Clark, D.P. (2014). Brock Biology of Microorganisms. 14thedition. Pearson International Edition.
3. Cappucino, J., and Welsh CT. (2020). Microbiology: A Laboratory Manual. 12thedition. Pearson Education Limited.
4. Wiley, J.M., Sherwood, L.M., and Woolverton, C.J. (2013) Prescott's Microbiology. 9th edition. McGraw Hill International.
5. Atlas, R.M. (1997). Principles of Microbiology. 2ndedition. WM.T. Brown Publishers.
6. Pelczar, M.J., Chan, E.C.S., and Krieg, N.R. (1993). Microbiology. 5thedition. McGraw Hill Book Company.
7. Stanier,R.Y., Ingraham, J.L., Wheelis, M.L., and Painter, P.R (2005). General Microbiology. 5thedition.McMillan.8
8. Duby, R.C. (2014) Textbook of Microbiology. 5th edition. S. Chand Publishing.

9. Talaro., Kathleen, P.T., Chess., and Berry, C., (2018). Foundations in Microbiology. (10th Ed). McGraw-Hill Higher Education, United States.

B.Sc. Microbiology **2023-2024**

Semester –V

23MBU102 **BIOCHEMISTRY I** **(5H–4C)**

Instruction Hours / week: L: 4 T: 1 P:0 **Marks:** Internal: **40** External: **60** Total:**100**

End Semester Exam: 3Hours

COURSE OBJECTIVES

- To provide the knowledge on basics of biochemistry and its applications.
- To describe the classification and functions of lipids.
- To summarize the structure and classification of enzymes
- To state the Structure and types of DNA and RNA
- To analyze the functions and properties of phosphoglycerides To understand about storage and structural polysaccharides.

COURSEOUTCOME (CO'S)

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

Cos	Course Outcomes	Blooms Level
CO1	Understand the structures of enzymes, proteins, carbohydrates and fats	Understand
CO2	Understand the functions of biomolecules	Understand
CO3	Analyze the process of metabolism	Analyze
CO4	Understand the nucleic acids and their importance to combine and analyses information.	Understand
CO5	Understand the Structure and classification of enzymes, specificity of enzymes	Understand
CO6	Summarize the DNA & RNA structure and base pairing schemes	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**S**											
CO2							**M**					
CO3		**M**										
CO4						**S**						
CO5									**M**			
CO6	**S**						**S**					

S-Strong; M-Medium; L-Low

Unit I- Carbohydrates (9 Hours)

Monosaccharides-families, stereo isomerism, epimers, Mutarotation and anomers. Forms of glucose and fructose, Fischer and Haworth projection. Sugar derivatives. Disaccharides- occurrence, concept of reducing and non-reducing sugars. Polysaccharides-storage and structural polysaccharides.

Unit II- Lipids (9 Hours)

Classification and functions of lipids. Storage lipids- structure and function of fatty acids. Triacylglycerols. Saponification. Structural lipids- structure, functions and properties of phosphoglycerides: glycogen and sphingolipids.

Unit III- Proteins (9 Hours)

Classification and functions of proteins and amino acids, Structure of amino acids and concept of zwitterion. Ninhydrin reaction. Natural modifications of amino acids in proteins. Non protein amino acids, Primary and Secondary structure of proteins- alpha helix, beta pleated sheet. Tertiary and quaternary structures of proteins. Structure of haemoglobin in mammals.

Unit IV- Enzymes (10 Hours)

Structure and classification of enzymes, specificity of enzymes. Michaelis-Menten equation, Km, Vmax, isoenzymes. Allosteric enzyme and its mechanism. Multienzyme complex. Enzyme inhibition.

Unit V- Nucleic Acids (11 Hours)

Nucleic Acids-Purines &Pyrimidines nucleotides, RNA, & DNA base pairing schemes, types of RNA: mRNA, rRNA, tRNA, Secondary structure of DNA, Watson and Crick model, Vitamins and its types.

SUGGESTED READINGS

1. Campbell, M.K. (2012) Biochemistry, 7th edition. Published by Cengage Learning.
2. Campbell, P.N., and Smith, A.D., (2011) Biochemistry Illustrated, 4thedition. Published by Churchill Livingstone.
3. Tymoczko, J.L., Berg, J.M., and Stryer, L. (2012) Biochemistry: A short course, 2ndedition. W.H.Freeman.
4. Berg, J.M., Tymoczko, J.L., and Stryer, L. (2011) Biochemistry, W.H. Freeman and Company. Nelson, D.Land Cox, M.M. (2008) Lehninger Principles of Biochemistry, 5thedition. W.H. Freeman andCompany.
5. Willey, M.J., Sherwood, L.M., & Woolverton, C. J. (2013) Prescott, Harley and Klein's Microbiology.9thedition. McGrawHill.
6. David L Nelson, Michael M cox, WH Freeman 2022. Lehninger Principles of Biochemistry, 8th edition.
7. Chakarapani. V, Sathyanarayana V 2020. Biochemistry, 5th edition, Elsevier.

B.Sc. Microbiology **2023-2024**

Semester –I

23MBU111 INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY (4H-2C) PRACTICAL

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

End Semester Exam: 6 Hours **COURSE**

OBJECTIVES

- To provide a strong base in the fundamentals of bacteria.
- To learn techniques and methods used in the cultivation and isolation of bacteria.
- To develop skills related to preservation of bacterial cultures.
- To learn about bacterial specialized structure using staining methods
- To learn the bacterial special structure capsule and spore
- To measure the bacterial size

COURSE OUTCOME (CO'S)

After Completion of this course candidate can able to demonstrate:

COs	Course Outcomes	Blooms Level
CO1	Theory and practical skills in staining procedures	Understand
CO2	Various Culture media and their applications	Apply
CO3	Various microbial culture techniques to obtain isolation of pure cultures of bacteria	Apply
CO4	Differentiate Bacterial endospore and capsule	Analyze
CO5	Able to analyze the Bacterial size	Analyze
CO6	Able to explain the bacterial motility and flagella	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			**S**									**S**
CO2									**M**			
CO3				**M**								
CO4								**S**				
CO5											**M**	
CO6			**S**						**S**			**S**

S-Strong; M-Medium; L-Low

EXPERIMENTS **(48 Hours)**

1. Preparation of different media: synthetic media BG-11, Complex media - Nutrient agar, Mac Conkey agar, EMBagar.
2. Examination of bacterial colony with morphological features.
3. Estimation of Colony Forming Unit (CFU) count by spread plate method/pour plate method.
4. Isolation of pure cultures of bacteria by streaking method - Quadrant, Continuous and T-streaking.

5. Preservation of bacterial cultures by various techniques - Agar slants and deeps - Mineral Oil, Glycerol stocks
6. Micrometry.
7. Motility by hanging drop method.
8. Simple staining
9. Negative staining
10. Gram's staining
11. Acid fast staining – demonstration permanent slide only.
12. Capsule staining 13. Endospore staining.

SUGGESTED READINGS

1. Madigan, M.T., Kelly, S.B., Daniel, H.B, Mathew, S and David, A.S (2017). Brock Biology of Micro-organisms. 15th edition. Parker J. Prentice Hall International,Inc.
2. Willey, J.M., Sherwood, L.M., and Woolverton, C.J.(2019). Prescott's Microbiology. 11thedition.McGraw Hill.
3. Talaro., Kathleen, P.T., Chess., and Berry, C., (2018). Foundations in Microbiology, 10thEd., McGraw Hill.
4. Benson's Microbiological Applications Laboratory Manual-Complete Version, 2015, 13th Edition, McGraw Hill.
5. Kathleen Park Talaro and Barry Chess, 2018. Foundations in Microbiology: Basic Principles,10th Edition, McGrawHill
6. Cappucino, J., and Sherman. N. (2010). Microbiology: A Laboratory Manual. 9thedition. Pearson Education Limited

B.Sc. Microbiology **2023-2024**
Semester I

23MBU112 **BIOCHEMISTRY - I PRACTICAL** **(4H–2C)**

Instruction Hours / week: L: 0 T: 0 P:4 **Marks:** Internal: **40** External: **60** Total:**100** **End Semester Exam:** 6 Hours

COURSE OBJECTIVES

- To familiarize the students with the basic cellular processes at molecular level
- To make students familiar with practical techniques used for studying biochemical structure and analysis of biochemical methods.
- To expertise in Qualitative/Quantitative tests of carbohydrates, reducing sugars, Protein and lipids
- To study the protein secondary and tertiary structures
- To study the effect of temperature, pH and heavy metals on enzyme activity.
- To gain the knowledge on vitamin estimation

COURSE OUTCOME

Upon the completion this course student will acquire

COs	Course Outcomes	Blooms Level
CO1	The practical knowledge and the skills associated about various techniques used in Biochemistry.	Understand
CO2	The skill in qualitative and quantity analysis of carbohydrates, protein and lipid	Apply
CO3	An understanding in protein secondary and tertiary structures	Apply
CO4	An insight in enzyme activity and its physical factors influence the activity	Analyze
CO5	Knowledge on vitamin estimation	Analyze
CO6	Cognitive skill and students able to solve the numerical problems	Understand

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		**S**										
CO2								**M**				
CO3			**M**									
CO4							**S**					
CO5										**M**		
CO6		**S**										

S-Strong; M-Medium; L-Low

EXPERIMENTS (48 Hours) 1. Properties of water, concept of pH and buffers, preparation of buffers and numerical problems to explain the concepts of molarity, normality and their calculation.

2. Numerical problems on calculations of standard free energy change and equilibrium constant.
3. Standard free energy change of coupled reactions.
4. Qualitative tests for carbohydrates, reducing sugars, and non-reducing sugars.
5. Qualitative tests for lipids and proteins.
6. Quantitative tests for carbohydrates.
7. Quantitative tests for proteins.
8. Study effect of temperature, pH and heavy metals on enzyme activity.
9. Estimation of any four vitamins.

SUGGESTED READING

1. Campbell., M.K.(2012) Biochemistry,7thedition. Published by Cengage Learning.
2. Campbell, P.N., and Smith, A.D. (2011) Biochemistry Illustrated, 4thedition. Published by ChurchillLivingstone.
3. Tymoczko, J.L., Berg, J.M., and Stryer, L. (2012) Biochemistry: A short course, 2ndedition.
4. Berg, J.M., Tymoczko, J.L. ,and Stryer, L.(2011) Biochemistry,W.H.Freeman andCompany.
5. Nelson,D.L.,andCox,MM..(2008)LehningerPrinciplesofBiochemistry,5thEdition.W.H.Freeman and Company.
6. Willey, M.J. Herwood, L.M. &Woolverton,C.J. (2013) Prescott ,Harley and Klein's Microbiology 9thEdition. McGrawHill
7. Voet,D,.and Voet,J.G. (2004) Biochemistry 3rdedition, John Wiley andSons.
8. Donald voet, J.G. Voet, CW Pratt Fundamentals of Biochemistry, CBS Publishers.

Semester – I

23VAC101 ENVIRONMENTAL STUDIES (2H–2C)

Instruction Hours / week: L: 2 T: 0 P:0 **Marks:** Internal: **40** External: **60** Total:**100**
End Semester Exam: 3Hours

COURSE OBJECTIVES

The main objectives of the course are

- To create awareness about environmental problems among people
- To develop an attitude of concern for the environment
- To motivate public to participate in environment protection and improvement
- To learn about the environment, resources available, biodiversity and its conservation
- To understand the current scenarios- to find ways for protection and betterment of or habitat
- To understand the concepts and methodologies to analyze the interactions between social and environmental processes

COURSE OUTCOMES

The learners will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the concepts and methods from ecological and physical sciences and their application in environment.	Understand
CO2	Study the concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions	Understand
CO3	Learn the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems	Apply
CO4	Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales	Apply
CO5	Apply systems concepts and methodologies to analyse and understand interactions between social and environmental processes	Apply
CO6	Creating the awareness about environmental problems among people	Create

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				**S**								
CO2										**M**		
CO3					**M**							

CO4									**S**			
CO5												**M**
CO6				**S**								

S-Strong; M-Medium; L-Low

Unit I **(4 Hours)**

INTRODUCTION - ENVIRONMENTAL STUDIES & ECOSYSTEMS:

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 **(4 Hours)**

NATURAL RESOURCES - RENEWABLE AND NON-RENEWABLE RESOURCES:

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 ground water.

Unit III **(4 Hours)**

BIODIVERSITY AND ITS CONSERVATION:

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 **(6 Hours)**

ENVIRONMENTAL POLLUTION:

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

Unit V **(6 Hours)**

SOCIAL ISSUES AND THE ENVIRONMENT:

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).

SUGGESTED READINGS:

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 AgeInternational Pvt. Ltd. Publications, New Delhi.
3. Arvind Kumar. 2009. A Textbook of Environmental Science. APH Publishing Corporation, New Delhi.
4. Botkin., and Keller. 2014. Environmental Science: Earth as a Living Planet. (9th ed.) Wiley
5. Mishra, D.D. 2010. Fundamental Concepts in Environmental Studies. S.Chand & Company Pvt. Ltd., NewDelhi.
6. Odum,E.P., Odum, H.T. and Andrews, J. 1971. Fundamentals of Ecology. Philadelphia: Saunders.
7. Rajagopalan, R. 2016.Environmental Studies: From Crisis to Cure, Oxford University Press.
8. Sing, J.S., Sing. S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand &Publishing Company, New Delhi.

9. Singh, M.P., Singh, B.S., and Soma, S. Dey. 2004. Conservation of Biodiversity and Natural Resources. Daya Publishing House, New Delhi.
10. Tripathy. S.N., and Sunakar Panda. (2011). Fundamentals of Environmental Studies (3rd ed.). Vrianda Publications Private Ltd, New Delhi.
11. Uberoi, N.K. 2010. Environmental Studies. (2nd ed.). Excel Books Publications, New Delhi.
12. Verma, P.S., and Agarwal V.K. 2016. Environmental Biology(Principles of Ecology).S. Chand and CompanyLtd, New Delhi.

கற·பகம· உயuகல· வ் க·கழகம·

மமuழ்் கள்் Fவற – தம் ழ்·

ப்் ப· u்் ்் ்் ்் வு தம் ழ· ப·

பuடத·த் ட·டம· (2023-2024)

இரண· டuம· பர் வம· -பக் தி – I, **தமிழ· , த ள·** II - **23LSU201** 4 - H, 4 - C

(இளந்் ்் ்் றவ அற்் வ்் யல்் பட்ட·
வக்்0ப்் ·ப ்்0கள்்0க்்0u்் ்் ்் ்் யF) (For I-UG ்்க·
Science Degree Classes) றஇக·கிய மநறிகள·

றஅகு – I **(8 மண நநரம·)**

நuயன்· மuர்் ்க ள்் : தமு ழ·இ க·கு ய வu· வசயு ல·து ருமு 0வறகளு 0ம· நuஇ u· யு ரத· து வ·யப·பு ரபந·தமு 0ம·

–பன·இ · ரு து ரு 0மு வறகள·அறு மு 0கம·– து ரு 0மு வற ஆசு u· யரகள ன·இ க·கு யப·

பங·கள
ப·பு

வசவம்-·் மபu்் ்் ்் ்் யபுரuணம்·் - கuவரக·கuல· அம·வமயuர· புரuணம· .

முக·கூடற·பள· ளு - 2 பuடல·கள·- சித·து ரக·கuலிவuஇ u· ன·(மநல·வவகளை) கு ற·றuஇ த· ·து u· கு டமuல·வவர (மீன·வவகளை, கuவள வவகளை)

கவிவத : மகuகவி பuரதியuர· - கயuகசித·தி

கவ் வத : கவ் மண கதசிக வ் நuயகம்·் **பள்் ·வள** -
வuழ·க·வகத·தத·Fவங·கள·

கவ்் ்் ்் ்் வத : கவ்் ்் ்் ்் ்் ்் ்் ்் ்் ்் ரமண்் ்் ்் வuழ ·வக ்் **யம்** ் ் ் க· ்· - பு 0· ்் **ஞu்** **ச்் 0கந்்** **ச்்** **த்்·** **0ப் ப** வதயு ணு ட·

ச்் ் ் ற்் 0கவத : மகuமசuற்் - பு 0· வமப · ·து த· **ம்்·** து 0· ப· ன·

றஇக்்கணம்் - வuக்்க ்்் யஅவமப்்் ்பு : இ து வuக்்கு யம்் – மதuடரவuக்்கு யம்் – இ் கவவவuக்்கு யம்்-

தன்்வு இ் வ வuக்்கு யம்் – பு றவு இ் வ வuக்்கு யம்்- மசய்்வு இ் வ, மசயப்்பuடடு 0 வு இ் வவuக்்கு யம்், கட்்டவளவuக்்கு ் யமு ்் – வ்் இ் ் u் வuக்்கு ் யமு ்் – உணரச்் ் ச ் ் வuக்்கு ் யமு ்்நன்்பல்் –

மபuF்வு ் யலு ்் - அறு 0வவகவு இ் ் u் (385) - எண்் வவகவு வட (386)

.

றஅகு– 2 **(8 மண நநரம்்)**

ஆழ்்்வuரகள்்் : இ க்்கியப்்பங்்கள பபு 0் - து வ்்யப்்பு ரபந்்தத்்து ல்்பக்்து மநறு யு 0ம்்இ் க்்கு ய நயமு 0ம்் **உவரநவட :** கதuற்்றமு 0ம்்வளரசசு யு ம்் **வவணவம்்் : மபuப்்் ்்் ்்் ்்் ்்் யuழ்்்வuர்்் த்்் ் – பத்்த் uம்்் ர்்0மமuழ்்் : 3-ஆம்்் பத்்் :**

த்ं ர்ं0மமuழி ‘மநறு நˑதகரு 0ஙˑகு 0ழலˑமடவuயˑ’ – சீவதகˑகு அFமனˑமதuˑ விதˑஅவடயuளமˑ.

கவ்ं வத - கவ்ं ஞரˑ வவரமுத்ंFˑ -

வு தˑது யuசமuஇˑ ˑ துuஇˑ uˑ டடுˑ**ச்ं ற்ं ˑப பuறிச்ं0ப்ंப**ˑ

ரமண்ं ंं ंं யன்ंˑ - பuரதி எஙˑகளˑகணˑமண

அரங்ंˑக பuuஂं - கணˑணு ˑ uˑ !

ं ं ं கணˑ ணˑ ˑ

ˑ uˑ ˑ !ˑ

தம்ं ंं ंं ंं ழற்ं சுசˑ ரபமˑதணு ˑ பuணு ˑ சு 0ˑ வuமு ˑ களு ¨- 10 பuடலு

ங்ंˑகuரம்ंˑ கˑ ளˑ

– ˑ ட

வணு ணˑ

1. கடலˑநு ˑ uˑ ˑ லˑகலˑமு தகˑகு 0மˑ, 2. வணˑடமு ழˑஆறˑறு 0து , 3. ககuளதˑவத மு 0டˑடி

4. எகˑகuஇˑ ˑ மˑ ˑஎனˑறு 0, 5. கடவு Nரˑமயuஇˑ ˑ தˑமதuர,ˑ6. கதவuது கதவனˑ, 7.

வு ணˑமuuˑ

ˑ ,

8. இ 9. அழு 0கதஙˑகு நஞˑசு டˑட, 10. அதˑதஇˑ வமபuதF.

கதவரˑ முˑ ˑ

வர,

ச்ं ற்ं0கவத : ஆu. ச் டuமண்ं ंं ंं - அநˑந யuˑ ˑ ˑ கள

கட்ं வர : றன்ंˑ அற்ं கவuம்ंˑ- தனˑஇˑ ˑ மˑ ˑபிகˑவக மuத தழு லு ரு நˑF

டுˑ ஆள் வமத்ंˑதி அண்ं ंं ंं ணம்ंˑ : உவவமயண – பு று Fமமuழு

தலˑஅண – சு இ கவட அண – **றஇக்ंக**ˑ து வக அண- ஏகததச உரு வக அண – கவறˑறுவமயண –

பினˑவருந

இ வயண

றஅகு - 3 **(8 மண நநரம்)**

ப்0Fக்க் வ்0 வத - சு யு
கதuற்றமு 0ம் 0ம் வளரச்

் யு
0ம்

சிற்0 ்ற் ற்0 க்க் ்0 யம்0் -

சி
கதuற்றமு 0ம்வளரச

மத்0 0வரமசu நuதர்0் - தமு ் ு ் டு 0□து 0் – தமு ் ழு ் னு பuடு யரு0ள uட ம்்
்சு ்

க்0 க் 0் ழு வ்் றபு ப ு் பத்து 0் பு ப் டு

-

வு ளம்பக்ககள்.

கவ் வத- ஈகரuட்0தம்0 ழன்0் பன்0் – ன் இு மuரு சு 0தந்து ரம்**சிறுகவத -**
க் . அழக் u்0 0்0 0்0 0 0 சuமி -
ருவர்கண்ட **வர - ஔளவவFவரசuமி**
- ஒகரஇு கவு **கட்0டு**் ஏடடு ல்
ல்இு ு u் த இ க்கு யம்

பவடப் ற்0 ்0 யப்0் பயிற்0 ்சிகள்0் - மரபு க்கவு வத, பு 0Fக்கவு வத, சு று
்ப க்0க் 0கவத, கடடு 0வர பவடப்ப க்க உத்திகள்–பயு
ற்சிகள்

அலகு – 4 **(8 மண நநரம்)**

ச் 0்ற்0் கவத - நத றற்றமு 0ம்வளரசசு யு 0ம் **ப் ்ப ரண –**
கல்0் கதவuசு ரம், உடலு ன்கமல், மநடு 0ங்கு 0து வர
ங்0்கத்0்F்
மிவசக்இு கவண,விரு ந்து இு ு ரு 0ம்வறு யவரு
0ம், தவரமகள்தன்மகuழு நன்றன், மபuரு
தடக்வகவuமளங்கக, மவயில்தuவர.

அர் ள˙ தர் ம˙ ப் ங˙ ககuவதயன˙ றவ அந˙தuதி - 11பuடல˙கள˙

1. பகவன˙மபயவர, 2.மமல˙லியல˙கஇமவ,3.வuலின˙கு ரங˙கு , 4.தவகள வள˙, 5.சு 0ரக˙கு 0ம˙
து ˙ ரு 0வரு டு ,˙˙6.வது ˙ வuய˙வு ˙ சபுக˙ பuூ ˙, வளபயு லு ,˙˙7.உவறவuன˙, 8.பசு வ˙˙ ˙

9.வு ˙ த˙தகமு ,˙ 10.Fவணயuய˙, 11.இூ கந˙தuர.˙

Semester – II (3H–3C)

23ENU201 **ENGLISH II**

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

End Semester Exam: 3Hours

Course Objectives

- To refresh the grammar knowledge of the students to improvise their language.
- To make the students to speak and write errors free English.
- To make the students understand different kinds of communication.
- 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

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

COs	Course Outcomes	Blooms Level
CO1	Strengthen the foundation of the language to elevate the command of standard grammar.	Remember
CO2	Formulate and communicate persuasive arguments for specific business outcome.	Apply
CO3	Utilize fundamentals of language for reading, writing and effective communication.	Apply
CO4	Standardize and demonstrate understanding of LSRW skills.	Understand
CO5	Introduce literature to enhance the moral and aesthetic values.	Evaluate

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			L									
CO2							S					
CO3					S							
CO4								L				
CO5		L										
CO6					S							

S-Strong; M-Medium; L-Low

UNIT-I **(6 Hours)**

Listening **:** Listening for Pleasure (Poetry)

Speaking **:** Developing speaking skills

Reading : Reading strategies

Writing : Developing a story with pictures

Literature : Refuge Mother and Child by Chinua Achebe

Grammar : Voice

UNIT- II **(6 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

Grammar : Subject, verb, agreement

(6 Hours)

UNIT-III 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 **(6 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 **(6 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

Books for References

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

Semester – II

23MBU201 MICROBIAL PHYSIOLOGY AND METABOLISM (6H–5C)

Instruction Hours / week: L: 5 T: 1 P:0 **Marks:** Internal: **40** External: **60** Total:**100**
End Semester Exam: 3Hours

COURSE OBJECTIVES

- To provide brief description on the microbial metabolism and its pathways
- To explain the various aerobic and an aerobic process through which the organisms obtain and utilize the energy for their growth and to produce industrially important products.
- To explain photosynthesis and photosynthetic bacteria
- To study the structure, function, growth, and regulatory mechanisms of microorganisms.
- To learn about the metabolic diversity exhibited by microorganisms.
- To explain the networks that supports the survival and growth of the microorganism.

COURSE OUTCOME

Upon the completion this course student will acquire

Cos	Course Outcomes	Blooms Level
CO1	The students will be able to understand and predict the various metabolic reactions in microbial cell.	understanding
CO2	This will make them predict the intermediate products which can be employed in industrial production processes.	applying
CO3	Students will understand the microbial growth, nutrition and environmental factors.	understanding
CO4	Students will be able to assess the prokaryotes by observing the biochemical reaction.	Evaluating
CO5	This course will support them to understand the concepts of microbial physiology	understanding

Mapping with Programme Outcomes

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

S- Strong; M-Medium; L-Low

Unit I- Microbial nutrition (10 Hours)

Microbial nutrition– Nutritional groups of microorganisms, (Carbon, energy and electron source), Nutrient requirements: Macro and micronutrients with their physiological functions. Uptake of nutrients by cell – Passive, Facilitated diffusion, Active transport- Uniport, Symport, Antiport. Group translocation and Iron uptake.

Unit II- Microbial growth and concept of Fermentation (10 Hours)

Growth; bacterial cell division, Growth curve - Different phases of growth curve - generation time, growth rate and growth kinetics. Methods of measuring microbial growth. Batch, fed-batch, Continuous and Synchronous culture, Diauxic growth, Influence of environmental factors on growth (Temperature, pH, solute, water activity, oxygen and pressure). Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways.

Unit III- Carbohydrate metabolism (10 Hours)

Carbohydrate metabolism – EMP, ED, Pentose phosphate pathway, TCA cycle, Aerobic respiration, oxidative phosphorylation, electron transport chain (Prokaryotic and Eukaryotic), substrate level phosphorylation. Uncouplers, inhibitors and ionophores. Chemical coupling, conformational coupling and chemiosmotic hypotheses.

Unit IV- Nitrogen metabolism (10 Hours)

Nitrogen Fixation – Nitrogen fixers, Physiology of nitrogen cycle and mechanism of nitrogen fixation- Symbiotic and non symbiotic Assimilatory and dissimilatory nitrate reduction, biological nitrogen fixation. Anaerobic respiration with special reference to dissimilatory nitrate reduction – Denitrification: nitrate/nitrite and nitrate/ammonia respiration; fermentative nitrate reduction.

Unit V- Phototrophic metabolism (10 Hours)

Phototrophic metabolism- Historical account of photosynthesis, diversity of phototrophic bacteria, Photosynthesis – bacteria and cyanobacteria: anoxygenic (Purple, green bacteria) and oxygenic (cyanobacterial) photosynthesis. Photosynthetic pigments: action and absorption spectrum, type, structure and location, physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation.

SUGGESTED READINGS

1. Madigan, M.T., Kelly, S.B., Daniel, H.B, Mathew, S and David, A.S (2017). Brock Biology of Micro-organisms. 15th edition. Parker J. Prentice Hall International, Inc.
2. Willey, J.M., Sherwood, L.M., and Woolverton, C.J. (2019). Prescott's Microbiology. 11th12 the dition.McGraw Hill.
3. Talaro., Kathleen, P.T., Chess., and Berry, C., (2018). Foundations in Microbiology, 10th Ed., McGrawHill.
4. Benson's Microbiological Applications Laboratory Manual CompleteVersion,2015,13th Edition, McGrawHill.
5. Kathleen Park Talaro and Barry Chess, 2018. Foundations in Microbiology: Basic Principles, 10thEdition, McGrawHill
6. Moat,A.G.,and Foster,J.W. (2002).Microbial Physiology. 4thedition. John Wiley& Sons. Reddy, S.R., and Reddy, M. (2007). Microbial Physiology. Scientific Publishers India

2023-2024

Semester – II

23MBU202 **BIOCHEMISTRY II** **(6H–5C)**

Instruction Hours / week: L: 5 T: 1 P:0 Marks: Internal: **40** External: **60** Total:**100**
End Semester Exam: 3Hour **COURSE**

OBJECTIVES

- To provide the informative understanding on Advances in Biochemistry and its applications.
- To study the various metabolic pathways and energy generation.
- To understand the free energy and electron carriers
- To gain knowledge on carbohydrate, lipid and protein metabolism
- To provide an understanding of the principle concept of biochemical compounds
- To gain information and detailed understanding of biological oxidation

COURSE OUTCOME (CO'S)

Upon completion of this course students will be able to

Cos	Course Outcomes	Blooms Level
CO1	Understand the metabolic pathways of carbohydrates, proteins, Lipids and Nucleic acid that improve their skills.	Apply
CO2	This course will provide clear understanding about the fattyacid oxidation.	Understand
CO3	Students will analyze structural functional relationships of genes and proteins from bacteria to eukaryotes.	Apply
CO4	Students able to demonstrate the carbohydrate, protein and nucleic acid	Apply
CO5	Students able to understand the metabolism of carbohydrate, protein and lipid.	Understand
CO6	Students can understand the energy generation.	Apply

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

Unit I- Introduction to metabolism **(10 Hours)**

Anabolism and catabolism - Definition. Bioenergetics - Thermodynamics principles, Concepts of free energy, Standard free energy, Mitochondrial Electron Transport Chain: electron carriers, chemiosmotic theory and ATP production, High Energy phosphate compounds, Inhibitors of electron transport chain and Redox potential and uncouplers of oxidative phosphorylation.

Unit II- Carbohydrate metabolism (10 Hours)

Glycolysis, TCA cycle, Glycogenesis, Glycogenolysis, HMP shunt, Gluconeogenesis, Glucuronic acid pathway. Regulation of glycogen metabolism. Oxidative Phosphorylation.

Unit III- Lipid metabolism (10 Hours)

Fatty acid oxidation – α, β, ω oxidation. Biosynthesis of saturated and unsaturated fatty acids. Metabolism of cholesterol, triglycerides and ketone bodies.

Unit IV- Protein metabolism (10 Hours)

Synthesis of Aliphatic and aromatic amino acids. Degradation of proteins: Deamination, Transamination and Decarboxylation, Urea cycle. Synthesis of ketogenic and glucogenic amino acid.

Unit V- Nucleic acid metabolism and Biological oxidation (10 Hours)

Biosynthesis and degradation of purine and pyrimidine nucleotides. Interconversion of nucleotides.

SUGGESTED READINGS

1. Fundamentals of Biochemistry, J.L. Jain, S.Chand publications,2004.
2. Lehninger's Principles of Biochemistry (2000) by Nelson, David l. and Cox, M.M. Macmillan /Worth,NY.
3. Harper's Biochemistry Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell,24th
4. edition, Prentice Hall International. Inc.
5. Principles of Biochemistry, Geoffrey L. Zubay, 3rd edition William W. Parson, Dennis E. Vance, W.C.Brown Publishers,1995.
6. Principles of Biochemistry, David L. Nelson, Michael M.Cox, Lehninger, 4th edition, W.H. Freeman and company.
7. Biochemistry, LubertStryer, 4th edition, W.H. Freeman & Co,1995.
8. Fundamentals of Biochemistry (1999) by Donald Voet, Judith G.Voet and Charlotte W Pratt, John Wiley& Sons, NY.
9. Molecular Biochemistry II"Nucleotides: Their Synthesis and Degradation". 2014.

2023-2024

Semester – II

23MBU211 MICROBIAL PHYSIOLOGY AND METABOLISM PRACTICAL (4H–2C)

Instruction Hours / week: L: 0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total:**100**
End Semester Exam: 9 Hour **COURSE**

OBJECTIVES

- To enhance the students' knowledge on various aspects of microbial physiology like growth, extremophiles studies and chemical characterization of microbes.
- To improve their skills in handing of microorganisms
- To analyze the growth condition of the bacteria.
- To facilitate the students to deal with the bacterial strain
- To demonstrate the fermentation technique
- To demonstrate the generation time and thermal death time of bacteria

COURSE OUTCOME (CO'S)

Upon completion of this course students will be able to

Cos	Course Outcomes	Blooms Level
CO1	The students will be able to analyze the bacterial growth and growth condition	Understand
CO2	Able to identify the various factors for optimal growth of E.coli.	Apply
CO3	Understand the basic microbial structure and functions of various physiological groups of prokaryotes	Understand
CO4	Able to apply various culture media in the proper physical condition for fermentation	Analyze
CO5	Able to explain the microbial metabolism and their physiological interaction for cellular function.	Apply
CO6	The students will be able to analyze the bacterial growth and growth condition	Remember

Mapping with Programme Outcomes

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

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

EXPERIMENTS (40 Hours)

1. Study and plot the growth curve of E. *coli* by turbidimetric and standard plate count methods.

2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data
3. Effect of temperature on growth of E. *coli*
4. Effect of pH on growth of E. *coli*
5. Effect of carbon and nitrogen sources on growth of E. *coli*
6. Effect of NaCl on growth of E. *coli*
7. BiochemicalCharacterization:
8. IMViC test
9. TSI Test
10. Nitrate reductionTest
11. Urease productionTest
12. CatalaseTest
13. OxidaseTest
14. Carbohydrate fermentationTest
15. Demonstration of alcoholic fermentation
16. Demonstration of the thermal death time and decimal reduction time of E. *coli*.
17. Lecithinase and gelatin liquefaction activity.

SUGGESTED READINGS

1. Madigan, M.T., Kelly, S.B., Daniel,H.B, Mathew, S and David, A.S (2017). Brock Biology of Micro-organisms. 15th edition. Parker J. Prentice Hall International,Inc.
2. Willey, J.M., Sherwood, L.M., and Woolverton, C.J. (2019). Prescott's Microbiology. 11thedition. McGraw Hill.
3. Talaro., Kathleen, P.T., Chess., and Berry, C., (2018). Foundations in Microbiology, 10th Ed., McGrawHill.
4. Benson's Microbiological Applications Laboratory Manual-Complete Version,2015, 13th Edition, McGrawHill.
5. Reddy, S.R., and Reddy, S.M. (2007). Microbial Physiology. Scientific PublishersIndia

2023-2024

Semester – II

23MBU202 BIOCHEMISTRY II - PRACTICAL (3H–1C)

Instruction Hours / week: L: 0 T: 0 P:3 Marks: Internal: **40** External: **60** Total:**100**
End Semester Exam: 6 Hour

COURSE OBJECTIVES

- To familiarize the students with some basic analytical techniques in Biochemistry that improve their skillsassociated with laboratory techniques
- To gain knowledge with these techniques used for purification
- To know principle behind the compound purification
- To measure the protein using standard method
- To analyze the lipid using routine test
- To determine the physical factors and substrate concentration of protein

COURSE OUTCOME (CO'S)
Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the metabolic pathways of carbohydrates, proteins, Lipids and Nucleic acid that improve their skills.	Apply
CO2	This course will provide clear understanding about the Biological oxidation.	Understand
CO3	Students will analyze structural functional relationships of genes and proteins from bacteria to eukaryotes.	Apply
CO4	Students able to demonstrate the carbohydrate, protein and nucleic acid	Apply
CO5	Students able to comment on metabolism of carbohydrate, protein and lipid.	Understand

Mapping with Programme Outcomes

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

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

EXPERIMENTS **(30 Hours)**

1. Separation of sugar by paper chromatography
2. Separation of amino acid by thin layer chromatography
3. Separation of plant pigments by thin layer / column chromatography
4. Estimation of carbohydrate by anthrone method
5. Estimation of Protein by Lowry'smethod
6. Estimation of Cholesterol by Zak'smethod
7. Estimation of Phosphorus by Fiske Subbarowmethod
8. Estimation of starch.
9. Extraction and estimation of chlorophyll in plant tissue

SUGGESTED READING

1. Biochemical Methods 1992, by S. Sadasivam and A. Manickam, Second Edition, New Age International Publishers, NewDelhi
2. Laboratory Manual in Biochemistry, 1981. J. Jayaraman, New Age International publishers, NewDelhi.
3. Laboratory Manual for Practical Biochemistry (2013), Shivaraja Shankara Ym2nd Edition. Jaypee Publishers.
4. A Laboratory Manual of Plant, Physiology, Biochemistry and Ecology 2012. Akhtar Inam. ISBN: 9788177544589 Agrobios Publisher, India.

23VAC201 **VALUE ADDED COURSE**
INDIAN KNOWLEDGE SYSTEM

Instruction Hours / week: L: 2 T: 0 P:0 **Marks:** Internal: **40** External: **60** Total:**100**
End Semester Exam: 3Hours **COURSE**

OBJECTIVES:

- To make the students
- To understand the Indian knowledge systems about origin, evolution and ontological approach
- To comprehend the Indian knowledge approaches with respect to time and language
- To obtain key knowledge on life and mind of Indian knowledge system
- To acquire key information on torchbearers of Indian knowledge system
- To attain strong knowledge on the role of Women in ancient and modern India

COURSE OUTCOMES:
Learners should be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the rich heritage that resides in our traditions.	Understand
CO2	Comprehend the Indian knowledge	Understand
CO3	Understand the importance of philosophical concepts	Understand
CO4	Understand the origin of Indic thought and practices	Understand
CO5	Understand role of Women in ancient and modern India.	Understand

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

UNIT I **(4 Hours)**

Tradition - 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 **(4 Hours)**

Time and Language - 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 **(4 Hours)**

Environment and Management - 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 **(4 Hours)**

Life and Mind - 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 **(4 Hours)**

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

SUGGESTED READINGS:

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

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

B.Sc/B.Com/BBA **2023-2024**

Semester II

23VAC202 YOGA FOR YOUTH EMPOWERMENT 3H2C

COURSE OBJECTIVES:

To make the students

1. To create awareness about Yoga and Physical Health
2. To providing Value Education to improve the students character understanding Greatness of Life force and Mind
3. To know about five aspects of life and to develop good Qualities and eliminating bad ones
4. Learning introspection practices like Analysis of Thoughts, Moralization of Desires, Neutralization of Anger and Eradication of Worries Diversity in Men (Why Men Differ).
5. To understand about the yoga, life and practice Yogasanas.

COURSE OUTCOMES:

Learners should 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: 1 **(8)**

Yoga and Physical Health

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 Hastha Uttanasana 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:2 **(7)**

Greatness of Life force and Mind

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:3 **(7)**

Personality Development - Sublimation

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 (Auto suggestion) Family blessing Blessing the others World blessing- Divine protection
Human Values: Set-cortio- Sell-confidence Honesty Contentment Humility Modesty To erance Adjustment- Sacrifice-Forgiveness Punty (Bocy, Dress, Enviorment) Physica purity- Mental purity-Spiritualpurity. Social Values: Nonviolence-Service Patriotism-Equality Respect for parents and elders care and protection Respect for teacher Punctuality-Time Management

UNIT: 4 **(7)**

Human Resource Development

Morality (virtues): Importance of Introspection: 1 Mine (Ego, Possessiveness) Six Evi Temperaments-Greed-Anger-Miserliness Immoral sexual passion - Inferionty 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: 5 **(7)**

Law of Nature

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

Text Book

Yoga for Yotuth 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

ஃ ஃ ஃஃ ஃஃ ஃஃ ட·டப் ஃஃ ·பப்ஃ மி·

டத்ஃ F ந)ஃஃ **க்ஃக்ஃ· த்ஃ·** ண ம·0இது·ன ு·து ··

பமு ·

1. நுத·· ு·யகு டு·யுரு· டுட·

·கு 0· லமபு ப··

மதரவு 0· களூ· ப இு டம·க டம·மபறுகின·ற,‘தமிழ

·ு ··, வு · ு·

ரு 0பு ப·· ப

இ க·கியஇவர று’ குறித·த முழுலமய ன அறு மு

கம மபற·று ரு த·இு த·.

2. ு· வடு· ம ு ஆவணத·

கஇ ு· யஇ ு· யியஇ ு·ு · ு· த·மறு·று·

ு· ு·

·மவடு ட· ·,

ஓஇல·சசு ு·யஇு ·ு · சு· ரந

மத

ு

·

இு ு·

ு ல·

மதடலுக·குர ய ஆய·வு மனப·ப ன· லமயுடன· , இ க·கியங·கலள அணுகுஇ த·.

3. தமு ழு· னு ·· வளரசசு· து F· லறய கு· ய, ‘அறு· வு· யஇு ·ு ··தமு ழு ·’ ;‘

லணயதமு ழு ·’ கு 0· று· த·த பனு· மநு· கக0ு ·

அண க மு0லறயு· ன ஆய ு· லன ு· டு 0. ு 0· ு 0இ ு ு

மமமு ப·

·

·வு 0சு ச

நுத··

ய ு க ு ர ய சு0யது·றனு ·· டட டனு ··,

4. ு· 0· ு க0· ு 0 மவலஇு வ· · ·

·பு ப·· மமமு ப·

பலடப ு த·து றனு · ு· டு 0மமபற·று ரு 0த·இு த·.

ா ப· · மமமு ·ப
· கு க··

5. சமுத ய மற·றும· வ ழ·விஇ ய· மதிப·புகலளப· மபணுவதற·குக· கருவியக இ
கு கி· யங· ·கலள ந· டு க· ன··ற . மம ழிமபயப·புத· Fலறச ரந·த
· ா · ணு ·· லம மனபு ப·
வளரசசிமவஇ லவ ய

பு 0த·து றன· மபற·று ரு
0த·இ த·
சு ··
துா· ளு ·க· ளு · வர மசயஇ ா ·ா ·
லசயு 0மு ·மதரவு 0· து · டு ட·· **(9 Hours)**
மு 0மு ··

து ரு க·குறள·-அலமப·பு -இ க·கு யச·சு றப·பு -இ உகப·மப
Fலமத·தன·லம-மபரு 0ட·

சு றப·பு -இ க·கு யச· சு றப·பு -ந இ ா ா டய ர·முஇ த க குமரகுருபரர ன· நு
திமநறிவிளக·கம·
ஈற க அலமநு த·· நு ா ா தி இ ககியங · களு · -நு ா ா தி நு N·
இ ா ·ா ·
கள இ ா ·ா · அகமு 0மு ·
ப றம மு ·· -தமு ழு ·· இ ய வர லசய·
ா 0ா 0· கு ா க·
·

இ ா ·ா ·· ஐம· மபரு0ங· க பபு ய·ங · களு0ம·,
ஐஞ·சிறு ப·பு யங·களும·- சிஇ ா ம மண க ·பும·
மமஇகலயும·–
ரடலடகக· பபி · · ங··கள··- கம· ா · வண
ா ய
பரு· மு· யணமு ·- ·மபர யபு 0· ரு · ணமு -· ர மு -· மதமு ப·· -
ர வண க வு யம·. சு ா ற பபு ·0 ா
· ணு ··

றஅக் 0:3 ்் ்் ்் **ம் 0மி·** **(8 Hours)**
த்் ர் ் 0ம்்0ளறகள்் 0ம் ் ்் **ரப**
)்் ்

்் ்·

த் ◌் ◌்◌ ◌்◌ ◌்◌ வ் ◌் ◌்ய· ப் ◌்
ப்◌·

தமிழகத·தி ·· பக
இ ◌ா ◌ா னு· ◌ா
·தி·

ரு

த்ஃ

ம0ம வளரச்சியும் -
தத்தன்மற்றயுக

23ENU301 **Semester - III**

ENGLISH III **(3H–3C)**

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

Course Objectives

- To enable students, learn correct pronunciation, spelling, meaning and usage of English Vocabularies.
- To give English language skill practice to students to enhance their English proficiency.
- To expose students to native speakers‟ spoken language to enable students to recognize native speakers‟ accent and language usage.
- To help students to become autonomous and self-directed English language learners.
- To produce entrepreneurs among students by making them English language trainers and take communicative English to schools and colleges around.

Course Outcomes

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

Cos	Course Outcomes	Blooms Level
CO1	Demonstrate the skill to write in English without grammatical error.	Apply
CO2	Practice listening effectively to communication in English.	Apply
CO3	Develop the ability to speak English language with the right way of pronunciation.	Understand
CO4	Express the viewpoints with confidence in English.	Analyze
CO5	Express values and skills gained through effective communication to other disciplines.	Analyze

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

UNIT-I **(7 Hours)**

Listening: Listening Comprehension-Listening for Specific Information- Interpreting Charts andDiagrams

UNIT- II **(7 Hours)**

Speaking: Essentials of effective Communication- **Telephone Skills**: Understanding TelephoneConversation-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- Reading Critically-Sequencing of Sentences-Reading Comprehension

UNIT- IV **(7 Hours)**

Writing: Descriptive and Narrative-Safety Instructions- Suggestions-Expansion of Abbreviations-Spellings Rules Translation- Translating Short Sentences and Passages from English to Tamil

UNIT-V **(8 Hours)**

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

Books for References

1. Oxford Handbook of Writing: St. Martins Handbook of Writing 2013 Cambridge Universiity Press

   Wren & Martin, 2008, *High School English Grammar & Composition*, S.Chand & Company Ltd, Board ofEditors,
2. Krashen, Stephen D (1982) Principles and practice in second language acquisition. New York: Pergamon Press.

Semester - III 23MBU301 VIROLOGY (5H–4C)

Instruction Hours / week: L: 4 T: 1 P:0 Marks: Internal: **40** External: **60** Total:**100 End Semester Exam:** 3 Hours

COURSE OBJECTIVES

- To study general aspects of viruses, classification, replication, interactions and immunity to viruses To explain the students about the virus classification based on host, genome, mode of replication and structure or shape
- To examine interaction between virus and host in infection process
- To study the disease caused by virus transformation and sub viral particles
- To study the vaccine development, antiviral drug and interferons in therapy

COURSE OUTCOMES

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

COs	**Course Outcomes**	**Blooms Level**
CO1	Understanding of types of virus that infect plant, microbes and animals	Apply
CO2	Clear understanding of virus entry, gene expression and regulation	Apply
CO3	Comprehend the intricate interaction between viruses and host cells	Understand
CO4	Understanding of disease caused by virus and sub viral infection	Apply
CO5	Explain vaccine development and mechanisms of antiviral drugs, interferons and immunotherapy	Apply

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

Unit I- History of viruses, virus multiplication and replication (9 Hours)

History of viruses. Properties of virus. Origin of virus. Structure, Classification, nomenclature of viruses. Viral replication strategies as per Baltimore classification. DNA virus, RNA virus and retrovirus replication.

Unit II- Bacteriophages (9 Hours)

Diversity, classification, one step multiplication curve, lytic and lysogenic life cycle of lambda phage, Genome of lambda phage, F2 phage, Ff phage concept of early and late proteins, regulation of transcription in lambda phage.

Unit III- Transmission of virus, genome organization of virus (9 Hours)

Modes of viral transmission in plant and animals. Viral genome size and organization. Salient features of viral nucleic acid (unusual bases, overlapping genes, splicing genes, terminal redundancy, cohesive ends, capping and tailing).

Unit IV- Viral infection diagnosis and prevention (9 Hours)

Oncogenic viruses and its types, General characters, epidemiology, pathogenicity, disease caused mechanism. Prevention and control of viral diseases. Laboratory diagnosis of emerging respiratory virus.Concept of viroids, virusoids, satellite viruses, Virophage and Prions.

Unit V- Antiviral compounds (12 Hours)

Antiviral compounds and their mode of action. Interferon and their mode of action. Viral vaccines and vaccine development. Use of viral vectors, gene cloning, expression in development of viral vaccines, Applications of gene therapy and phage display in disease control.

SUGGESTED READINGS

1. Dimmock, N.J., Easton., A.L., Leppard, K.N. (2007). Introduction to Modern Virology. 6thedition,BlackwellPublishing Ltd.
2. Carter J., and Saunders, V. (2007). Virology: Principles and Applications. John Wiley andSons.
3. Flint, S.J., Enquist, L.W., Krug, R.M., Racaniello, V.R., Skalka, A.M. (2004). Principles of Virology,Molecular biology, Pathogenesis and Control. 2ndedition. ASM press WashingtonDC.
4. Levy, J.A., Conrat, H.F., Owens, R.A. (2000). Virology. 3rdedition. Prentice Hall publication, NewJersey.
5. Wagner, E.K., Hewlett, M.J. (2004). Basic Virology. 2ndedition. BlackwellPublishing.
6. Mathews. (2004). Plant Virology. Hull R. Academic Press, NewYork.
7. Nayud, M.V. (2008). Plant Viruses. Tata McGraw Hill,India.
8. Ananthanarayanan R and CK Jayaram Panicker, (2017). Textbook of Microbiology 10thEd. OrientLongman.

B.Sc. Microbiology **2023-2024**

23MBU302	**MICROBIAL GENETICS**	**Semester –III (4H–4C)**

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

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

Cos	**Course Outcomes**	**Blooms Level**
CO1	This course will provide candidates with basic awareness and outline of Molecular Biology with unique reference to microbial genome.	Apply
CO2	Students will be able to describe the nature of molecular world and its application in modern Microbiological sectors.	Apply
CO3	Students will be able to understand the process of Mutation and mutagenesis.	Understand
CO4	This paper provided the knowledge about the central dogma of biology.	Apply
CO5	This course provided the concepts of genetic recombination techniques.	Apply
CO6	Students will gain the awareness about the transposons and it applications	Understand

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1		**M**										
CO2								**S**				
CO3			**S**									
CO4							**M**					
CO5										**S**		
CO6												

S-Strong; M-Medium; L-Low

Unit I- History of genetics **(9 Hours)**

Concept of Genetics, Mendelian principles, DNA as a genetic material, Experimental evidence Chromosomal theory of inheritance. DNA structure, models of DNA, RNA structure and types. DNA replication in Prokaryotes, and eukaryotes Proof reading, Enzymes involved in replication.

Unit II- Plasmids **(9 Hours)**

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

Unit III- Genetic code **(9 Hours)**

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

Unit IV- Mutations **(9 Hours)**

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

Unit V- Transposons **(12 Hours)**

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

SUGGESTED READINGS

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

Semester –III

23MBU303A MICROBIAL BIOTECHNOLOGY (3H–3C)

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

COURSE OBJECTIVE

- To make students understand the aspects of industrial, soil, environmental, agricultural microbiology.
- Gain knowledge about the Industrially important microorganisms &nutritional requirements.
- Know about the Commercialization methods of Microbial products.
- To understand the industrially important microorganisms' commercial value and importance of patent and IPR.
- Describe about different sewage treatment methods employed in waste water treatment. know the microorganisms responsible for water pollution.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	This paper imparts knowledge on applications of microorganisms in various fields and helps to gain employability in pharmaceutical industries	Understand
CO2	Describe about different sewage treatment methods employed in waste water treatment.	Apply
CO3	Learn about the global environmental problems.	Understand
CO4	To provide a fundamental knowledge about the various scopes in environmental and industrial studies.	Analyze
CO5	Learn about the applications of microbes in biotransformation, therapeutic and industrial biotechnology	Understand
CO6	Describe aspects of genetically engineered microbes for industrial application	Remember

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				**M**								
CO2										**S**		
CO3					**S**							
CO4									**M**			
CO5												**S**
CO6				**M**								

S-Strong; M-Medium; L-Low

Unit I **(7 Hours)**

Microbial biotechnology and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), biostimulants environmental, and food technology. Use of prokaryotic and eukaryotic microorganisms in biotechnological applications. Genetically engineered microbes for industrial application: Bacteria and yeast. Brief history of fermentation- Fermentation, general concepts and application of fermentation.

Unit II **(7 Hours)**

Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine). Microbial polysaccharides and polyesters, Microbial production of bio-pesticides, bioplastics, Microbial biosensors. Gene transfer technique. Biotechnological application of microalgae- Food, Feed, colorant, fuel and aquaculture feed.

Unit III **(7 Hours)**

Microbial based transformation of steroids and sterols. Bio- atalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute. Phage typing, gene therapy. Biotransformation of antibiotics. Industrial production of organic acids & vitamins. Importance of microbes in industry-microbial biomass, microbial enzymes and microbial recombinant products.

Unit IV **(7 Hours)**

Microbial product purification: filtration, ion exchange &affinity chromatography techniques Immobilization metho and their application: Whole cell immobilization. RNAi and its applications in silencing genes, drug resistance, therapeutics and host pathogen interactions. MDR, XDR and PDR resistance mechanism.

Unit V **(8 Hours)**

Basic cloning steps and product development. Bioethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass, Significance of Experimental plants. Biogas production: Methane and hydrogen production using microbial culture. Microorganisms in bioremediation: Degradation of xenobiotics, mineral recovery, removal of heavy metals from aqueous effluents. Microbial Valorization of Plastic Wastes.

SUGGESTED READINGS

1. Ratledge, Cand Kristiansen,B.(2001).Basic Biotechnology,2ndedition,Cambridge University Press.
2. Swartz,J.R. (2001).Advances in *Escherichia coli* production of therapeutic proteins. Current Opinion inBiotechnology,12, 195–201.
3. Prescott,HarleyandKlein'sMicrobiologybyWilleyJM,SherwoodLM,WoolvertonCJ(2014),9theditio n, Mc GrawHill Publishers.
4. GuptaPK(2009)ElementsofBiotechnology2ndedition,RastogiPublications.
5. GlazerANandNikaidoH(2007)MicrobialBiotechnology,2ndedition,CambridgeUniversityPress
6. GlickBR,PasternakJJ,andPattenCL(2010)MolecularBiotechnology4thedition,ASMPress.
7. Poonam Singh & Ashok Pandey, Biotechnology for agro-Industrial residues utilisation. (2019), Springer.

8. Satyanarayana T. and Johri B.N. (2015). Microbial diversity, Current Perspectives and Potential Applications,IK international.

Semester –III

23MBU303B BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS (3H–3C)

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

COURSE OBJECTIVES

- To learn the basic handling of microorganisms.
- To understand the various biological containments.
- To emphasize on IPR issues and need for knowledge in patents in biotechnology.
- To gain knowledge on steps of a patenting process and the role of biosafety committee. To emphasize the components and design of laboratory.
- Provide learning opportunities to critically evaluate research methodology and findings

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Able to understand safety aspects in biological laboratory.	Understand
CO2	To create awareness on the Intellectual property rights and patenting of biotechnological processes.	Apply
CO3	To equip students with a basic understanding of the underlying principles of quantitative and qualitative patenting methods.	Understand
CO4	Provide students with in-depth training on the conduct and management of patent filing from inception	Analyze
CO5	Enable students to acquire expertise in the use and application of the methods of data collection and analysis.	Analyze
CO6	Enable students to be reflexive about their role and others' roles as researchers.	Apply

Mapping with Programme Outcomes

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

CO6			**M**								

S-Strong; M-Medium; L-Low

Unit I Biosafety: **(7 Hours)**

Introduction; biosafety issues in biotechnology; Biological Safety Cabinets & their types; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms.

Unit II Biosafety Guidelines: **(7 Hours)**

Biosafety guidelines and regulations (National and International); GMOs/LMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of International Agreements - Cartagena Protocol.

Unit III AERB/RSD/RES guidelines **(7 Hours)**

AERB/RSD/RES guidelines for using radioisotopes in laboratories and precautions. Agreements and Treaties: GATT, TRIPS Agreements; Role of Madrid Agreement; Hague Agreement; WIPO Treaties; Buda pest Treaty on international recognition of the deposit of microorganisms; UPOV& Berne conventions; Patent Co- operation Treaty (PCT); Indian Patent Act 1970 & recent amendments.

Unit IV Introduction to Intellectual Property **(7 Hours)**

Introduction to Intellectual Property: Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge, Geographical Indications-importance of IPR–patentable and nonpatentable–patenting life–legal protection of biotechnological inventions–World Intellectual Property Rights Organization (WIPRO).

Unit V Grant of Patent **(8 Hours)**

Grant of Patent and Patenting Authorities: Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing and agreement; Patent infringement -meaning, scope, litigation, case studies, Rights and Duties of patent owner.

SUGGESTED READINGS

1. BareAct,(2007).IndianPatentAct1970Acts&Rules,UniversalLawPublishingCo.Pvt.Ltd.,NewDelhi.
2. KankanalaC(2007).GeneticPatentLaw&Strategy,1stEdition,ManupatraInformationSolutionPvt.Ltd.New Delhi.
3. Mittal, D.P.(1999).Indian Patents Law, Taxmann, Allied Services(p)Ltd.
4. SinghKK(2015).BiotechnologyandIntelectualPropertyRights:LegalandSocialImpliications,Springer India

.

Semester -III

23MBU311 VIROLOGY AND GENETICS PRACTICAL (4H–2C)

Instruction Hours / week: L: 0 T: 0 P:4 Marks: Internal: **40** External: **60** Total:**100**
End Semester Exam: 6 Hours **COURSE OBJECTIVES**

- To study general aspects of viruses structure and classification
- To explain the students about the virus that infect animals, plants and bacteria.
- To study general aspects of viral morphology and classification.
- Cultivation of viruses and various methods of propagation of bacterial virus.
- To discuss the application of various immunological and molecular diagnostic tools. To study general aspects of viral particles.

COURSE OUTCOMES

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

COs	Course Outcomes	Blooms Level
CO1	Upon paper completion, students will have skill-based knowledge on structure of plants, animal, bacteria viruses and genetics.	Apply
CO2	This paper also enables the student on isolation, propagation of various viruses.	Apply
CO3	It will help the students to understand the plant virus, animal virus and bacterial virus.	Understand
CO4	Students can distinguish the viruses According to their characteristic features. Perform bacterial conjugation, transformation and transduction.	Apply
CO5	It will explain the research activities involved in virology studies, genetics, and medical research.	Apply

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1			**S**									
CO2									**M**			
CO3				**S**								
CO4								**S**				
CO5											**S**	
CO6			**M**									

S-Strong; M-Medium; L-Low

EXPERIMENTS (48 Hours)

1. Study of the structure of important animal viruses (rhabdo, influenza, paramyxo hepatitis B and retroviruses) using electron micrographs–Demonstration.

2. Study of the structure of important plant viruses (caulimo, Gemini, tobacco ring spot, cucumber mosaic and alpha-alpha mosaic viruses) using electron micrographs–Demonstration.
3. Study of the structure of important bacterial viruses (φX174, T4, λ) using electron micrograph – Demonstration.
4. Isolation and enumeration of bacteriophages (PFU) from water/sewage sample using double agar layer technique.
5. Isolation, purification and assay of virus - Demonstration.
6. Preparation of Master and Replica Plates.
7. Perform Bacterial Conjugation.
8. Perform bacterial transformation.
9. Perform transduction with bacteriophage.
10. Isolation of total DNA from environmental sample.
11. Quantification of DNA using agarose gel electrophoresis.
12. Studying isolation and propagation of animal viruses by chick embryo technique.
13. Types of animal cell culture and cell lines.
14. Study of cytopathic effects of viruses using photographs.
15. Perform local lesion technique for assaying plant viruses.
16. Immunization schedule, stability of vaccines.

SUGGESTED READING

1. Dimmock, N.J., Easton, A.L., Leppard, K.N. (2007). Introduction to Modern Virology.6th
2. edition, Blackwell Publishing Ltd.
3. Carter, J., and Saunders, V. (2007). Virology: Principles and Applications. John Wiley and Sons.
4. Flint, S.J., Enquist, L.W., Krug, R.M., Racaniello, V.R., Skalka, A.M. (2004). Principles of Virology, Molecular biology, Pathogenesis and Control. 2nd edition. ASM press Washington DC.
5. Levy, J.A., Conrat, H.F., Owens, R.A. (2000). Virology. 3rdedition. Prentice Hall publication, New Jersey.
6. Wagner, E.K., Hewlett, M.J. (2004). Basic Virology. 2ndedition. Blackwell Publishing.
7. Mathews. (2004). Plant Virology. Hull R. Academic Press, NewYork.
8. Nayudu, M.V. (2008). Plant Viruses. Tata McGraw Hill, India.
9. Bos, L. (1999) Plant viruses-A text book of plant virology by Backhuys Publishers.
10. Versteeg, J. (1985). A Color Atlas of Virology. Wolfe Medical Publication.
11. Watson, J.D., Baker, T.A., Bell, S.P., et al. (2008) Molecular Biology of the Gene,6th edition, Benjamin Cummings.
12. Gardner, E.J., Simmons, M.J., Snus tad, D.P. (2008). Principles of Genetics. 8th edition, Wiley-India.

Semester -III

23MBU312A MICROBIAL BIOTECHNOLOGY PRACTICAL (3H–1C)

Instruction Hours / week: L: 0 T: 0 P:3 Marks: Internal: **40** External: **60** Total:**100 End Semester Exam:** 6 Hours

COURSE OBJECTIVE

- To make students understand the aspects of industrial, soil, environmental, agricultural microbiology.
- To understand the methods for Production of industrially important compounds from fungal source.
- This paper is designed to provide an exposure to the students about the potential of fungi as food and in field of biotechnology as source of different enzymes, secondary metabolites, vitamins, polysaccharides, polyhydric alcohols, pigments and lipids.
- Develop an understanding of various aspects of bioprocess technology.
- Evaluate nanotechnology and microbial production of therapeutic compounds
- The laboratory training in addition to theory is included so that the students will acquire the skills to qualify for a broad range of positions in research, industry, consultancy, education and public administration, or for further education in a doctoral program

COURSE OUTCOMES

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

COs	Course Outcomes	Blooms Level
CO1	Impart knowledge on applications of microorganisms in various fields	Understand
CO2	Provides skill development on microbial products.	Apply
CO3	To study the immobilization techniques and fungal pigment production.	Understand
CO4	Develop a xylanase and lipase production technology.	Apply
CO5	Demonstration of algal single cell proteins.	Apply
CO6	State of art knowledge about various methodological and analytic approaches that are used within the specialization.	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						**S**						
CO2												**M**
CO3							**S**					
CO4											**S**	
CO5				M								
CO6						**M**						

S-Strong; M-Medium; L-Low

EXPERIMENTS **(36 Hours)**

1. Study yeast cell immobilization in calcium alginate gels and storage stability.
2. Study enzyme immobilization by sodium alginate method and storage stability.
3. Study of cell viability and enzyme estimation
4. Pigment production from fungi (*Trichoderma*/*Aspergillus*/*Penicillium*).
5. Isolation of *xylanase* or *lipase* producing bacteria.
6. Production of Microbial Biomass in bioreactor.
7. Study of algal Single Cell Proteins.

SUGGESTED READINGS

1. Ratledge,CandKristiansen,B.(2001).BasicBiotechnology,2ndedition,CambridgeUniversityPress.
2. Swartz,J.R.(2001).AdvancesinEscherichiacoliproductionoftherapeuticproteins.Current
3. OpinioninBiotechnology,12,195–201.
4. Prescott,HarleyandKlein'sMicrobiologybyWilleyJM,SherwoodLM,WoolvertonCJ(2014),9thedition, Mc GrawHill Publishers.
5. GuptaPK(2009)ElementsofBiotechnology2ndedition,RastogiPublications.
6. GlazerANandNikaidoH(2007)MicrobialBiotechnology,2ndedition,CambridgeUniversityPress.
7. GlickBR,PasternakJJ,andPattenCL(2010)MolecularBiotechnology4thedition,ASMPress.
8. Corinne Whitby, Torban Lund Skovhus (2018). Applied Microbiology and molecular biology in oil fieldsystems,Springer.
9. Head, Steven R., Ordoukhanian, Phillip, Salomon, Daniel R (2018) Next Generation Sequencing Methods and Protocol. Springer
10. Izard, Jacques., Rivera, Maria. (2014) Metagenomics for Microbiology. Elsevier B.Sc.Microbiology

Semester –III

23MBU312B BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS PRACTICAL

(3H–1C)

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

COURSE OBJECTIVES

- To learn the basic handling of microorganisms.
- To understand the various biological containments.
- To emphasize on IPR issues and need for knowledge in patents in biotechnology.
- To gain knowledge on steps of a patenting process and the role of biosafety committee. To emphasize the components and design of laboratory.
- Provide learning opportunities to critically evaluate research methodology and findings

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Able to understand safety aspects in biological laboratory.	Understand
CO2	To create awareness on the Intellectual property rights and patenting of biotechnological processes.	Apply
CO3	To equip students with a basic understanding of the underlying principles of quantitative and qualitative patenting methods.	Understand
CO4	Provide students with in-depth training on the conduct and management of patent filing from inception	Analyze
CO5	Enable students to acquire expertise in the use and application of the methods of data collection and analysis.	Analyze
CO6	Enable students to be reflexive about their role and others' roles as researchers.	Apply

Mapping with Programme Outcomes

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

CO6			**M**								

S-Strong; M-Medium; L-Low

EXPERIMENTS **(36 Hours)**

1. Study of component sand design of a BSL-III laboratory
2. Perform Standard Microbiological practices
3. Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents.
4. Decontamination in Microbiological Laboratory
5. Risk management methodology.
6. Filing applications for approval from biosafety committee
7. Filing primary applications for patents
8. Studyon step sofa patenting process
9. Principles of biomedical ethics.

SUGGESTED READINGS

1. BareAct,2007.IndianPatentAct1970Acts&Rules,UniversalLawPublishingCo.Pvt.Ltd.,NewDelhi.
2. KankanalaC(2007).GeneticPatentLaw&Strategy,1stEdition,ManupatraInformationSolutionPvt.Ltd.N ew Delhi.
3. Mittal,D.P.(1999).IndianPatentsLaw,Taxmann,AlliedServices(p)Ltd.
4. SinghKK(2015).BiotechnologyandIntelectualPropertyRights:LegalandSocialImplications,SpringerI ndia.
5. GoelD&PrasharS(2013).IPR,BiosafetyandBioethics.Pearson.

B.Sc. Microbiology **2023-2024**

23VAC301	**CYBER SECURITY**	**Semester –III (2H–2C)**

Instruction Hours / week: L: 2 T: 0 P:0 **Marks:** Internal: **40** External: **60** Total:**100**
End Semester Exam: 3Hours

COURSE OBJECTIVES

- To state the basic concepts of cybercrimes and classification.
- To provide an exposure to the spectrum of cyber offenses and attacks.
- To understand the social media overview and security.
- To gain knowledge about E-commerce and digital payments.
- To understand key terms and concepts in digital device security.
- To provide the learner will be able to examine tools and technologies for cybersecurity.

COURSE OUTCOMES (COS)

1. Students would be able to understand the concept of Cyber security and issues and challenges associated with it.
2. Students, at the end of this module, should be able to understand the cybercrimes, their nature, legal remedies and as to how report the crimes through available platforms and procedures.
3. Students should be able to appreciate various privacy and security concerns on online Social media and understand the reporting procedure of inappropriate content, underlying legal aspects and best practices for the use of Social media platforms.
4. Students would be able to understand the basic concepts related to E-Commerce and digital payments. They will become familiar with various digital payment modes and related cyber security aspects.
5. Students, after completion of this module will be able to understand the basic security aspects related to Computer and Mobiles. They will be able to use basic tools and technologies to protect their devices.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					**L**							
CO2											**M**	
CO3						**L**						
CO4										**L**		
CO5		M										
CO6					**M**							

S-Strong; M-Medium; L-Low

Unit I - INTRODUCTION TO CYBERCRIME **(4 Hours)**

Definition and Information Security-who are cybercriminals? - Classification of cybercrimes. Cybercrime: The legal perspectives- cybercrimes: An Indian Perspective - cybercrime and the Indian ITA2000: Hacking and the Indian law(s) - A Global Perspective on cybercrimes: cybercrime and the Extended Enterprise - cybercrime Era: Survival Mantra for the Netizens - Concluding Remarks and Way Forward to Further Chapters.

Unit II - CYBER OFFENSES (4 Hours)

How Criminals Plan Them: Introduction: categories of Cybercrime -How criminals Plan the Attacks: Reconnaissance Passive Attacks Active Attacks Scanning and Scrutinizing Gathered Information Attack (Gaining and Maintaining the system Access) -social Engineering: Classification of Social Engineering – Cyber talking: Types of stalkers Cases Reported on Cyber stalking How stalking Works? real-life incident of Cyber stalking - Botnets: The Fuel for cybercrime: Botnet - Attack Vector-Cloud Computing: Why cloud computing? Types of Services Cybercrime and Cloud Computing.

Unit III – SOCIAL MEDIA OVERVIEW AND SECURITY (4 Hours)

Introduction to Social networks. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case studies

Unit IV - E - C O M M E R C E AND DIGITAL PAYMENTS (5 Hours)

Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorized banking transactions. Relevant provisions of Payment Settlement Act,2007

Unit V - DIGITAL DEVICES S E C U R I T Y, TOOLS AND TECHNOLOGIES FOR CYBER SECURITY (7 Hours)

End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions.

SUGGESTED READINGS

1. Nina Godbole & SUNIT Belapure. (2013). CYBER SECURITY. Wiley India Pvt. Ltd. New Delhi 2.Godbole, N. (2009). Information Systems Security: Metrics Frameworks and Best Practices. Wiley India.New Delhi
2. Cyber Crime Impact in the New Millennium, by R. C Mishra, Auther Press. Edition2010.
3. Cyber Security Understanding Cyber Crimes, Computer F o r e n s i c s and Le g a l Perspectives by SumitBelapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011)
4. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver,CreateSpace Independent Publishing Platform. (Pearson , 13th November, 2001)

5. Electronic Commerce by Elias M. Awad, Prentice Hall of India Pvt Ltd.
6. Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, DominantPublishers. 3.Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2nd Edition, Wiley IndiaPvt. Ltd.

WEBSITES

1.www.Cybercrime.gov.in
2.https://gac.gov.in/
3.https://www.india.gov.in/password-policy-ministry-electronics-and-information-technology?page=3
4.https://mahe.gov.in/mobile-app-policy/
5.https://www.dsci.in/

JOURNALS

1. Noura Al-Suwaidi , Haitham Nobanee , & Fauzia Jabeen, **Estimating Causes of Cyber Crime: Evidence from Panel Data FGLS Estimator,** International Journal of Cyber Criminology Vol 12 Issue 2 July – December 2018.

23MBU391	**Semester –III**
INTERNSHIP	**(2C)**

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

Semester IV

23LSU401 **தமிழ் த ள் 4** **(4H–4C)**

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

களற் , அற் வியற்் ் ் ் ்,் வண்் ்் ்் கவ்் யற்் ் ் ்் ்் ்மற் ் ற்ு்் ம் ்
்் ்நறம்் ண் ் ் ்் ்
ளமய்் ்் ்் ்் யற்் ் ் ் ்் ்ப்்0ற்் மபம ழிறக் ்் Fளற –
தமிழ்் ப் ்ப ர்் ்் ்் வு த ற் 4,்

4 - H, 4 - C
(2024 – 2025 Even Semester)

ப டத்்திட்்ட பயன் விறளவு

மழ
ர

1. ர் மு ற் ப ட்்ட தமு் ழகத்்லத ள க அறு மு0 ட இத்ர
வரஇ ர ர் று் ர 0் கு் ர் கபு ப்் ர 0த ்
று ்்றம் ணவ் கு் ர F்
க

2. ர த்் வ ழ க் ர ல் க ள் அறிய பழந
ர ்
த

பணு ் பு ் ம்0லறலய ம்
ட ர ச ரந ணவ் க ஊக்குவித்்இ த்

5. நு ை ·த

மது · வு 0· கள

யகு · குடு· ர லமபு · பண மு தஇ ை ை · ன யு 0· மப ட·டு ·

து ·

இ ை ை ··

வு· ரு 0· பு ப·· பு · ப டமு · க டமு · மபறு 0கு னு ·· ற தமு · ழு ··

நு

கர

3. தமு ழ·மம ழு யு ன· பலழலமயு ம·, திர விட மம ழு கள ·தமிழ·மம ழு யு ன

இ ை ை தன· றபு ல·· பய·0ம·· ளுக·கு

அறு மு கப·படுதF·இ த·

சசி ம· ணவரக

4. ளு· னு · வ ை · தமு· ழரு ·கஇலு ·க ளு · , ஆறு ·ற· ஙு ··கலரபு ·

ழு வ· ை யஇ ை · பணு ·

· ை ,··

தம ப· டு கள··குறு த·F ள·அறியச·மசய·இ த·.

ை · ம·

ழரக

ை ·

ணவ ரக

கமு 0மு ·· பணு · பு · டு 0மு ·· குறு · த·த முழுலமயு · ன அறு மு 0கம மபற·று ரு 0த·இ த·.

ப் ட·டப் ்் ·பப்் F மி·

டத் ் ந)்் க் ் க்·் ் ண முதஇ ை ை · ை · மதரவு 0· கள ··, **தி·்** 1. யகு · ன மப டட து ·

இ ை ை நு ை த· கு டு · யு 0· ர லமபு ப·

வு · ப டம· க டம·மபறுகு ன·ற,‘தமிழ· இ க·கு யஇவர று’ ர பு ை · கு று த·த ை 0· ·ப· ப

முழு லமய ன அறு மு கம·மபற·று ரு 0த·இ த·.

2. வட·ட· இய·ை ,·· ச வடு· ம··மத· இ ை ை ·

கஇ ஓஇல ா யியஇ ா ்ா ்
ா ா ா ச் 0்
்ம மறு ்
று்
மதடலுக்குர ய ஆய்வு மனப்ப ன் லமயுடன் , இ க்கியங்கலள அணுகுஇ த்.

3. தமு் ழு் னு ¨ வளரசு ச ் த்Fலறயு ் கு ் ய,
‘அறு் வு் ம் ழ’’ ;‘ லணயதம் ழ’’ குறித்த யஇ ா ்ா த்

ா
மமமு ப்
.
டு 0்
.

4. மஇவலவ ய்ப்புக்குர ய சுயதிறன் மமம்ப டன், பலடப்ப க்கத்திறன டுமமம்ப டு ம் மபற்று ரு 0த்இ த்.

5.

2023-2024
Semester –IV

23ENU401 **English IV** **(3H–3C)**

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

COURSE OBJECTIVES

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

COURSE OUTCOMES

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 in a wide range of contexts.	Understand
CO3	Understand the nuances of listening, speaking and reading English.	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 English better.	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		**M**										
CO2								**M**				
CO3			**M**									
CO4					**S**							
CO5										**M**		
CO6		**M**										

S-Strong; M-Medium; L-Low

UNIT-I **(6 Hours)**

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

UNIT- II **(6 Hours)**

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

UNIT-III **(6 Hours)**

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

UNIT- IV **(6 Hours)**

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

UNIT-V **(6 Hours)**

Punctuation Marks- Figures of Speech

Books for References:

1. Oxford Handbook of Writing: St. Martins Handbook of Writing 2013 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.

2023-2024

23MBU401 **IMMUNOLOGY** **Semester –IV (5H–5C)**

Instruction Hours / week: L: 5 T: 0 P:0 Marks: Internal: **40** External: **60** Total:**100 End Semester Exam:** 3Hours

COURSE OBJECTIVES

- To strengthen the knowledge of students in immunodiagnostics.
- To learn the latest trends in immunology.
- To analyze rapid diagnosis and Immune reaction.
- To provide overview of immune system, antigen antibody structure and interactions.
- To develop understanding of innate and adaptive immunity along with major cells and molecules involved.
- To integrate immunology with health and enrich the knowledge for autoimmune disorders, hypersensitivity reaction

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Introducing the employment aspect of immunology and to study various types of immune systems, their classification, structure and mechanism of immune activation.	Understand
CO2	Upon completion, students will gain knowledge of immune system, cells involved along with complement system and autoimmunity	Apply
CO3	Develop understanding about immune system, antigen antibody interactions.	Understand
CO4	Gain theoretical knowledge of various diseased conditions generated due to interplay of immune system components.	Analyze
CO5	Students can able to perform basic immunological assays.	Understand
CO6	It will distinguish fundamental knowledge on immunology and its advancement	Remember

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1		**S**										
CO2								**M**				

B.Sc. Microbiology

CO3			**M**								
CO4							**S**				
CO5										**M**	
CO6								S			

S-Strong; M-Medium; L-Low

UNIT I **(12 Hours)**

Concept of Innate and Adaptive immunity; Contributions of following scientists to the development of field of immunology – Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Elie Metchnikoff, Peter Medawar, MacFarlane Burnet, Neils K Jerne, Rodney Porter and Susumu Tonegawa. Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT.

Unit II **(12 Hours)**

Antigens – Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants. Antigenicity, Immunogenicity and Factors influencing Immunogenicity. Antibodies – Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); Monoclonal and Chimeric antibodies.

Unit III **(10 Hours)**

MHC – Organization of MHC locus; Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways). Complement system – Components of the Complement system; Activation pathways (Classical, Alternative); Biological consequences of complement Activation

Unit IV **(14 Hours)**

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells, Introduction to tolerance. Types of Autoimmunity and Hypersensitivity with examples; Immuno deficiencies – Animal models (Nude and SCID mice), DiGeorge syndrome, Chediak-Higashi syndrome. Transplantation immunology, Graft versus host reaction, Graft rejection.

Unit V **(12 Hours)**

Types of tumors, tumor Antigens, causes and therapy for cancers. Types of vaccine and their vaccination schedule in Practice. Principles of precipitation, agglutination, complement fixation, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT, Western blotting, Immunofluoresence, Flow cytometry, Immunoelectron microscopy. Immunological biosensors.

SUGGESTED READINGS

1. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6thedition. W.H. Freeman andCompany, NewYork.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication,Oxford.
3. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7thedition Garland SciencePublishers, NewYork.
4. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition, SaundersPublication,Philadelphia.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2ndedition Churchill LivingstonePublishers,Edinberg.

B.Sc. Microbiology

2023-2024

23MBU402 **MEDICAL MICROBIOLOGY** **Semester –IV (5H–4C)**

Instruction Hours / week: L: 4 T: 1 P:0 **Marks:** Internal: **40** External: **60** Total:**100**
End Semester Exam: 3Hours **COURSE**

OBJECTIVES

- The aim of Medical Microbiology course is to introduce basic principles and applications of various clinical diseases and their epidemiology.
- Students can be able to characterize, isolate and identify different microbes under a wide range of host pathogen interaction.
- It includes a detailed study of etiology, clinical systems and laboratory diagnosis of disease- causing Microorganisms.
- The content of the course will be including many etiological agents responsible for global infectious diseases.
- To provide the clear knowledge about the pathogen identification from the patient.
- The course creates the conceptual basis for understanding pathogenic microorganisms and particularly addresses the fundamental mechanisms of their pathogenicity.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	It will provide opportunities for a student to develop diagnostic skills in microbiology, including the practical application and interpretation of laboratory tests for the diagnosis of infectious diseases.	Understand
CO2	It will develop the student's knowledge on medically important microorganism's morphology with the main focuses being the characterization based on physiological factors.	Apply
CO3	It will give improved knowledge on current antimicrobial chemotherapy, antibiotics towards target sites, drug resistance mechanisms and spectrum evaluation methods in the clinical settings.	Understand
CO4	Student can be able to safeguard the society.	Analyze
CO5	Able to work for advanced clinical diagnostics practices.	Understand
CO6	It will render the prophylaxis measures and strategies of deadly microorganisms upon the completion of this study.	Remember

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				S								

CO2										**M**		
CO3					**M**							
CO4									**S**			
CO5												**M**
CO6										S		

S-Strong; M-Medium; L-Low

Unit I: Introduction to Medical Microbiology (9 Hours)

Normal micro flora of the human body: skin, throat, gastrointestinal tract, urogenital tract. Definitions – Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity. Transmission of infection, Carriers and their types, Opportunistic infections, Nosocomial infections. Collection, transport and processing of clinical samples – Blood, Sputum, Stool, Urine and CSF.

Unit II: Medical Bacteriology (9 Hours)

List of diseases of various organ systems and their causative agents. Respiratory pathogens: Streptococcus pyogenes, Haemophilus influenzae, Mycobacterium tuberculosis. Gastrointestinal pathogen Escherichia coli, Salmonella typhi, Vibrio cholerae, Helicobacter pylori. Others: Staphylococcus aureus, Bacillus anthracis, Clostridium tetani, Treponema pallidum Klebsiella pneumonia

Unit III Virology (9 Hours)

Study of following diseases – Causative agents, Mode of transmissions, Pathogenicity, Symptoms and prophylaxis of Polio, Herpes, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of Adeno virus, swine flu, Ebola, Chikungunya, Japanese Encephalitis, Coronavirus (COVID-19) and omicron virus.

Unit IV: Medical Mycology and Parasitology (10 Hours)

Study of mycoses- transmission, symptoms and prevention. Cutaneous mycoses: Tinea pedis (Athlete's foot).Systemic mycoses: Histoplasmosis. Opportunistic mycoses: Candidiasis. The detailed study of following diseases– Causative agents, Mode of transmissions, Pathogenicity, Symptoms and prophylaxis of Amoebiasis, Giardiasis, Elephantiasis, Taeniasis, Malaria, Kala- azar.

Unit V: Antimicrobial agents (10 Hours)

Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Antibiotic resistance - MDR, XDR, MRSA, NDM-1 and PDR resistance mechanisms. Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin. Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine. Molecular Diagnosis of infectious diseases. Artificial Intelligence.

SUGGESTED READINGS

1. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013). Jawetz, Melnick and Adelberg's Medical Microbiology. 27th edition. McGraw Hill Publication.

2. Greenwood D, Slack R, Barer M, and Irving W. (2018). Medical Microbiology, 19th Edition. Churchill Living stone.
3. Ananthanarayan R. and Paniker C.K.J. (2022) Textbook of Microbiology. 12th edition, University Press Publication.
4. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14thedition. Pearson International Edition.
5. GoeringR.,DockrellH.,ZuckermanM.andWakelinD.(2007).Mims'MedicalMicrobiology.4th 6. edition. Elsevier.
7. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott, Harley and Klein's Microbiology. 9thedition. McGraw Hill Higher Education.

23MBU403A **MOLECULAR BIOLOGY** **Semester –IV (3H–3C)**

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

COURSE OBJECTIVES

- To provide an experience for the students in an interdisciplinary research program connecting animal genomics with animal reproduction and biotechnology. To impart information on the historical developments in Molecular Biology An in-depth study on structure and organization of chromosome and mutagenesis.
- To expose the students on the basic understanding of various techniques used in molecular studies.
- To gather information to know mechanism of DNA replication.
- To gain the knowledge of translational machinery in prokaryotes and eukaryotes

COURSE OUTCOME (CO'S)

COs	Course Outcomes	Blooms Level
CO1	Explores technologies using molecular biology and cell biology	Apply
CO2	Understand the genetic make up and Manipulate the genomes of animals for ways to improve the livestock for food production and biomedical purpose	Understand
CO3	Develop the skills in molecular biology.	Apply
CO4	Executing concept of RNA splicing and mRNA and its significance.	Apply
CO5	Students able to be inferring various model of DNA replication	Apply
CO6	Students able to contrast translational machinery	Apply

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1			**S**									
CO2									**M**			
CO3				**M**								
CO4								**S**				
CO5											**M**	
CO6									S			

S-Strong; M-Medium; L-Low

Unit I DNA Structure **(6 Hours)**

DNA Structure: Miescher to Watson and Crick - historical perspective, DNA Structure, Salient features of double helix, Chargaff's rule, Types of DNA, Conformations of nucleic acids, Stability of nucleic acid structure, Types of genetic material, Organization of DNA Prokaryotes, Viruses, Eukaryotes. RNA Structure, Organelle DNA—mitochondria and chloroplast DNA.

Unit II DNA Replication **(6 Hours)**

DNA replication, prokaryotic and Eukaryotic replication, Mechanism of DNA replication: Enzymes and proteins involved in DNA replication–DNA polymerases, DNA ligase, primase, telomerase– for replication of linear ends. DNA topology –linking number, proof reading mechanism.

Unit III DNA Transcription **(6 Hours)**

Transcription and transcriptional control in prokaryotes and eukaryotes, initiation, elongation, termination, promoter sequences, TATA box, Hogness Box, CAAT box, Enhancers, upstream activating sequences, Post-transcriptional modification, splicing, spliceosomes, nuclear transport of mRNA.

Unit IV DNA Translation **(6 Hours)**

Translational machinery, charging of tRNA, amino acyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptide s in both prokaryotes and eukaryotes, Fidelity of translation, Inhibitors of protein synthesis in prokaryotes and eukaryote and post translational modifications. Regulation of gene expression in prokaryotes lacoperon and trp operon.

Unit V Molecular Biology Techniques **(6 Hours)**

Extraction of DNA, Extraction of RNA, Isolation of plasmid, DNA purification and estimation, PCR, Gelelectrophoresis, Blotting techniques, SDS-PAGE. Expression Cloning, DNA microarray.

SUGGESTED READINGS

1. WatsonJD, BakerTA, BellSP,GannA, Levine Mand Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab.Press, Pearson Publication. Becker WM, KleinsmithLJ, Hardin.J and Bertoni GP (2009). The Worldof the Cell,7th edition, Pearson Benjamin Cummings Publishing, SanFrancisco.
2. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippin cott Williams and Wilkins,Philadelphia.
3. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons.Inc.
4. SambrookJ and Russell DW (2001). MolecularCloning: A Laboratory Manual 4thEdition, Cold Spring HarbourLaboratory press.
5. Krebs J,Goldstein E, Kilpatric kS (2013).Lewin's Essential Genes, 3rd Ed., Jonesand Bartlett Learning.
6. Gardner EJ,Simmons MJ, Snustad DP (2008).). Principles of Genetics.8thEd.Wiley-India.

Semester –IV

23MBU403B PLANT TISSUE AND ANIMAL TISSUE CULTURE (3H–3C)

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

COURSE OBJECTIVES

- To provides detailed idea about laboratory organization in plants, basic techniques in tissue culture, genetic transformations in plants, plant genetic engineering and industrial products.
- To learn the basic tools in recombinant technology
- To understand the various concepts of cloning vectors and cloning strategies To emphasize the knowledge in biotechnology and techniques.
- To familiarize the students to versatile tools and techniques employed in genetic engineering and recombinant DNA technology.
- A sound knowledge on procedural repertoire allows students to innovatively apply these in basic and applied fields of biological research.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Provides detailed idea about laboratory organization for conservation of plants in laboratory condition through tissue culture techniques.	Understand
CO2	To provide idea about genetic transformations in plants, plant genetic engineering and plant based industrial products production.	Apply
CO3	Provide fundamental knowledge for the development of genetically modified crop including expression of genes related to water deficit tolerance, pest resistance, insect resistance and cold resistance.	Understand
CO4	Explain the general principles of generating transgenic plants, animals and microbes.	Analyze
CO5	Technical know-how on versatile techniques in recombinant DNA technology.	Understand
CO6	An understanding on application of genetic engineering techniques in basic and applied experimental biology	Remember

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			S									
CO2									M			

CO3				**M**							
CO4								**S**			
CO5										**M**	
CO6									S		

S-Strong; M-Medium; L-Low

UNIT-I **(6 Hours)**

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

UNIT-II **(6 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 **(6 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 **(6 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 **(6 Hours)**

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

SUGGESTED READINGS

1. Slater, A., Scott, N.W., & Fowler, M. R. (2008). Plant Biotechnology. Oxford: Oxford University Press.
2. Ignacimuthu, S. (2004). Plant Biotechnology. New Delhi: Oxford and IBH Publishing House.
3. Chawla, H.S. (2002). Introduction to Plant Biotechnology. New Delhi: Oxford and IBHP Publishing Co.Pvt.Ltd.
4. Kumar,U. (2008). Plant Biotechnology and biodiversity conservation. Jodhpur: Agrobios.
5. Stewart, N.C. (2008). Plant Biotechnology and Genetics. New Jersey: John Wiley & Sons,Inc.

6. Halford, N., & Halford, N. G. (2006). Plant Biotechnology: Current and Future Applications of Genetically Modified Crops. New Jersey: John Wiley &Sons.

Semester –IV

23MBU411 IMMUNOLOGY PRACTICAL (4H–2C)

Instruction Hours / week: L: 0 T: 0 P:4 **Marks:** Internal: **40** External: **60** Total:**100**
End Semester Exam: 6 Hour

COURSE OBJECTIVES

- To introduce the knowledge of the medically important microorganisms, microbial morphology with the main focuses being the characterization, isolation and identification of different microorganism.
- The aim of Medical Microbiology course is to introduce basic principles and application relevance of clinical disease for students who are in preparation for physicians.
- The content of rigorous course includes many etiological agents responsible for global infectious diseases.
- To strengthen the knowledge of students in immunodiagnostics on skill basis.
- To integrate immunology with health and enrich the knowledge for autoimmune disorders, hypersensitivity reaction.
- It will develops the basic skills on handling clinical pathogens.

COURSE OUTCOME

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

Cos	Course Outcomes	Blooms Level
CO1	It will also provide opportunities for a student to develop diagnostic skills in microbiology, including the practical application and interpretation of laboratory tests for the diagnosis of infectious diseases.	Understand
CO2	Comprehend the various methods for identification of unknown microorganisms.	Apply
CO3	Develop understanding about immune system, antigen antibody interactions.	Understand
CO4	Gain theoretical knowledge of various diseased conditions generated due to interplay of immune system components.	Analyze
CO5	After course completion, students can apply the knowledge in further studies and higher education.	Understand
CO6	Knows the concepts of advanced immunological assays	Remember

Mapping with Programme Outcomes

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

CO5										**M**		
CO6								S				

S-Strong; M-Medium; L-Low

EXPERIMENTS **(40 Hours)**

1. Identification of human blood groups - ABO Blood grouping, Rh Typing.
2. Perform Total Leukocyte Count of the given blood sample.
3. Perform Differential Leukocyte Count of the given blood sample.
4. Separate serum and plasma from the blood sample.
5. WIDAL test, RPR and CRP.
6. Perform immunodiffusion by Ouchterlony method.
7. Perform DOTELISA. 8. Perform immune electrophoresis.

SUGGESTED READINGS

1. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A and Mietzner,T.A (2013). Jawetz, Melnick and Adelberg'sMedical Microbiology.26th edition. McGraw Hill Publication.
2. Greenwood D, Slack R, Barer M and Irving W. (2012). Medical Microbiology, 18th Edition. Churchill Livingstone.
3. Ryan KJ and Ray CG.(2014). Sherris Medical Microbiology, 6th Edition. McGraw-Hill Professional.
4. Ananthanarayan R.and Paniker C.K.J (2009) Textbook of Microbiology 8th edition, University PressPublication.
5. Peakman M and Vergani D (2009). Basic and Clinical Immunology.2nd edition Churchill LivingstonePublishers, Edinberg.
6. Richard C and Geiffrey S.(2009). Immunology 6th edition.Wiley Blackwell Publication.

Semester –IV

23SEC412 MEDICAL MICROBIOLOGY PRACTICAL (4H–2C)

Instruction Hours / week: L: 0 T: 0 P:4 **Marks:** Internal: **40** External: **60** Total:**100**
End Semester Exam: 9 Hours

COURSE OBJECTIVES

- To introduce the knowledge of the medically important microorganisms, microbial morphology with the main focuses being the characterization, isolation and identification of different microorganism.
- The aim of Medical Microbiology course is to introduce basic principles and application relevance of clinical disease for students who are in preparation for physicians.
- The content of rigorous course includes many etiological agents responsible for global infectious diseases.
- It covers all biology of bacteria, viruses and other pathogens related with infectious diseases in humans.
- The course will provide the conceptual basis for understanding pathogenic microorganisms and particularly address the fundamental mechanisms of their pathogenicity.
- It will develops the basic skills on handling clinical pathogens

COURSE OUTCOME

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

Cos	Course Outcomes	Blooms Level
CO1	It provides the entrepreneurial ability to characterize, isolate and identify different microbes.	Understand
CO2	It includes a detailed study of characterization, etiology, pathogenicity, clinical systems, and laboratory diagnosis of disease-causing Microorganisms.	Apply
CO3	It will also provide opportunities for a student to develop diagnostic skills in microbiology, including the practical application and interpretation of laboratory tests for the diagnosis of infectious diseases.	Understand
CO4	Comprehend the various methods for identification of unknown microorganisms.	Analyze
CO5	Recall the relationship of this infection to symptoms, relapse and the accompanying pathology.	Understand

CO6	Explain the methods of microorganisms control, e.g. chemotherapy & vaccines. Solve problems in the context of this understanding. • Demonstrate practical skills in fundamental microbiological techniques	Remember

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				**S**								
CO2										**M**		
CO3					**M**							
CO4									**S**			
CO5												**M**
CO6										S		

S-Strong; M-Medium; L-Low

EXPERIMENTS **(40 Hours)**

1. Identify bacteria (any three of *E. coli, Salmonella, Pseudomonas, Staphylococcus, Bacillus*) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests.
2. Study of composition and use of important differential media for identification of bacteria: EMB Agar, MacConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS, Salmonella Shigella/ BSA Agar.
3. Study of bacterial flora of skin by swab method.
4. Antibacterial sensitivity assay by Kirby- Bauer method.
5. Determination of minimal inhibitory concentration (MIC) of an antibiotic.
6. Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chickenpox, HPV warts, AIDS (candidiasis), dermatomycoses (ringworms).
7. Studyofvariousstages of malarial parasite in RBCs using permanent mounts.

SUGGESTED READINGS

1. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013). Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
2. Green wood D, Slack R, Barer M, and Irving W. (2012).Medical Microbiology,18th Edition. Churchill Livingstone.
3. Ryan KJ and Ray CG.(2014).Sherris Medical Microbiology,6th Edition .McGraw-Hill Professional.
4. AnanthanarayanR.andPanikerC.K.J.(2009)TextbookofMicrobiology.8th edition,UniversityPressPublication.
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.
6. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. ElsevierWilley JM, Sherwood LM, and Woolverton CJ. (2013). Prescott, Harley and Klein's Microbiology. 9th edition.McGraw Hill HigherEducation

Semester –V

23MBU501 INDUSTRIAL MICROBIOLOGY AND BIOTECHNIQUES (5H–5C)

Instruction Hours / week: L: 5 T: 0 P:0 Marks: Internal: **40** External: **60** Total:**100 End Semester Exam:** 3Hours

- To encompasses the employability skill by the use of microorganisms in the production of food or industrial products.
- The aim of the course is to give the students broad theoretical and practical skills in industrial microbiology.
- This course covers the principles of various processes associated with the production and recovery of different bio-products derived from microorganisms.
- The students will be able to discuss the role of microorganisms in industry, as well as to carry out experiments to produce microbial metabolites.
- It will make the students to explore their practical skills in entrepreneurial development.
- It will deliver the largescale production of microbial products techniques in advanced level.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Provides knowledge in the largescale production of industrial product, providing the trends to cater the needs of industry.	Understand
CO2	This will help the students to enhance their employment knowledge on microbiology based commercial products.	Apply
CO3	The aim of the course is to give the students broad theoretical and practical skills in industrial microbiology.	Understand
CO4	This course covers the principles of various processes associated with the production	Analyze
CO5	Students are able recover the different bio-products from microorganisms.	Understand
CO6	The students will be able to discuss the role of microorganisms in industry, as well as to carry out experiments to produce microbial metabolites.	Remember

Mapping with Programme Outcomes

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

CO6									S			

S-Strong; M-Medium; L-Low

Unit I: Screening of Industrial Important Microbes (12 Hours)

Exploitation of microbes and their products. Sources of industrially important microbes and methods for their isolation, primary and secondary screening methods. Strain improvement method (protoplast fusion, mutation and recombinant DNA technology). Preservation and maintenance of industrial strains. Cell growth kinetics- Kinetics of Substrate utilization.

Unit II: Upstream Process (12 Hours)

Media formulation. Types of fermentation processes – Solid-state and liquid-state (stationary and submerged) fermentations; batch, fed-batch and continuous fermentations. Design of laboratory bioreactor. Types of bioreactors – Laboratory, pilot- scale and production fermenters, constantly stirred tank and air-lift fermenters.

Unit III: Downstream Process (12 Hours)

Down stream processing-techniques and methods: Stages in downstream processing. Separation of cells– filtration and centrifugation. Cell disruption– physical, chemical and enzymatic methods. Product separation- solvent extraction and precipitation. Lyophilization and spray drying, freeze drying and vacuum drying. Immobilization, Methods of immobilization, advantages and applications of immobilization.

Unit IV: Instrumentation (10 Hours)

Principle, Instrumentation and application of spectrophotometer, colorimeter and turdido meter. MALDI-TOF, FTIR, MS, Nuclear Magnetic Resonance, ESR. Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column Chromatography - packing types (IEC, AC, SEC), fraction collection. Nano LC, CGMS, LCMS, HPLC and Gel filtration chromatography.

Unit V: Microbial production of industrial products (14 Hours)

Citric acid, Ethanol, Penicillin, Bacitracin, Chlorempenicol, monoclonal antibodies, Glutamic acid, VitaminB12, Enzymes (DHA, amylase, protease, lipase, chitinase) Wine, Beer, probiotics (*Lacto bacillus*, *Bacillus* and yeast) Development of designer microbes for food, energy and health care products.

SUGGESTED READINGS

1. NdukaOkafor, Benedict C. Okeke (2017) Modern Industrial Microbiology and Biotechnology, 2ndEdition, CRCPress.
2. StanburyPF,WhitakerAandHallSJ.(2016).PrinciplesofFermentationTechnology.3ndedition,Elsevier Science Ltd.
3. Crueger W and Crueger A. (2017). Biotechnology: A textbook of Industrial Microbiology. 3rd edition.PanimaPublishingCo.NewDelhi.
4. GeoffreyMGadd,SimaSariaslani(2015)AdvancesinAppliedMicrobiology,CRCPress.

5.MansiEl-Mansi(2012)FermentationMicrobiologyandBiotechnology,CRCPress.

6.E M T El-Mansi, Jens Nielsen, David Mousdale (2019). Fermentation Microbiology and Biotechnology,Fourth Edition, CRCPress

7. NdukaOkafor, Benedict C. Okeke (2022). Modern Industrial Microbiology and Biotechnology2nd Edition. CRC Press.
8. David B. Wilson, Hermann Sahm, Klaus-Peter Stahmann, MattheosKoffas (2019).Industrial Microbiology 1st Edition. Wiley-VCH.
9.WilsonKandWalkerJ.(2010).PrinciplesandTechniquesofBiochemistryandMolecularBiology.7thEd.,Cambridge UniversityPress

Semester V

23MBU502 ENVIRONMENTAL MICROBIOLOGY (5H–5C)

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

End Semester Exam: 3Hours

COURSE OBJECTIVES

- To develop an attitude of concern for the environment.
- To know the social issues of the environment.
- To understand the core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
- To know about the various renewable and non renewable resources of the region.
- The students will develop set of skills to recognize the ecological problems and critical evaluation of the human impacts on pollution, climate changes and as well as environmental protection. Familiarize students with general principles and subject knowledge in the field of environment microbiology.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Make appropriate judgments and decisions for the protection and improvement of the earth.	Understand
CO2	Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.	Apply
CO3	Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.	Understand
CO4	Students will get the basic knowledge how to prepare and perform sampling and microbial analyses to determine the abundance, growth rate and microbial community composition together with the basic environmental parameters.	Analyze
CO5	Clarify application of microorganisms in varied fields of environmental microbiology like bioremediation, biofertilizers and waste water treatment.	Understand
CO6	Describe role of microorganism in recycling soil nutrients, biodegradation of complex plant polymers, sustaining and improving plant growth through improving nutrient availability.	Apply

Mapping with Programme Outcomes

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

CO5										**M**	
CO6								S			

S-Strong; M-Medium; L-Low

Unit I: Microbes in Environment (12 Hours)

Terrestrial Environment- soil profile and soil microflora. Biogenesis and Abiogenesis in environment Aquatic Environment- Microflora of fresh water and marine habitat. Atmosphere- Aeromicrobes and dispersal of microbes. Development of microbial communities. Environmental monitoring through microorganisms, monitoring of water and soil.

Unit II: Microbial role and diagnosis (12 Hours)

Physiological ecology of micro-organisms. C, N, P nutrient cycle, Treatment and safety of drinking (potable) water, membrane filter technique, Microbial interaction. Bio-films-surface colonization, Biofilm structure, Biofouling and Biotechnological applications. Xenobiotics. Artificial Intelligence in Environmental sustainability.

Unit III Waste Management (12 Hours)

Solid waste management- sources and types, methods of disposal (composting sanitary landfill), Liquid Waste Management – Composition and strength of sewage (BOD and COD), Primary, Secondary (Oxidation ponds, trickling filter and activated sludge process) and tertiary sewage treatment.

Unit IV: Air Pollution (10 Hours)

Introduction, Microbial Contamination of Air, Sources of Contamination, Enumeration and Isolation of Bacteria in Air, Air samplers and sampling techniques, Effects and control measures of air pollution.

Unit V: Biogas and biodegradation technology (14 Hours)

Biogas Technology- Plant design, construction, operation. Biogas from organic wastes. GMO impact and their important - Use in environmental management recycling technology. Principles and biodegrading of common pesticides, organic (Hydrocarbons and Oil spills) and inorganic (Heavy Metal), Biosurfactants. Biotransformation, bio-conservation, bioremediation, microbial remediation.

SUGGESTED READING

1. Singh, M.P., Singh, B.S., and Dey, S.S., (2004). Conservation of Biodiversity and Natural Resources.Daya Publishing House,Delhi.
2. Uberoi, N.K., (2010). Environmental Studies, Excel Books Publications, New Delhi,India.
3. Tripathy, S.N., and Panda, S., (2011). Fundamentals of Environmental Studies; 3rdEdition, VriandaPublications Private Ltd., NewDelhi.
4. Kumar, A., (2004). A Textbook of Environmental Science; APH Publishing Corporation, NewDelhi.
5. Verma, P.S., Agarwal, V.K., (2001). Environmental Biology (Principles of Ecology); S.Chand andCompany Ltd., NewDelhi.
6. Kaushik, A., Kaushik, C.P., (2006). Perspectives in Environmental Studies, New Age International Pvt.Ltd. Publications, NewDelhi.

7. Maier RM, Pepper IL, Gerba CP (2019). Environmental microbiology,Elsevier

8. Environmental Biotechnology: Principles and Applications by Bruce E Rittmann and Perry L McCarty,McGraw-Hill International (2020) 2nd edition

9. Ljungdahl LG, Adams MW, Barton LL, Ferry JG, Johnson MK (2003). Biochemistry and Physiology ofAnaerobic Bacteria, Springer. 8. Madigan MT, Martinko JM, Dunlap PV, Clark DP (2012).

Semester –V

23MBU503 RECOMBINANT DNA TECHNOLOGY (5H–5C)

Instruction Hours / week: L: 5 T: 0 P:0 **Marks:** Internal: **40** External: **60** Total:**100 End Semester Exam:** 3Hours

COURSE OBJECTIVES

- To learn the basic tools in recombinant technology
- To understand the various concepts of cloning vectors and cloning strategies
- To emphasize the knowledge in biotechnology and techniques.
- To familiarize the students to versatile tools and techniques employed in genetic engineering and recombinant DNA technology.
- A sound knowledge on procedural repertoire allows students to innovatively apply these in basic and applied fields of biological research.
- This course offers theoretical bases to properties and applications of versatile DNA modifying enzymes, cloning strategies, vector types, host genotype specificities for selection and screening of recombinants and/or recombinant transformants

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Imparts the entrepreneurial concepts of rDNA technology and their applications and Acquire knowledge on the applications of genetic engineering.	Understand
CO2	Understand the difference between old biotechnology and modern biotechnology.	Apply
CO3	Provide examples of current applications of biotechnology and advances in the different areas like medical, microbial, environmental, bioremediation, agricultural, plant, animal, and forensic sciences.	Understand
CO4	Explain the general principles of generating transgenic plants, animals and microbes.	Analyze
CO5	Technical know-how on versatile techniques in recombinant DNA technology.	Understand
CO6	An understanding on application of genetic engineering techniques in basic and applied experimental biology	Remember

Mapping with Programme Outcomes

Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1				**S**								
CO2										**M**		
CO3					**M**							
CO4									**S**			

CO5												**M**
CO6										S		

S-Strong; M-Medium; L-Low

I **(12 Hours)**

Milestones in genetic engineering and Biotechnology cloning Tools - Restriction modification systems – Types I, II and III. Mode of action, nomenclature, applications of Type II restriction enzymes in genetic engineering. DNA modifying enzymes and their applications – DNA polymerases, DNA ligases, Topoisomerase, gyrases, Terminal deoxynucleotidyl transferase, kinases and phosphatases.

Unit II **(12 Hours)**

Cloning Vectors: - Definition and Properties Plasmid vectors – pBR 322 and pUC Vector, Bacterio phage – lambda(λ) and M13 based vectors Cosmids, BACs, YACs. Use of linkers and adaptors. Expression vectors- *E. coli* lac and T7 promoter - based vectors, yeast – YIp, Yep and YCp vectors, Baculovirus based vectors, mammalian – SV- 40- based expression vectors

Unit III **(12 Hours)**

Transformation of DNA – Chemical method, Electroporation. Gene delivery – Micro injection, electroporation, biolistic method (gene gun), liposome and viral – mediated delivery, *Agrobacterium*-mediated delivery DNA, RNA and Protein analysis – Agarose gel electrophoresis, Blotting techniques - Southern, Northern, Western blotting, dot blot, SDS - PAGE.

Unit IV **(10 Hours)**

PCR – Basics of PCR, RT - PCR, Real - Time PCR(Quantitative), Multiplex PCR, Sybr Green PCR, Sanger's method of DNA Sequencing, traditional and automated sequencing. Primer walking and shotgun sequencing, Methylation sequencing and RNA sequencing. Microarrays – DNA and Protein microarray.

Unit V **(14 Hours)**

Construction of Genomic and cDNA libraries, screening of libraries: Colony hybridization and colony PCR, Chromosome walking and chromosome jumping. Products of recombinant DNA technology – Products of human therapeutic interest - insulin, hGH. Bt transgenic-cotton, brinjal, recombinant vaccines, protein engineering and site directed mutagenesis. Gene therapy, Replacement and augmentation, gene correction, gene editing, gene silencing, SiRNA, miRNA, Antisense RNA, CRISPR/Cas9.

SUGGESTED READINGS

1. BrownTA.(2010).GeneCloningandDNAAnalysis.6th edition.BlackwellPublishing,Oxford,U.K.

2. ClarkDPandPazdernikNJ.(2009).BiotechnologyApplyingtheGeneticRevolution.ElsevierAcademicPress, USA. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. BlackwellPublishing, Oxford,U.K.
3. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring HarborLaboratoryPress.
4. WileyJM,SherwoodLMandWoolvertonCJ.(2008).Prescott,HarleyandKlein'sMicrobiology.McGrawHill HigherEducation.
5. BrownTA.(2007).Genomes-3.GarlandSciencePublishers
6. Primrose SB and Twyman RM. (2008). Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K.

		Semester –V
23MBU504A	**BIOINFORMATICS**	**(5H–4C)**

Instruction Hours / week: L: 4 T: 1 P:0 Marks: Internal: **40** External: **60** Total:**100 End Semester Exam:** 3Hours **COURSE OBJECTIVES**

- To detail the importance of computer in field of life sciences.
- To obtain good understanding about the interpretation of biological data base.
- To uptake knowledge in latest tools and technology.
- Aimed to provide an overview of various bioinformatics tools, databases available and sequence analysis
- Provide knowledge on database concept, management, retrieval along with utilization in gene and protein analysis.
- To get introduced to the basic concepts of Bioinformatics and its significance in Biological data analysis

COURSE OUTCOME

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

COs	**Course Outcomes**	**Blooms Level**
CO1	Provides computational skill on search engines and various software tools involved in bioinformatics	Understand
CO2	It will impart computational based techniques which includes genomics and proteomics in Bioinformatics.	Apply
CO3	Retrieve information from available databases and use them for microbial identifications and drug designing	Understand
CO4	Gain ability to modify gene and protein structures in simulated systems.	Analyze
CO5	Introduction to the basics of sequence alignment and analysis.	Understand
CO6	Describe about the different types of Biological databases	Apply

Mapping with Programme Outcomes

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

CO6								S				

S-Strong; M-Medium; L-Low

I **(9 Hours)**

History of computers, Basics of Computer and operating systems, Data Representation, Data Abstraction, Concepts of flowcharting and algorithm development. Database, Database Management system, RDBMS - Definition of relational database. Mode of data transfer (FTP, SFTP, SCP), advantage of encrypted data transfer.

Unit II **(9 Hours)**

Biological databases – nucleic acid, genome, protein sequence and structure, gene expression databases, Database of metabolic pathways, Mode of data storage - File formats - FASTA, Genbank and Uniprot, Data submission & retrieval from NCBI, EMBL, DDBJ, Uniprot, PDB, SWISS- Prot, Specialized Databases. Gene prediction tools, ORF Prediction tool.

Unit III **(9 Hours)**

Local and Global Sequence alignment, pairwise and multiple sequence alignment. Scoring an alignment, scoring matrices, PAM & BLOSUM series of matrices. Types of phylogenetic trees, Different approaches of phylogenetic tree construction - UPGMA, Neighbour joining, Maximum Parsomony, Maximum likelihood. Introduction to Genomics, Proteomics, Transcriptomics, Systems biology and Infectomics.

Unit IV **(9 Hours)**

Diversity of Genomes: Viral, prokaryotic & eukaryotic genomes Genome, transcriptome, proteome, 2-D gel electrophoresis, MaldiTof spectroscopy. Major features of completed genomes: *E.coli, S.cerevisiae*, Arabidopsis, Human. Genomic database SGD, TIGR.

Unit V **(12 Hours)**

Hierarchy of protein structure - primary, secondary and tertiary structures, modeling. Structural Classes, Motifs, Folds and Domains. Protein structure prediction in presence and absence of structure template Energy minimizations and evaluation by Ramachandran plot Protein structure and rational drug design. Recent software and tools.

SUGGESTED READINGS

1. Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing.
2. Pradeep and Sinha Preeti (2007) Foundations of Computing, 4th ed., BPB Publications.
3. Lesk M.A.(2008) Introduction to Bioinformatics . Oxford Publication, 3rd International Student Edition.
4. Rastogi S.C., Mendiratta N. and Rastogi P. (2007) Bioinformatics: methods and applications, genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication.
5. Primrose and Twyman (2003) Principles of Genome Analysis & Genomics. Blackwell

Semester –V

23MBU504B METAGENOMICS AND FORENSIC MICROBIOLOGY (5H–4C)

Instruction Hours / week: L: 4 T: 1 P:0 **Marks:** Internal: **40** External: **60**Total:**100**

End Semester Exam: 3Hours

COURSE OBJECTIVES

- The course aims to appraise the students to basic and high throughput techniques in Genomics and Proteomics and their applications.
- Get introduced to the field of chemical synthesis of DNA.
- Sequencing of DNA and its applications in human health.
- The course presents methods and experimental tools used in modern genomics with emphasis on prokaryotes and eukaryotes.
- The course also deals with the genome structure, stability, organization, and its expression.
- The course includes among others model systems, genetics behind complex diseases.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Infer the basic concepts of genomics, transcriptomics and proteomics.	Understand
CO2	List and discuss the use of genomics and proteomics in human health.	Apply
CO3	Suggest and outline solution to theoretical and experimental problems in metagenomics and forensic Microbiology	Understand
CO4	Understand various steps involved in protein engineering.	Analyze
CO5	Understand methods for sequencing of DNA	Understand
CO6	Identification of disease genes and different types of mutations.	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					**S**							
CO2								**M**				
CO3			**M**									
CO4							**S**					
CO5										**M**		
CO6								S				

S-Strong; M-Medium; L-Low

UNIT I Introduction about metagenomics (12 Hours)

Need of Metagenomics, Omics: Stream of omics- Proteomics, Genomics, Metabolomics, Lipidomics and Epigenomics. Role of omics in Microbiology, Application of Metagenomics.

UNIT II Metagenomic Techniques (12 Hours)

Introduction – Shot gun sequencing Vs 16S sequencing. Metagenomics Technique: Sample processing, Metagenomic DNA extraction, NGS (Next generation sequencing), Binning, Annotation, Data analysis.

UNIT III Genomics (12 Hours)

Genome projects: The Human genome project, Structural genomics: Assembly of a contiguous DNA sequence- shotgun method, clone contig method, and whole –genome shotgun sequencing. Determining the functions of individual genes and by studying the activity of a protein coded of an unknown gene. Synthetic genomes and their applications.

UNIT IV Molecular and Epidemiological tools (10 Hours)

Nucleic amplification and molecular epidemiological techniques are essential tools in clinical microbiology for identifying pathogens. Typing tools for Phylogenetic study.

UNIT V Protein arrays (14 Hours)

Basic principles. Computational methods for identification of polypeptides from mass spectrometry. Protein arrays: bioinformatics-based tools for analysis of proteomics data (Tools available at ExPASy Proteomics server); databases (such as InterPro) and analysis tools. Protein-protein interactions: databases such as DIP, PPI server and tools for analysis of protein- protein interactions.

SUGGESTED READINGS

1. Brown T. A. 2007, Genomes 3. Garland Science Publishing, New York.
2. Dunham, I., 2003. Genome Mapping and sequencing. Horizon Scientific
3. Graur, D and W H Li, 2000. Fundamentals of molecular evolution. Sinauer Associates.
4. Hartwell, L. H., L. Hood, M. L. Goldberg, A. E. Reynolds, L. M. Silver and R. G. Veres. 2004. Genetics from Genes to Genomes. McGraw Hill.
5. Lewin B. 2003. Genes VIII. Oxford University Press. Oxford.
6. Primrose, S. B., and R. M. Twyman. 2006. Principles of gene manipulation and Genomics, Blackwell Publishing MA. USA.
7. Discovering Genomics, Proteomics and Bioinformatics 2nd edition - by A. Malcolm Campbell and
   Laurie
   J. Heyer by Cold Spring Harbor Laboratory Press 2006.
8. Principles of Genome Analysis and Genomics (3rd Ed.) by Primrose, S.B. and Twyman, R.M., Blackwell Publishing Company, Oxford, UK. 2003
9. Introduction to Proteomics – Tools for the new biology (1st Ed.) by Liebler, D.C., Humana Press Inc., New Jersey, USA. 2002

10. Bioinformatics and Functional Genomics by Pevsner, J., John Wiley and Sons, New Jersey, USA. 2003
11. Bioinformatics: Sequence and Genome Analysis by Mount, D., Cold Spring Harbor Laboratory Press,New York. 2004

23MBU511 INDUSTRIAL MICROBIOLOGY AND BIOTECHNIQUES PRACTICAL (4H–2C)

Instruction Hours / week: L: 0 T: 0 P:4 **Marks:** Internal: **40** External: **60** Total:**100**
End Semester Exam: 9 Hours

COURSE OBJECTIVES

- To encompasses the use of microorganisms in the manufacture of food or industrial products on the basis of employment.
- Get equipped with a theoretical and practical understanding of industrial microbiology
- Appreciate how microbiology is applied in manufacture of industrial products
- Know how to source for microorganisms of industrial importance from the environment
- Know about design of bioreactors, factors affecting growth and production, heat transfer, oxygen transfer
- To understand working of different laboratory equipment used in microbiological laboratories

COURSE OUTCOME

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

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

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1						**S**						
CO2									**M**			
CO3				**M**								
CO4								**S**				
CO5											**M**	
CO6									S			

S-Strong; M-Medium; L-Low

EXPERIMENTS **(48 Hours)**

1. Study of different parts of fermenter
2. Microbial fermentation – Production and estimation of enzyme – Amylase and Protease
3. Microbial fermentation – Production and estimation of organic acid- Citric acid
4. Assess quality of probiotics in tablets and nutritional supplements, stability of vials at different time.
5. Perform Cell growth kinetics.
6. Separation of mixtures by paper/thin layer chromatography.
7. Demonstration of column chromatography packing.
8. Separation of protein mixtures by SDS- Poly Acrylamide Gel Electrophoresis (SDS - PAGE).
9. Separation of components of a given mixture using a laboratory scale centrifuge.

SUGGESTED READINGS

1. NdukaOkafor, Benedict C. Okeke (2017) Modern Industrial Microbiology and Biotechnology, 2nd Edition, CRCPress.
2. StanburyPF,WhitakerAandHallSJ.(2006).PrinciplesofFermentationTechnology.2nd edition,ElsevierScienc eLtd.
3. CruegerWandCruegerA.(2017).Biotechnology:AtextbookofIndustrialMicrobiology.3rd edition.Panima PublishingCo.NewDelhi.
4. GeoffreyMGadd,SimaSariaslani(2015)AdvancesinAppliedMicrobiology,CRCPress.
5. E.MTEl-Mansi,JensNielsen,DavidMousdale(2009)FermentationMicrobiologyand Biotechnology, FourthEdition, CRCPress.
6. KarpG.(2010)CellandMolecularBiology:ConceptsandExperiments.6th edition.JohnWiley&Sons.Inc.
7. Nigam A and AyyagariA. (2007). Lab Manual in Biochemistry, Immunologyand Biotechnology.Tata McGraw Hill

B.Sc. Microbiology **2023-2024**

Semester –V

23MBU512

ENVIRONMENTAL MICROBIOLOGY AND R-DNA PRACTICAL (4H–2C)

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

End Semester Exam: 6 Hours

COURSE OBJECTIVES

- To educate students about Environmental monitoring and environmental aspects of microbes.
- To impart a skill-based knowledge on Microbes and environment and ecological importance.
- Appreciate the diversity of microorganism and microbial communities inhabiting a multitude of habitats and occupying a wide range of ecological habitats
- Learn the occurrence, abundance and distribution of microorganism in the environment and their role in the environment
- and also learn different methods for their detection and characterization
- To provide an experience for the students in an interdisciplinary research program connecting animal genomics with animal reproduction and biotechnology.
- The course will facilitate in understanding of molecular biology by examining common processes and principles in genes to illustrate complexity.

COURSE OUTCOME

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

Cos	Course Outcomes	Blooms Level
CO1	Provides a comprehensive overview of biogeochemical processes relevant to environmental scientists and engineers mediated by microorganisms.	Understand
CO2	Understand various plant microbes' interactions especially rhizosphere and their applications especially the biofertilizers and their production techniques	Apply
CO3	Understand the basic principles of environment microbiology	Understand
CO4	Explores technologies using molecular biology, cell and tissue culture to manipulate the genomes of animals for ways.	Analyze
CO5	Develop the skills in molecular biology.	Understand
CO6	Students are capable of explaining process involved in genetic changes and mutations	Remember

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							**S**					
CO2										**M**		
CO3					**M**							

CO4									**S**			
CO5												**M**
CO6										S		

S-Strong; M-Medium; L-Low

EXPERIMENTS **(48 Hours)**

1. Analysis of soil - pH, moisture content, water holding capacity, percolation, capillary action.
2. Isolation of microbes (bacteria &fungi) from rhizosphere and rhizoplane.
3. Analysis of potable water- MPN method.
4. Determination of BOD and COD of wastewater sample.
5. Isolation of phosphate solubilizing bacteria from soil and study.
6. Resolution and visualization of proteins by SDS – Polyacrylamide Gel Electrophoresis (SDS-PAGE).
7. Competent cell preparation
8. Bacterial transformation
9. Isolation of genomic DNA from *E.coli.*
10. Isolation of plasmidfrom *E. coli.*

SUGGESTEDREADINGS

1. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology.2nd edition, Academic Press.
2. Okafor,N (2011). Environmental Microbiology of Aquatic & Waste systems. 1st edition, Springer, NewYork.
3. Atlas RM and Bartha R (2000). Microbial Ecology: Fundamentals & Applications. 4thedition.Benjamin/Cummings Science Publishing,USA
4. Barton LL & Northup DE (2011). Microbial Ecology. 1stedition, Wiley Blackwell, USA Campbell RE.(1983). Microbial Ecology. Black well Scientific Publication, Oxford,England.
5. Coyne MS. (2001).Soil Microbiology: An Exploratory Approach. Delmar ThomsonLearning.
6. Madigan MT, Martinko JM and Parker J. (2014).Brock Biology of Microorganisms. 14thedition.Pearson/BenjaminCummings.
7. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9thedition. McGraw HillHigherEducation.
8. Singh A, Kuhad, RC & Ward OP (2009). Advancesin Applied Bioremediation. Volume17, Springer-Verlag, BerlinHedeilberg.

B.Sc. Microbiology **2023-2024**

Semester –V

23MBU591 **INTERNSHIP**

(2C)

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

23MBU601 FOOD AND DAIRY MICROBIOLOGY **Semester –VI (5H–5C)**

Instruction Hours / week: L:5 T: 0 P:0 Marks: Internal: **40** External: **60** Total:**100 End Semester Exam:** 3Hours

COURSE OBJECTIVES

- To understand the manufacturing process of textile fibers and yarns.
- The course aims to provide instruction in the general principles of food microbiology.
- The course covers the biology and epidemiology of food borne microorganisms of public health significance, including bacteria, yeasts, fungi, protozoa and viruses,
- Understand food spoilage microorganisms.
- Understand the microbiology of food preservation and food commodities; fermented and microbial foods;
- Understand the principles and methods for the microbiological examination of foods;
- To study the micro biological quality control, and quality schemes.

COURSE OUTCOME

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

Cos	Course Outcomes	Blooms Level
CO1	Understand the principles of microorganisms during various food-processing and preservation steps.	Understand
CO2	Comprehend the interactions between microorganisms and the food environment, and factors influencing their growth and survival.	Apply
CO3	Understand the significance and activities of microorganisms in food.	Understand
CO4	Recognize the characteristics of food-borne, waterborne and spoilage microorganisms, and methods for their isolation, detection and identification.	Analyze
CO5	Analyze the importance of microbiological quality control programme's in food production. Discuss the microbiology of different types of food commodities	Understand
CO6	Describe the rationale for the use of standard methods and procedures for the microbiological analysis of food.	Apply

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						**S**						
CO2									**M**			
CO3				**M**								
CO4								**S**				

CO5											**M**	
CO6									S			

S-Strong; M-Medium; L-Low

Unit I **(10 Hours)**

Food and microorganisms – Important microorganisms in food (bacteria, molds and yeast). Sources of contamination of food. Intrinsic and extrinsic factors that affect growth and survival of microbes in foods. Microbial spoilage of various foods–Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods and sea food.

Unit II **(10 Hours)**

General principles of food preservation. Physical methods of food preservation: asepsis, removal of microorganism, drying, temperature (low, high), radiation, Chemical methods of food preservation, food additives, flavoring agents and enzyme preparation.

Unit III **(10 Hours)**

Fermented dairy products: yogurt, acidophilus milk, kumiss, kefir and cheese. Other fermented foods: Idly, sauerkraut, soy sauce and tampeh. Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market. Beneficial uses of microorganisms in food industry.

Unit IV **(8 Hours)**

Causative agents, foods involved, symptoms and preventive measures of the following diseases, Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins. Food infections: Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis, Shigellosis, Yersinia enterocolitica, Listeria monocytogenes and Campylobacter jejuni, fungal diseases (Mycotoxins, Aflatoxins, Alternaria toxins).

UnitV **(12Hours)**

Cultural and rapid detection methods of food borne pathogens in foods and introduction to predictive microbiology. HACCP, FSSAI (ISO9001:2008) Indices of food sanitary quality (record maintenance and standards) sanitizers. Quality control of milk – MBRT, Litmus Milk – Alkaline phophatase tests. Biosensors in food processing.

SUGGESTED READINGS

1. Jay JM, Loessner MJ and Golden DA.(2005).Modern Food Microbiology.7thedition, CBS Publishers andDistributors, Delhi, India.
2. Lund BM, Baird Parker AC, and Gould GW.(2000).The Microbiological Safety and Quality of Foods.Vol.1-2,ASPEN Publication, Gaithersberg,MD.
3. Frazier W.C. and Westhoff D.C. (2008) Food Microbiology, 4th Edn. Tata McGraw Hill Publishing Co.,New Delhi.
4. Bamforth C.W. (2005) Food, Fermentation and Microorganisms, Blackwell Science.
5. Doyle M.P. and Buchanan R.L. (Ed.) (2013) Food Microbiology: Fundamentals and Frontiers, 4th Edn.ASM press.

6. Jay J.M., Loessner M.J. and Golden D.A. (2005) Modern Food Microbiology, 11th Edn. SpringerPublishers.
7. Robinson R.K. (2018) Dairy Microbiology: Milk and Milk Products, 6rd Edn. Wiley Publishers.
8. James M Jay (2003). Modern Food Microbiology. Fourth edition, CBS Publishers, New Delhi.

23MBU602 MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT (5H–5C)

Instruction Hours / week: L: 5 T: 0 P:0 **Marks:** Internal: **40** External: **60** Total:**100**
End Semester Exam: 3Hours

COURSE OBJECTIVES

- The goal of sustainable agriculture is to meet society's food and textile needs in the present without compromising the ability of future generations to meet their own needs.
- Able to evaluate the application of ecological principles and concepts in sustainable agriculture system.
- To know the role of microbes which make crop output more and increase the fertility of crops.
- To know the specific reference to agriculture and biotechnological terms
- To know the physiological processes that advocating microbial development and evolution
- To make them to understand issues related to plant nutrition, quality improvement, environmental adaptation, transgenic crops and their use in agriculture

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Develops the programmatic activities in sustainable agriculture and food systems	Understand
CO2	Able to relate their knowledge about ecology to its relevance in sustainable agriculture	Apply
CO3	Provides detailed idea about biofertilizer production and develop entrepreneur skill related to agriculture field.	Understand
CO4	Understand on soil characteristics and biogeochemical cycling.	Analyze
CO5	Students able to the uses of microorganisms as bio control agents.	Understand
CO6	Understand transgenic crops and their use in agriculture.	Apply

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						**S**						
CO2									**M**			
CO3				**M**								
CO4								**S**				
CO5											**M**	
CO6									S			

S-Strong; M-Medium; L-Low

Unit I (10 Hours)

Soil as Microbial Habitat, Soil profile and properties, Soil formation, Role of microbes in soil fertility, Factors influencing the microbial density in the soil Mineralization of cellulose, hemicelluloses, lignocelluloses, lignin and humus, phosphate, nitrate, silica and potassium

Unit II **(10 Hours)**

Role of microbes in production and control of carbon dioxide, methane, nitrous oxide and nitric oxide, Microbial interactions- Mutualism, Protocooperation, Commensalism, Neutralism, Competition, Amensalism, Parasitism, Predation, Syntrophism,

Unit III **(10 Hours)**

Biocontrol mechanisms and ways- direct antagonism, indirect antagonism and mixed path antagonism Microorganisms used as biocontrol agents against Microbial plant pathogens, Insects, Weeds. Recycling of agriculture waste, Bioconversion of organic wastes-sugarcane wastes. Role of microbes in composting process –coir-pith composition-composting, principles and applications.

Unit IV **(8 Hours)**

Plant growth promoting bacteria, biofertilizers – symbiotic (Bradyrhizobium, Rhizobium, Frankia, VAM, potash solubilizer), Non-Symbiotic (Azospirillum, Azotobacter, Mycorrhizae, MHBs, Phosphate solubilizers, algae), Novel combination of microbes as biofertilizers, PGPRs, Marine resource biofertilizers, vermicomposting.

Unit V **(12 Hours)**

Biotech feed, Silage, Bio manure, biogas, biofuels – advantages and processing parameters, Advantages, social and environmental aspects, GM crops, Bt crops, golden rice, transgenic animals.

SUGGESTED READINGS

1. Stephen Burchett, Sarah Burchett (2018) Plant Pathology, 1st Edition, Garland Science.
2. Ching T. Hou, Jei-Fu Shaw (2019) Biocatalysis and Agricultural Biotechnology, 1st Edition, CRC Press.
3. Parmjit S. Panesar, Satwinder S. Marwaha (2017) Biotechnology in Agriculture and Food Processing:Opportunities and Challenges, 1st Edition, CRC Press.
4. NoureddineBenkeblia (2019) Sustainable Agriculture and New Biotechnologies, 1st Edition CRC Press.
5. SangitaSahni, BishunDeo Prasad, Prasant Kumar (2017) Plant Biotechnology, Volume 2: Transgenics,Stress Management, and Biosafety Issues, 1st Edition, Apple Academic Press.
6. Pradeep Kumar, PhD., Jayanta Kumar Patra, Pranjal Chandra (2018) Advances in Microbial Biotechnology: Current Trends and Future Prospects, 1st Edition, Apple Academic Press.
7. Allen I. Laskin (2017) Microbial Ecology, 1st Edition, CRC Press.
8. Tanya E. Cheeke, David C. Coleman, Diana H. Wall (2012) Microbial Ecology in Sustainable Agroecosystems, 1st Edition, CRC Press.
9. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology, 4th Edition, ASM Press.

23MBU603A **BIOPHARMACY** **Semester –VI (5H–5C)**

Instruction Hours / week: L: 5 T: 0 P:0 Marks: Internal: **40** External: **60** Total:**100 End Semester Exam:** 3Hours

COURSE OBJECTIVES

- An introduction to know about the biological substance which has the medicinal value.
- It aids to improve the biopharmaceutical components and technical knowledge.
- To study the origin, types and action of drugs; legislations on them.
- To acquire knowledge on the action and effects of drugs on human health.
- To know the various physical, physicochemical properties and principle involved in formulations
- It provides the basic concept about the technique involved in the field of biopharmacy.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	This course deals with the various physical and physicochemical properties	Understand
CO2	Students will understand the principle involved in formulations	Apply
CO3	Understand various physicochemical properties of drug molecules in the designing the dosage form	Understand
CO4	The sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals.	Analyze
CO5	Understand the medicinal and pharmaceutical importance of inorganic compounds.	Understand
CO6	Students will understand the various processes involved in pharmaceutical manufacturing process.	Apply

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							**S**					
CO2										**M**		
CO3					**M**							
CO4									**S**			
CO5												**M**
CO6										S		

S-Strong; M-Medium; L-Low

UNIT – I Phytochemistry **(10 Hours)**

Biosynthesis of primary and secondary metabolites - alkaloids, terpenoids. glycosides, Phenolic compounds and coumarins. Classification and sources of alkaloids. Major classes in phenolic compounds – carotenoids, flavonoids, tannins and phenolic acids. Classification of terpenoids.

UNIT – II Extraction Techniques (10 Hours)

General extraction and isolation techniques for compounds from plants. Techniques involved in extraction of phytochemicals – Percolation, Soxhlet extraction, Supercritical Fluid extraction, Pilot scale extraction, reflux and other methods.

UNIT – III Isolation and purification techniques (10 Hours)

Thin layer and Column chromatography, Liquid Chromatography, Gas chromatography, Affinity chromatography and super critical fluid chromatography. Chemical fingerprinting – HPLC and HPTLC, Mass Spectroscopy.

UNIT – IV Biotechnology of medicinal plants (8 Hours)

Production of secondary metabolites from cultured plant cells, elicitation, immobilization and biotransformation. Medicinal plants – Plant DNA isolation.

UNIT – V Bioactive studies (12 Hours)

Anticancer, antidiabetic, anti-inflammatory, hepatoprotectives, antimicrobials from medicinal plants. Antioxidants of plant origin – Reactive Oxygen Species (ROS), antioxidant polyphenols.

SUGGESTED READINGS

1. Harborne, J.B., 1998. Phytochemical methods to modern techniques of plant analysis. Chapman & Hall,London.
2. Trease G.E. and M.C. Evans, 1979. Textbook of Pharmacognosy 12th Edition. Balliere-Tindal, London.
3. Irfan A. Khan and AtityaKhanum, (Eds.) 2004. Role of Biotechnology in medicinal and Aromatic plants, Vols. I-X. Ukaaz Publications, Hyderabad.

Semester VI

23MBU603B BIO NANOTECHNOLOGY (5H–5C)

Instruction Hours / week: L: 5 T: 0 P:0 **Marks:** Internal: **40** External: **60** Total:**100** **End Semester Exam:** 3Hours

COURSE OBJECTIVES

- This course has been intended to provide knowledge about the Bio nanomaterials synthesis and its advancement.
- To foundational knowledge of the Nanoscience and related fields.
- To make the students acquire an understanding the Nanoscience and Applications To help them understand in broad outline of Nanoscience and Nanotechnology.
- Understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment
- Apply their learned knowledge to develop Nanomaterial's.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Students get an idea about application of nanotechnology in biology.	Understand
CO2	It provides analytical knowledge of trends and developments in the field of nanotechnology	Apply
CO3	Acquire knowledge in nanotechnology and how it will support the employment greatly.	Understand
CO4	Students able to construct hierarchy strategy in machine.	Analyze
CO5	Able to describe self-application and machine phase biotechnology	Understand
CO6	Students have an enhanced knowledge and understanding of chemical transformation and biomolecular sensing	Apply

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					**S**							
CO2								**M**				
CO3			**M**									
CO4							**S**					
CO5										**M**		
CO6								S				

S-Strong; M-Medium; L-Low

UNIT – I Nano particles **(10 Hours)**

Biotechnology to Bionanotechnology: Bio nanomachines – Modern bionano materials – protein, nucleic acid, lipids used for carrying information – polysaccharides use in special structural roles – Present status of bionanotechnology.

UNIT – II Bionanomachines (10 Hours)

Molecular design for nanotechnology: Recombinant DNA technology – X-ray crystallography, NMR spectroscopy and electron microscopy, use in nanotechnology – Computer modeling to bionanomachines and computer assisted molecular design.

UNIT – III Natural bio nanotechnology designing (10 Hours)

Structural principles of Bionanotechnology: Natural bio nanotechnology design for specific environment– Biomolecular structure as low materials – Hierarchical strategy in construction of nanomachines – protein folding – self organization – molecular recognition – flexibility.

UNIT – IV Principles of Nanotechnology (8 Hours)

Functional principles of Bionanotechnology: Information driven nano assembly – chemical transformation – bio molecular sensing – self application – machine phase bio nanotechnology.

UNIT – V Ethics of Nanotechnology (12 Hours)

Future of Bio nanotechnology: Problems in bionanotechnology – Abide finger problem – Sticky finger problem – role of enzyme to solve these problems – Core studies – nomotuble synthesis, nano scale assembler, nanozurveillance – ethical consideration – respect for life, potential dangers, fuel.

SUGGESTED READINGS

1. David, S. (2004). Goodsell. Bionanotechnology. Wiley-Blackwell.
2. Gonsalves, K., Halberstadt, C., Laurencin, C.T., (2007). Biomedical Nanostructures. Wiley-Blackwell.
3. Sabliov, C., Hongda, A., Yada, R., (2015). Nanotechnology and Functional Foods. Wiley-BlackwellPublishers
4. Rakesh Kumar, and Tiwari, K., (2013). A Textbook of Nanoscience. Publisher: S.K. Kataria& Sons.
5. Goosell, D.S. (2004). Bionanotechnology: Lessons from nature. John Wiley & Sons Inc. publication.
6. Goodsell, D.S. (1996). Biomolecules and Nanotechnology. Ancient Scientist, 88, 230 – 237.
7. Blundell, T.L., and Johnson, L.N., (1976). Protein crystallography. New York.
8. Eisenberg, D., and Crothers, D., (1979). Physical Chemistry with Applications to the Life Sciences.Benjamin Cummings, Menlo Park, California.
9. Ausubel, F.M., Breut, R., Kingston, R.E., Moore, D.D., Siedman, J.G., Smith, J.A., and Struhl K., (1999).Short protocols in Molecular Biology. (4th ed.). Wiley, New York.

B.Sc. Microbiology

2023-2024

Semester –VI

23MBU611 FOOD AND DAIRY MICROBIOLOGY PRACTICAL (4H–2C)

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

End Semester Exam: 3Hours

COURSE OBJECTIVES

- To encode the importance of the role of microorganisms in food industries both in beneficial and harmful ways.
- To obtain a good entrepreneurial understanding of food and dairy products and become qualified as microbiologist in food and dairy industries.
- Understand the significance and activities of microorganisms in food and role of intrinsic and extrinsic factors on growth and survival of microorganisms in foods
- To know the spoilage mechanisms in foods and thus identify methods to control deterioration and spoilage
- Recognize and describe the characteristics of important pathogens and spoilage microorganisms in foods.
- To Learn various methods for their isolation, detection and identification of microorganisms in food and employ in industries.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Provides necessary entrepreneurial information on the food, dairy Microbiology in safety and quality perspective.	Understand
CO2	It will help to study the importance in the prevention of contamination that might be caused by the microorganisms.	Apply
CO3	To Learn various methods for their isolation, detection and identification of microorganisms in food and employ in industries	Understand
CO4	Identify ways to control microorganisms in foods and thus know the principles involving various methods of food preservation	Analyze
CO5	Students can able to understand of the basis of food safety regulations and Discuss the rationale for the use of standard methods and procedures for the microbiological analysis of food	Understand
CO6	Acquire, discover, and apply the theories and principles of food microbiology in practical, real-world situations and problems.	Apply

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						**S**						
CO2									**M**			

CO3				**M**								
CO4								**S**				
CO5											**M**	
CO6									S			

S-Strong; M-Medium; L-Low

EXPERIMENTS **(40 Hours)**

1. Methylene Blue Dye Reduction Test and Resazurin test for testing the Raw milk quality
2. Standard plate count of milk sample.
3. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
4. Isolation of food borne bacteria from food products.
5. Isolation of spoilage microorganisms from spoiled vegetables/fruits.
6. Production of yogurt.
7. Isolation of microorganisms from curd (*Lactobacillus* observation).
8. Visit to microbiology based Food and dairy industry and observe the unit operation procedures.

SUGGESTED READINGS

1. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7thedition, CBS Publishersand Distributors, Delhi,India.
2. Lund BM, Baird Parker AC, and Gould GW. (2000). The Microbiological Safety and Quality of Foods.Vol. 1-2, ASPEN Publication, Gaithersberg,MD.
3. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9thedition. Pearson Education.
4. Diane Roberts (2013). Practical Food Microbiology, Third Edition, Print ISBN:9781405100755, Blackwell PublishingLtd.

B.Sc. Microbiology

2023-2024
Semester –VI

23MBU612 MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT PRACTICAL

(4H–2C)

Instruction Hours / week: L: 0 T: 0 P:4 **Marks:** Internal: **40** External: **60** Total:**100**
End Semester Exam: 6 Hours

COURSE OBJECTIVES

- Able to relate their knowledge about ecology to its relevance in sustainable agriculture
- Able to evaluate the application of ecological principles and concepts in sustainable agriculture system.
- To know the role of microbes which make crop output more and increase the fertility of crops**.**
- To analyses the degrading microorganisms by various techniques.
- Able to design biogas plant.
- To obtain knowledge in entrepreneur in agricultural area.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Able to relate their knowledge about ecology to its relevance in sustainable agriculture	Understand
CO2	Provides detailed idea about biofertilizer production and develop entrepreneur skill related to agriculture field.	Apply
CO3	Able to device biogas plant	Understand
CO4	Students will be annotating various zone in soil profile	Analyze
CO5	Students will be isolate various degrading microorganisms for agricultural use.	Understand
CO6	Understand the role of soil microbes in crop production.	Apply

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						**S**						
CO2									**M**			
CO3				**M**								
CO4								**S**				
CO5											**M**	
CO6									S			

S-Strong; M-Medium; L-Low

EXPERIMENTS **(40 Hours)**

1. Study of soil profile
2. Study the microflora of different types of soils
3. Preparation of compost
4. *Rhizobium*and *Azotobacter*as soil inoculants characteristics
5. Design and functioning of a biogas plant
6. Isolation of cellulose degrading organisms, urea decomposers and nitrate utilizers
7. Screening of bacterial isolates for PHB production by using "Sudan black B" method
8. Estimation of soil microbial activity- CO2 evolution method

SUGGESTED READINGS

1. Stephen Burchett, Sarah Burchett (2018) Plant Pathology, 1st Edition, Garland Science.
2. Ching T. Hou, Jei-Fu Shaw (2019) Biocatalysis and Agricultural Biotechnology**,** 1st Edition, CRC Press.
3. Parmjit S. Panesar, Satwinder S. Marwaha (2017) Biotechnology in Agriculture and Food Processing: Opportunities and Challenges, 1st Edition, CRC Press.
4. Noureddine Benkeblia (2019) Sustainable Agriculture and New Biotechnologies, 1stEdition CRC Press.
5. Sangita Sahni, Bishun Deo Prasad, Prasant Kumar (2017) Plant Biotechnology, Volume 2: Transgenics, Stress Management, and Biosafety Issues, 1st Edition, Apple Academic Press.
6. Pradeep Kumar, PhD., Jayanta Kumar Patra, Pranjal Chandra (2018) Advances in Microbial Biotechnology: Current Trends and Future Prospects, 1st Edition, Apple Academic Press.
7. Allen I. Laskin (2017) Microbial Ecology, 1st Edition, CRC Press.
8. Tanya E. Cheeke, David C. Coleman, Diana H. Wall (2012) Microbial Ecology in Sustainable Agro ecosystems, 1st Edition, CRC Press.
9. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology, 4th Edition, ASM Press.

B.Sc. Microbiology
2023-2024

Semester –VI

23MBU691	**PROJECT**	**(7H-4C)**

Instruction Hours / week: L:0 T: 0 P:7 **Marks:** Internal: **80** External: **120** Total:**200**

B.Sc. Microbiology **2023-2024**

Semester –VII

23MBU701 **TEXTILEMICROBIOLOGY** **(6H_5C)**

Instruction Hours / week: L: 5 T: 1 P:0 **Marks:** Internal: **40** External: **60** Total:**100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To understand the manufacturing process of textile fibers and yarns.
- To gain knowledge about the fabric weaving methods.
- To understand microbial enzyme technology in textile field.
- To know about the innumerable applications of enzymes in textile processing.
- The students will develop set of skills to recognize and to gain knowledge in antimicrobial finishes.
- To familiarize students with general principles and subject knowledge in the field of textile microbiology.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Classify fibers and explain fiber properties	Understand
CO2	Analyze the advantages of enzyme based detergents and explain the enzyme immobilization methods	Apply
CO3	The aim of the course is to give the students broad theoretical and practical skills in textile microbiology.	Understand
CO4	This course covers the principles of various processes associated with the textile manufacturing	Analyze
CO5	Outline the microbial applications in textile field	Understand
CO6	Justify eco-friendly textile processing with enzymes	Apply

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					**S**							
CO2								**M**				
CO3			**M**									
CO4							**S**					
CO5										**M**		
CO6								S				

S-Strong; M-Medium; L-Low

Unit I: Introduction to fiber Science (12 Hours)

Classification of textile fibres according to their nature and origin, manufacturing process of end uses of various fibers. Essential and desirable properties of textile fibres. Natural fibres: Vegetable fibers (bast, leaf and seed fibres), animal fibers (wool and silk) and mineral fibers (glass, asbestos and metallic fibres). classification, distinctive properties and end uses. Man-made fibres- Rayon & Bamboo.

Unit II: Extraction and Fabrication of Natural Fibers and Biomaterials (12 Hours)

Introduction, Need, and Classification of retting – Mechanical, running water, pool retting, and dew retting, stagnant retting and enzymatic retting. Yarn making and fabrication weaving, knitting and non woven. Biomaterials utilized in medical textiles – an overview. Definition and classification of biomaterials, Structure of biomaterials, Mechanical properties - Elastic behaviour, Stress and Strain, Tension and Compression, Shear, Isotropy -Fatigue- Toughness - Effect of Fabrication on Strength.

Unit III: Enzymes in textile industry (12 Hours)

Enzymes in textile processing- cellulosic fibres- desizing, scouring, bleaching, biopolishing, flax retting, denim fading. Protein fibres degumming, wool deprickling, shrink proofing. Enzymes in treatment of textile dye effluent.

Unit IV: Enzyme based eco-friendly detergents (10 Hours)

Introduction, disadvantages of conventional detergents, role of enzymes in detergents. Immobilized enzymes- preparation and industrial applications. Enzymes as fermentation products- amylases, proteases, pectinases and cellulases.

Unit V: Microbial applications in textile field (14 Hours)

Microbial Pigments - Extraction of bacterial and fungal pigments. Application of microbes - decolourization of textile dye effluent, Extraction and softening of fibres. Antimicrobial Finish- Impact of microbial growth on textiles and need for antimicrobial finish. Antimicrobial agents- Mode of action, types, characteristics. Commercially available antimicrobial agents. Assessment of antimicrobial activity: Antimicrobial finishing methods on fabrics.

SUGGESTED READING

1. DeepaliRastogi and Sheetal Chopra,(2017). Textile Science, Orient Black Swan Private Limited, Hyderabad.
2. SeemaSekhri, (2011). Textbook of Fabric Science: Fundamentals to Finishing, PHI Learning Pvt Limited,New Delhi.
3. Trever Palmer,(2004). Enzymes, Biochemistry, Biotechnology Clinical Chemistry: Affliated East-WestPress Ltd., New Delhi.
4. Satyanarayana.U and Chakrapani.U ,(2006). Biochemistry, Third Edition, ArunabhaSen Books and AlliedP Ltd., Kolkata.
5. V NierstraszACavaco-Paulo,(2010). Advances in Textile Biotechnology, Woodhead Publishing Ltd.,U.K.
6. Purohit.S,S, (2008). Microbiology Fundamentals and Applications, 7 Th Edition, AGROBIOS, India.

B.Sc. Microbiology **2023-2024**

Semester –VII

23MBU702 POULTRY AND VETERINARY MICROBIOLOGY (6H–5C)

Instruction Hours / week: L:5 T: 1 P:0 **Marks:** Internal: **40** External: **60** Total:**100**

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To understand the role of microorganisms in animal health.
- Identify a variety of types of pathogenic microorganisms and the diseases they produce in the host.
- Perform basic microbiological techniques used in the laboratory setting of a veterinary hospital.
- Identify organisms from unknown samples using a variety of tests.
- To understand animal disease and gives a brilliant grounding in immunology, molecular biology, microbiology and epidemiology.
- The infectious disease cycle of the pathogens enables to solve the epidemics. The territory covered by infections and the immune response.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Students will be able to understand the importance of commercialization in veterinary industry	Understand
CO2	Students will be able to develop, investigation, pharmacy and vaccine production is offering various career opportunities for the Veterinary professionals	Apply
CO3	Candidate able to explain the host response to infection.	Understand
CO4	Students will be able to analyze the morphology and crystallographic structure of animal virus.	Analyze
CO5	Students will be able to predict cytocidal changes in animal due to virus infection.	Understand
CO6	Demonstrate an understanding at an advanced level of microbial virulence mechanisms	Apply

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						**S**						
CO2									**M**			
CO3				**M**								
CO4								**S**				
CO5											**M**	
CO6									S			

S-Strong; M-Medium; L-Low

UNIT I: Introduction to Veterinary Microbiology (12 Hours)

Introduction- etiology, pathogenesis, laboratory diagnosis and treatment of infection in the individual. Epizootiology - prevention and control of infection in the community.

UNIT II: Veterinary Bacteriology & Mycology (12 Hours)

Study of pathogenic bacteria and fungi in relation to their morphology, isolation, growth, colonial, biochemical characteristics, Pathogenicity and diagnosis of bacterial and fungal diseases: Bacteria - Staphylococcus, Streptococcus, Bacillus, Clostridium, Mycobacterium, Enterobacteriaceae, Campylobacter, Brucella, Pasteurella, Listeria, Actinomyces, Mycoplasma, Rickettsia, Chlamydia. Fungi - Dermatophytes, Candida, Aspergillus, Zygomycetes, Mycotic mastitis and Mycotoxicosis.

UNIT III: Cell interaction and cell damage (12 Hours)

Virus –cell interactions, types of interactions, Cytocidal changes in virus infected cells, mechanisms of cell damage., Inclusion bodies, ultrastructural changes in virus infected cells, interferons. Viral persistence, viral strategies to evade host defense mechanisms, persistent infection and chronic damage to tissues and organs, infection induced damage to immune system, autoimmune disease, hypersensitivity.

UNIT IV: Veterinary Parasitology (10 Hours)

Principles of Taxonomy, Physiology and Parasite Identification. Animal Parasitic diseases - Parasite morphology, parasite life cycles, host pathology, epidemiology of infections, treatment and control of infections- Platyhelminthes, Nemat helminthes and Acanthocephala.

UNIT V: Livestock Management (14 Hours)

Animal nutrition- Energy sources. Dairy production and Management. Taxonomy, anatomy and biology of commercially important fishes. Most common cattle, sheep, goat, poultry and pig diseases. Types of vaccines-Live, Inactivated, Recombinant, synthetic peptide, genetically modified vaccines etc.

SUGGESTED READING:

1. Glen Sonder J & Karen W Post 2005. Veterinary Microbiology: Bacterial and Fungal Agents ofAnimal Diseases. ColdSpringHarbor Lab. Press.
2. Prescot LM, Harley JP & Klen DA. 2005. Microbiology. Wm. C. Brown Publications.
3. Tortora GJ, Funke BR & Case CL. 2004. Microbiology: An Introduction. Benjamin/Cummins 4. Publications.
5. C.L. Gyles, J. .F Prescott, J.G. Songer, C.O. Thoen. Pathogenesis of Bacterial Infections in Animals.2004 Wiley
6. Fenner.S,2016. Veterinary virology (5 th Edition). Academic Press.

B.Sc. Microbiology **2023-2024**

Semester –VII

23MBU703A DRUG DESIGN AND DEVELOPMENT (5H–4C)

Instruction Hours / week: L:4 T: 1 P:0 Marks: Internal: **40** External: **60** Total:**100 End Semester Exam:** 3Hours

COURSE OBJECTIVES

- To know the significance of Drug Design and Discovery
- To know the course, introduce the basic principles of modern drug design, discovery and development.
- To know the different source of drug with specific focus on microbial source
- To understand the drug manufacturing process.
- To identify the Lead compound series
- To know the biosimilars and pharmaceuticals of microbial origin.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	The course will impart knowledge on detection, selection, and validation of new antibacterial targets,	Understand
CO2	Candidates able to involve in the vaccines	Apply
CO3	The use of gene technology in pharmaceutical industry	Understand
CO4	Students could understand the significance of tolerability, side effects at different doses	Analyze
CO5	Can contribute to the upstream process	Understand
CO6	Gain the knowledge on the drug development process and engineering technology in drug development	Apply

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						**S**						
CO2									**M**			
CO3				**M**								
CO4								**S**				
CO5											**M**	
CO6									S			

S-Strong; M-Medium; L-Low

UNIT-I Introduction to drug design (12 Hours)

Introduction- History of drug design, Current approaches and philosophies in drug design, Molecular mechanisms of diseases and drug action with examples. Pharmaceutical products, Pharmaceuticals

of microbial origin (macrolides, ansamycins, Peptide and other antibiotics) animal origin (sex hormones androgens), plant origin (Alkaloids Atropine and scopolamine)

UNIT-II Microbial drugs (12 Hours)

Sources of Drugs- Microbial drugs, E. coli as a source of recombinant therapeutic proteins. Expression of recombinant proteins in yeasts, animal cell culture systems. Transgenic animals, Transgenic plants and Insect cell-based systems. Rational drug design and Combinatorial approaches to drug discovery, Antibody Drug Conjugates.

UNIT-III Drug production (12 Hours)

Drug development process- Impact of genomics and related technologies upon drug discovery: Gene chips, Proteomics, Structural genomics and Pharmacogenetics, Model systems in the development of drugs, Nano scaffolds for Drug Delivery. Drug manufacturing process- Guides to good manufacturing practice, Production of final product - Cell banking systems, Upstream processing, Microbial cell fermentation, Mammalian cell culture systems, Downstream processing, Final product formulation, Freeze drying, Labelling and packing

UNIT-IV Vaccines and adjuvant (10 Hours)

Traditional vaccine preparations, attenuated, dead or inactivated bacteria, Attenuated and inactivated viral vaccines, Toxoids, antigen-based and other vaccine preparations. Impact of genetic engineering on vaccine technology. Peptide vaccines Vaccine vectors. Development of an AIDS vaccine, Difficulties associated with vaccine development, AIDS vaccines in clinical trials, Cancer vaccines, Recombinant veterinary vaccines. Adjuvant technology: Adjuvant mode of action, Mineral-based adjuvants, Oil-based emulsion adjuvants Bacteria/bacterial products as adjuvants, Biosimilars.

UNIT-V Applications of drugs (14 Hours)

Nucleic acid as drugs- Gene therapy: Basic approach to gene therapy, Vectors used in gene therapy - Retroviral vectors, Additional viral-based vectors, Manufacture of viral vectors, Non-viral vectors. Gene therapy and genetic disease, cancer, Gene therapy and AIDS. Gene based vaccines, Repurposing of drugs.

SUGGESTED READING

1. Kristian Stromgaar, PovlKrogsgaard-Larsen and Ulf Madsen (2017). Textbook of Drug Design andDiscovery, Fifth Edition, CRC press,2017.
2. Thomas J. Dougherty and Steven J. Projan. Microbial Genomics and Drug Discovery, Taylor andFrancis,2003
3. Kenneth M. Merz, Dagmar Ringe and Charles H. Reynolds. Drug Design: Structure- and Ligand-BasedApproaches, Cambridge University press,2010.
4. Kristian Stromgaar, PovlKrogsgaard-Larsen and Ulf Madsen (2017). Textbook of Drug Design andDiscovery, Fifth Edition, CRC press,2017
5. David B. Weiner and William V. Williams. Biological Approaches to Rational Drug Design (Handbooksin Pharmacology and Toxicology) CRC press,1994
6. Gary Wlash (2004). Biopharmaceuticals, Biochemistry and Biotechnology. 2nd edition. Wiley publisher.

B.Sc. Microbiology

2023 - 2024

Semester –VII

23MBU703B BIOPRODUCT DEVELOPMENT AND ENTERPRENEURIAL MICROBIOLOGY

(5H–4C)

Instruction Hours / week: L: 4T: 1 P:0 **Marks:** Internal: **40** External: **60** Total:**100**

End Semester Exam: 3Hours

COURSE OBJECTIVES

- To detail the entrepreneurship in field of life sciences.
- To obtain good understanding about the interpretation of biological products.
- To uptake knowledge in latest tools and technology.
- Aimed to provide an overview of various microbial bioproducts.
- Provide knowledge on manufacturing and production of bioproducts.
- To get introduced to the entrepreneurship skill in microbiology.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Describe and apply several entrepreneurial ideas and business theories in practical framework	Understand
CO2	Clarify the metabolic pathways and control mechanisms of commercially important metabolites	Apply
CO3	Commentate single cell proteins and express the importance of mushroom cultivation and probiotics	Understand
CO4	Express the mass production of microbial inoculants used as Biofertilisers and Bioinsecticides in response with field application and crop response	Analyze
CO5	Analyze the application and commercial production of Monoclonal antibodies, Cytokines. TPH and teaching kits	Understand
CO6	Decode the significance of industrial production of Biofuels and Point out the role of Bioplastics and Biopigments	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					**S**							
CO2								**M**				
CO3			**M**									
CO4							**S**					
CO5										**M**		
CO6								S				

S-Strong; M-Medium; L-Low

Unit I **(12 Hours)**

Entrepreneurship: Notions and theories of Entrepreneurship, Entrepreneurial traits and motivation- Nature and importance of Entrepreneurs, - Financial Analysis Investment process, Break even analysis, Profitability analysis, Budget and planning process. Government schemes for commercialization of technology - Funding and support mechanisms for entrepreneurship. Professional ethics in entrepreneurship.

Unit II **(12 Hours)**

Production of microbial metabolites and Single cell proteins: Metabolic pathways and control mechanisms of primary and secondary metabolites; Commercially important metabolites: Primary – ethanol, citric acid; Secondary –β exotoxin; Single Cell Protein: Algae (Spirullina maxima, Chlorella pyrenoidosa) and Yeast (Candida tropicana) as SCP, Mushroom Cultivation and Probiotics.

Unit III **(12 Hours)**

Biofertilizers and Biopesticides: Production of Rhizobium, Azotobacter, *Azospirillum*, Phosphobacterium, BGA (Anabena, Nostoc); Packing, Quality assurance, Field Application and Crop Response. Bioinsecticide: Mass Production, field Application, and Crop Response of Bacteria (Bacillus thuringiensis, Bacillus papillae, Pseudomonas fluorescens), Fungi (Verticilliumlecanii, Coelomyces) and Viruses (Bacuulo viruses, NPV, Granulosis virus).

Unit IV **(10 Hours)**

Commercial Products: Production and Application of TPA, HGH, Cytokines and Monoclonal Antibodies; Production of enzymes – Cellulase, Protease, Amylase and lipase Production of teaching kits-DNA isolation, widal. Biochemistry, Industrial Production and Application of biogas, bio-diesel, hydrogen fuel, gasoline; Bioplastics - PHB, PHA; Biopigments – Lycopene, Betacarotene, and its applications.

Unit V **(14 Hours)**

Government regulatory practices and policies: Regulatory aspects of quality control. Sterilization control and sterility testing- Chemical and biological indicators. Regulatory authorities for introduction of medicines in market – Role of Food and Drug Administration, FDA guidelines for drugs / biologicals, Validation (GMP, GLP, GCP, etc.). Clinical studies: Phase I, phase II, phase III and phase IV of clinical trials – Objectives, Conduct of trials, Outcome of trials.

SUGGESTED READINGS

1. Stanbury, P.F, and Whitekar. A. (1999), Principles of Fermentation Technology, 2nd Edition. Butterworth-Heinemann: Oxford.
2. Stockholm, K.T.H., Sven-OlofEnfors, and Lena Haggstrom. (2000), Bioprocess Technology:Fundamentals and Applications, Royal Institute of Technology: Sweden.

3. Ashton Acton, Q., (2012). Biological Pigments– Advances in Research and Application.Scholorly Editions: Atlanta, Georgia.
4. Crueger, W, and Crueger. A. (2000), Biotechnology: A Text Book of Industrial microbiology, 2nd Edition,SinauerAssociates :Sunderland.Mass.
5. Hugo, W.B. and Russel, A.D. (2003), Pharmaceutical Microbiology, 6th Edition. Blackwell ScientificPublications: U K.

2023-2024
Semester –VII

23MBU704A INHERITANCE BIOLOGY (5H–4C)

Instruction Hours / week: L: 4 T: 1 P:0 **Marks:** Internal: **40** External: **60** Total:**100**
End Semester Exam: 3Hours

COURSE OBJECTIVES

- To make students understand the principles of Genetics and inheritance biology.
- To study cell structure and functions of organelle.
- Exposure on transportations through cell membrane.
- To focus on different receptors and model of signaling.
- To introduce the concept of cell signaling.
- To know the inherited characters and response.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	This paper imparts knowledge on the different aspects of genetics and pedigree analysis.	Understand
CO2	Basic concept of cell structure, membrane, cellular functions of different types of cell, modes of cellular signaling and signal amplification.	Apply
CO3	Students undertaking this practical shall be able to describe the steps involved in the basic Microbial Genetics	Understand
CO4	Effectively understand the implication of mutation and its characteristics.	Analyze
CO5	Further, the experiments would allow students to recall and relate the Information gained from Microbial Genetics theory paper and skills associated with it	Understand
CO6	Students undertaking this course will be able to describe the nature of molecular world and its application in modern Microbiological and biotechnological sectors	Apply

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					**S**							
CO2								**M**				
CO3			**M**									

CO4							**S**					
CO5										**M**		
CO6								S				

S-Strong; M-Medium; L-Low

UNIT I – Introduction to Genetics (12 Hours)

Historical developments: Model organisms in genetic analyses and experimentation: Escherichia coli, Saccharomyces cerevisiae, Neurosporacrassa, Caenorhabditiselegans Drosophila melanogaster, Arabidopsis thaliana.

UNIT II – Mendelian Principles (12 Hours)

Mendel's Laws: Dominance, segregation, independent assortment, deviation from Mendelian inheritance, Rediscovery of Mendel's principles, Chromosome theory of inheritance: Allele, multiple alleles, pseudoallele, complementation tests, Extensions of Mendelian genetics: Allelic interactions, concept of dominance, recessiveness, Incomplete dominance and co-dominance, Multiple alleles, Epistasis, penetrance and expressivity.

UNIT III – Linkage and Crossing over & Recombination (12 Hours)

Linkage and recombination of genes, Cytological basis of crossing over, crossing over at four-strand stage, Molecular mechanism of crossing over, mapping Homologous and non-homologous recombination, including transposition, site-specific recombination.

UNIT IV – Extra-Chromosomal Inheritance & Human genetics (8 Hours)

Rules of extra nuclear inheritance, Organelle heredity - Chloroplast mutations in Chlamydomonas, mitochondrial, mutations in Saccharomyces, Maternal effects – Shell coiling in Limnaeaperegra Infectious heredity - Kappa particles in Paramecium. Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Polygenic inheritance, heritability and its measurements, QTL mapping.

UNIT V – Characteristics of Chromosomes (14 Hours)

Structural organization of chromosomes - centromeres, telomeres and repetitive DNA, Packaging DNA molecules into chromosomes, Concept of euchromatin and heterochromatin, Normal and abnormal karyotypes of human chromosomes, Chromosome banding, Giant chromosomes: Polytene and lamp brush chromosomes, Variations in chromosome structure: Deletion, duplication, inversion and translocation, Variation in chromosomal number and structural abnormalities -Klinefelter syndrome, Turner syndrome, Down syndrome.

SUGGESTED READINGS

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India.
2. Snustad DP, Simmons MJ (2011). Principles of Genetics. 6th Ed. John Wiley and Sons Inc.
3. Weaver RF, Hedrick PW (1997). Genetics. 3rd Ed. McGraw-Hill Education.

4. Klug WS, Cummings MR, Spencer CA, Palladino M (2012). Concepts of Genetics. 10th Ed. BenjaminCummings.
5. Griffith AJF, Wessler SR, Lewontin RC, Carroll SB. (2007). Introduction to Genetic Analysis. 9th Ed.W.H.Freeman and Co., New York.
6. Hartl DL, Jones EW (2009). Genetics: Analysis of Genes and Genomes. 7th Ed, Jones and Bartlett Publishers.
7. Russell PJ. (2009). i Genetics - A Molecular Approach. 3rd Ed, Benjamin Cummings.

B.Sc. Microbiology

2023-2024
Semester –VII

23MBU704B BIOSTATISTICS AND RESEARCH METHODOLOGY (5H–4C)

Instruction Hours / week: L: 4 T: 1 P:0 Marks: Internal: **40** External: **60** Total:**100 End Semester Exam:** 3Hours **COURSE OBJECTIVES**

- About collection, interpretation and presentation of statistical data
- The analytics of data, probability, and hypothesis testing of samples
- The essential role of statistics in present, future use and applications of Biology.
- Analytical techniques to generate results
- Comparison of different groups.
- To know the significant among the groups.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Apply basic statistical concepts commonly used in health and medical sciences	Understand
CO2	Use basic analytical techniques to generate results	Apply
CO3	Interpret results of commonly used statistical analyses in written summaries.	Understand
CO4	Demonstrate statistical reasoning skills correctly and contextually and this course will support the employment in various bioscience sector.	Analyze
CO5	The analytics of data, probability, and hypothesis testing of samples	Understand
CO6	The essential role of statistics in present, future use and applications of Biology	Apply

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					**S**							
CO2								**M**				
CO3			**M**									
CO4							**S**					
CO5										**M**		
CO6								S				

S-Strong; M-Medium; L-Low

UNIT I - Introduction of Biostatistics and Correlation (12 Hours)

Introduction to Biostatistics, Basic Measures - Central Tendency and Dispersion, Variables in Bioscience, Correlation – Meaning and definition - Scatter diagram –Karl Pearson's Correlation Coefficient. Rank Correlation. Regression: Regression in two variables – Properties of Regression, uses of Regression

UNIT II - Test of Significance (12 Hours)

Sampling parameters- Difference between sample and Population, Censoring, difference between parametric and non-parametric statistics. Sampling Distributions, Standard Error, Testing of Hypothesis, Level of Significance and Degree of Freedom, Confidence Interval, Small sample test based on t - test, Large Sample Test based on Normal Distribution – Z – test and F test.

UNIT III Analysis of Variance (12 Hours)

Distribution - free test - Chi-square test; Basic Introduction to Multivariate statistics, etc. Test of significance: Tests based on Means only-Both Large sample and Small sample tests –Chi-square test –the goodness of fit. Analysis of Variance – one-way and two-way classification, CRD, RBD Designs.

UNIT IV-Research (10 Hours)

Research: Scope and significance – Types of Research – Research Process – Characteristics of good research – Problems in Research – Identifying research problems.

UNIT V - Sampling Design (14 Hours)

Research Designs – Features of good research designs. Sampling Design: Meaning – Concepts – Steps in sampling – Criteria for good sample design. Scaling measurements - Types of scale, Types of sampling – random sampling and non-random sampling. Sampling Errors.

SUGGESTED READING

1. Jerrold H. Zar. (2003). Biostatistical Analysis. (4th ed.). Pearson Education(P) Ltd, New Delhi.
2. Kothari. C.R. (2004). Research Methodology – Methods and Techniques. (2nded.). New Age International Pvt. Ltd, NewDelhi.

B.Sc. Microbiology **2023-2024**

Semester –VII

23MBU711 TEXTILE MICROBIOLOGY PRACTICAL (3H–1C)

Instruction Hours / week: L: 0 T: 0 P:3 Marks: Internal: **40** External: **60** Total:**100 End Semester Exam:** 9 Hours

COURSE OBJECTIVES

- The students will develop set of skills to recognize and to gain knowledge in antimicrobial finishes.
- To familiarize students with general principles and subject knowledge in the field of textile microbiology.
- To understand the manufacturing process of textile fibers.
- To gain knowledge about the fabric dyeing methods.
- To understand microbial enzyme technology in textile field.
- To know about the innumerable applications of microbes in textile processing.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Determine the efficacy of fabric dyeing.	Understand
CO2	Analyze the advantages of microbial based textile dyeing.	Apply
CO3	The aim of the course is to give the students broad theoretical and practical skills in textile microbiology.	Understand
CO4	This course covers the principles of various processes associated with the textile manufacturing	Analyze
CO5	Outline the microbial applications in textile field	Understand
CO6	Justify eco-friendly textile processing with enzymes	Remember

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					**S**							
CO2								**M**				
CO3			**M**									
CO4							**S**					
CO5										**M**		
CO6								S				

S-Strong; M-Medium; L-Low

EXPERIMENTS (36 Hours)

1. Antibacterial activity assessment of textile materials: Parallel Streak Method (AATCC 147).
2. Antibacterial Activity of Fabrics: Agar Plate Method (AATCC 90).
3. Antimicrobial activity assessment of Textiles against Fungi (AATCC 30).
4. Demonstration of fabric dyeing by pad dry cure method.

5. Study of coated fabrics in terms of air permeability, thickness, tensile strength, tear strength and fabric stiffness test.
6. Microbial Enumeration test in fabrics.
7. Determination of colour strength and wash fastness test of coated fabrics.
8. Textile dye degradation using micro-organisms.

SUGGESTED READING

1. DeepaliRastogi and Sheetal Chopra,(2017). Textile Science, Orient Black Swan Private Limited, Hyderabad.
2. SeemaSekhri, (2011). Textbook of Fabric Science: Fundamentals to Finishing, PHI Learning Pvt Limited,New Delhi.
3. Trever Palmer,(2004). Enzymes, Biochemistry, Biotechnology Clinical Chemistry: Affliated East-WestPress Ltd., New Delhi.
4. Satyanarayana.U and Chakrapani.U ,(2006). Biochemistry, Third Edition, ArunabhaSen Books and AlliedP Ltd., Kolkata.
5. V NierstraszACavaco-Paulo,(2010). Advances in Textile Biotechnology, Woodhead Publishing Ltd.,U.K.
6. Purohit.S,S, (2008). Microbiology Fundamentals and Applications, 7 Th Edition, AGROBIOS, India.

B.Sc. Microbiology **2023-2024**

Semester –VII

23MBU713A DRUG DESIGN AND DEVELOPMENT PRACTICAL (3H–1C)

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

End Semester Exam: 6 Hours

COURSE OBJECTIVES

- To know the significance of Drug Design and Discovery
- To know the course, introduce the basic principles of modern drug design, discovery and development.
- To know the different source of drug with specific focus on microbial source
- To understand the drug manufacturing process.
- To identify the Lead compound series
- To know the biosimilars and pharmaceuticals of microbial origin

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	The course will impart knowledge on detection, selection, and validation of new antibacterial targets	Understand
CO2	Candidates able to involve in the vaccines	Apply
CO3	The use of gene technology in pharmaceutical industry	Understand
CO4	Students could understand the significance of tolerability, side effects at different doses	Analyze
CO5	Can contribute to the upstream process	Understand
CO6	Gain the knowledge on the drug development process and engineering technology in drug development	Remember

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					**S**							
CO2								**M**				
CO3			**M**									
CO4							**S**					
CO5										**M**		
CO6								S				

S-Strong; M-Medium; L-Low

EXPERIMENTS (36 Hours)

1. Routes of drug administration to laboratory animals
2. To evaluate the analgesic potency of drug by tail flick method
3. Screening of anti-inflammatory drugs using hind paw method
4. Drug design and development and computer aided drug design
5. Study the effect of drugs on spontaneous motor activity (SMA) and evaluate their nature as CNS stimulants using drugs
6. Structure based drug design using freely available molecular modeling tools
7. Protein structure analysis
8. Ligand selectivity analysis
9. Molecular basis of drugs
10. Homology modeling
11. Pharmacophore design and search

SUGGESTED READING

1. Kristian Stromgaar, PovlKrogsgaard-Larsen and Ulf Madsen (2017). Textbook of Drug Design and Discovery, Fifth Edition, CRC press,2017.
2. Thomas J. Dougherty and Steven J. Projan. Microbial Genomics and Drug Discovery, Taylor and Francis,2003
3. Kenneth M. Merz, Dagmar Ringe and Charles H. Reynolds. Drug Design: Structure- and Ligand-Based Approaches, Cambridge University press,2010.
4. Kristian Stromgaar, PovlKrogsgaard-Larsen and Ulf Madsen (2017). Textbook of Drug Design and Discovery, Fifth Edition, CRC press,2017
5. David B. Weiner and William V. Williams. Biological Approaches to Rational Drug Design (Handbooks in Pharmacology and Toxicology) CRC press,1994
6. Gary Wlash (2004). Biopharmaceuticals, Biochemistry and Biotechnology. 2nd edition. Wiley publisher.

B.Sc. Microbiology **2023-2024**

Semester –VII

23MBU713B BIOPRODUCT DEVELOPMENT AND ENTREPRENEURIAL MICROBIOLOGY PRACTICAL

(3H–1C)

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

End Semester Exam: 6 Hours

COURSE OBJECTIVES

- To detail the entrepreneurship in field of life sciences.
- To obtain good understanding about the interpretation of biological products.
- To uptake knowledge in latest tools and technology.
- Aimed to provide an overview of various microbial bioproducts.
- Provide knowledge on manufacturing and production of bioproducts.
- To get introduced to the entrepreneurship skill in microbiology.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Describe and apply several entrepreneurial ideas and business theories in practical framework	Understand
CO2	Clarify the metabolic pathways and control mechanisms of commercially important metabolites	Apply
CO3	Commentate single cell proteins and express the importance of mushroom cultivation and probiotics	Understand
CO4	Express the mass production of microbial inoculants used as Biofertilisers and Bioinsecticides in response with field application and crop response	Analyze
CO5	Analyze the application and commercial production of Monoclonal antibodies, Cytokines. TPH and teaching kids	Understand
CO6	Decode the significance of industrial production of Biofuels and Point out the role of Bioplastics and Biopigments	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					**S**							
CO2								**M**				
CO3			**M**									
CO4							**S**					
CO5										**M**		
CO6								S				

S-Strong; M-Medium; L-Low

EXPERIMENTS **(36 Hours)**

1. Production of bioproducts- Biofertilizers.
2. Production of bioproducts- Probiotics.
3. Production of Antibiotics – (Any antibiotic Eg: Penicillin)
4. Organic Farming- Vermicompost.
5. Quality control in biofertilizers
6. Study on integrated farming system
7. Study of models of IFS for rainfed and irrigated farming system and conditions.
8. Government schemes - NPOF, NPOF, NHM, HMNEH, NPMSH&F and RKVY

REFERENCE BOOKS:

1. The One-Straw Revolution: An Introduction to Natural Farming, YRB Classics; Main edition (2 June 2009),Masanobu Fukuoka, Frances Moore Lappé Wendell Berry

1 Subba Rao, N. S. (2002). Soil Microbiology. 4th ed. Soil Microorganisms and Plant Growth. Oxford & IBHPublishing Co. Pvt. Ltd., New Delhi.

3. Dubey, R. C. (2008). A Textbook of Biotechnology. S. Chand & Co., New Delhi.

B.Sc. Microbiology **2023-2024**

Semester VIII

23MBU801 BIOPROCESS ENGINEERING (5H–4C)

Instruction Hours / week: L: 4 T: 1 P:0 **Marks:** Internal: **40** External: **60** Total:**100**

End Semester Exam: 3Hours

COURSE OBJECTIVES

- This course encompasses the use of microorganisms in the manufacture of food or industrial products.
- The use of microorganisms for the production of food, either human or animal, the microorganisms used in bio processes may be natural isolates; laboratory selected mutants or genetically engineered organisms.
- To know the basics and concepts of various biotechnological related terms
- Elucidate the significance of transgenic plants as bioreactors for the production of enzymes.
- Address bioethical and biosafety issues related to plant transgenics
- Elucidate the molecular techniques involved in gene manipulation and rDNA technology

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	This course will enable the students to design the various microbial fermentation products and their production, purification for various applications	Understand
CO2	To know the process protocol for the, synthesis and characterization of nanoparticles	Apply
CO3	Explain the gene transfer methods for the production of transgenic animals	Understand
CO4	Gain experimental knowledge to perform animal biotechnology related experiments	Analyze
CO5	Explain the application of biotechnology in medical and its allied fields, gene therapy, genetic counselling	Understand
CO6	Address the bioethical issues & concerned linked to medical biotechnology	Apply

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					**S**							
CO2								**M**				
CO3			**M**									
CO4							**S**					
CO5										**M**		
CO6								S				

S-Strong; M-Medium; L-Low

UNIT I – Fermenter **(10 Hours)**

Design of a basic fermenter, bioreactor configuration, design features, computer control of fermentation process, measurement and control of process. Types of Bioreactors and its functions.

UNIT II - Cultures in the fermenter (10 Hours)

Growth of cultures in the fermenter. Importance of media in fermentation, media formulation and modification. Kinetics of growth in batch culture, continuous culture with respect to substrate utilization, specific growth rate, steady state in a chemostat, fed-batch fermentation, yield of biomass, product, calculation for productivity.

UNIT III - Physical factors and scale-up (10 Hours)

Transport phenomena in fermentation: Gas- liquid exchange and mass transfer, oxygen transfer, critical oxygen concentration, heat transfer, aeration/agitation, its importance. Sterilization of Bioreactors, nutrients, air supply, products and effluents, process variables and control, scale-up of bioreactors.

UNIT IV – Microbial Products and Downstream process (8 Hours)

Enzymes- Introduction, Enzyme Kinetics, Immobilized Enzyme system, large scale production, Vitamins (Vitamin C), Amino acids, Enzymes, Antibiotics, Organic acids, Vaccines, Cheese, and Exopolysaccharides. Biotransformation product (steroid). Down streaming process of microbial products (Peptides, Biopolymers, surfactants, Enzymes) - separation, centrifugation, filtration, extraction, purification, crystallization, crystal washing, drying of crystals, freeze-drying, spray drying.

UNIT V - Strain improvement & Preservation (12 Hours)

Isolation, selection and improvement of important strains and pathways –Mutation, Protoplast fusion, parasexual cycle and genetic engineering for strain improvements, product formation and inhibition pathways and their regulations; applications in medicine, agriculture and industry. Role of plant and animal cells in bioprocess. Industrially important microorganisms, preservation, national and international culture collection centers.

SUGGESTED READING

1. Shuler, M.L., Kargi F., and DeLisa, M. Bioprocess Engineering: Basic concepts, 3rd Edition, 2017,Prentice Hall, Engelwood Cliffs.
2. Peter Stanbury, Allan Whitaker., S, Stephen Hall. Principles of Fermentation Technology, 3rd Edition,2016, Elsevier Science and technology.
3. Casida, L.E.J.R. Industrial Microbiology, 2 nd Edition, 2019, New Age International Private Limited
4. Richard H. Baltz., Arnold L. Demain., Julian E. Davies. Manual of Industrial Microbiology and Biotechnology, 3rd edition, 2010, American Society for Microbiology.
5. Michael J. Waites., Neil L. Morgan. Industrial Microbiology: An Introduction, 2001, Wiley- Blackwell
6. El-Mansi, E. M. T., Bryce, C. F. A., Arnold L. Demain., Allman, A.R. FermentationMicrobiology and Biotechnology, 3rd Edition, 2011, CRC Press.

B.Sc. Microbiology **2023-2024**

Semester –VIII

23MBU802 **MICROBIAENZYMOLOGY**

(5H–4C)

Instruction Hours / week: L: 4 T: 1 P:0 Marks: Internal: **40** External: **60** Total:**100 End Semester Exam:** 3Hours

COURSE OBJECTIVES

- The course presents methods and experimental tools used in enzymology with an emphasis on prokaryotes and eukaryotes.
- The theoretical grounds of methods and their applications in research will be discussed.
- The course also deals with enzyme structure, stability, organization, and expression.
- The courses include among others model systems, the enzymes behind complex diseases
- To know the production and purification of microbial enzymes.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	This course allows the candidate to recollect the basics of enzymes and apply cognitive thinking to the application-oriented sectors of enzymes.	Understand
CO2	Students would be able to practically apply this knowledge in different sectors with possibilities ranging from the treatment of human diseases.	Apply
CO3	The development of novel medicines for treatment.	Understand
CO4	A thorough understanding of the process of translation and operons along with the recombination of DNA.	Analyze
CO5	An in-depth study of enzyme analysis with enzyme techniques.	Understand
CO6	Full understanding of all aspects of all important techniques used for the study of enzymes.	Apply

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					**S**							
CO2								**M**				
CO3			**S**									
CO4							**M**					
CO5										**S**		
CO6								S				

S-Strong; M-Medium; L-Low

UNIT I - Bio energetics: **(10 Hours)**

Enzyme nomenclature, classification, general properties of enzymes, factors affecting enzyme activity, activation energy, transition state, turnover number, enzyme co-factors. Enzyme kinetics; General kinetic principles; steady-state enzyme kinetics, Michelis-Menton equation, importance of Km and Vmax.

UNIT II-Enzyme regulation: **(10 Hours)**

Allosteric and cooperative effects, conquered model of Monod et al, and sequential model of Koshl and et al, Principles of metabolic regulations; feedback regulations of multifunctional pathway.

UNIT III Isolation and purification of enzymes: (10 Hours)

Enzyme extraction –soluble enzymes, membrane bound enzymes, purification-precipitation methods, concentration of biomolecules: salting with ammonium sulphate precipitation, dialysis, lyophilisation, chromatographic methods, total activity and specific activity.

UNIT IV- Assay techniques for microbial enzymes: (8 Hours)

Amylases, proteases, cellulases, and lipases, Basic principles of cell and enzyme immobilization.

UNIT V Uses of enzymes in analysis (12 Hours)

Enzyme electrodes. Enzyme as biosensor, potentiometric biosensor, industrial applications of enzymes. Commercial value: steroidal conversions, penicillin and antibiotic conversion, immunosensor. Recent advances and future prospects of enzyme engineering; artificial enzymes. Enzymes in organic solvents, enzyme targeting using liposomes, isoenzymes

SUGGESTED READING

1. WatsonJD,BakerTA,BellSP,GannA,LevineMandLosickR(2008)MolecularBiologyoftheGene,6th edition, ColdSpringHarbourLab.Press,PearsonPublication.
2. BeckerWM,KleinsmithLJ,HardinJandBertoniGP(2009). TheWorldoftheCell,7thedition,PearsonBenjaminCummingsPublishing,SanFrancisco.
3. DeRobertisEDPandDeRobertisEMF(2006)CellandMolecularBiology,8thedition.LippincottWilliamsand Wilkins,Philadelphia.
4. KarpG(2010)CellandMolecularBiology:ConceptsandExperiments,6thedition,JohnWiley&Sons.Inc.
5. SambrookJandRussellDW.(2001).MolecularCloning:ALaboratoryManual.4THEdition,ColdSpringHarbou rLaboratory press.
6. KrebsJ,GoldsteinE,KilpatrickS(2013).Lewin'sEssentialGenes,3rdEd.,JonesandBartlettLearning.
7. GardnerEJ,SimmonsMJ,SnustadDP(2008).).PrinciplesofGenetics.8thEd.Wiley-India.

B.Sc. Microbiology **2023-2024**

Semester –VIII

23MBU803 **MARINEMICROBIOLOGY**

(5H–4C)

Instruction Hours / week: L: 4 T: 1 P:0 **Marks:** Internal: **40** External: **60** Total:**100**

End Semester Exam: 3Hours

COURSE OBJECTIVES

- To provide students with basic knowledge on the biology and ecology of marine microorganisms, and their ecological role.
- To know the basic biology of marine microorganisms and their activities
- To impart modern techniques for the characterization and study of marine microorganisms and microbial communities.
- To understanding the ecological role of marine microorganisms and marine microbial communities.
- To know the main techniques of modern use necessary for the characterization and study of marine microbes.
- To understand basic biological processes that occur in and between organisms in nature.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Capable of describing and explaining both biological interaction processes and their importance to ecosystems.	Understand
CO2	To acquire knowledge of the most common research methods used to develop our knowledge of biological processes.	Apply
CO3	learn to work independently in collecting and analysing scientific data, both in the field and in the laboratory.	Understand
CO4	Understand the architecture of marine ecosystem and its essential role	Analyze
CO5	Specify the biological significance of biomolecules in metabolism	Apply
CO6	To understand computer applications and Bioinformatics.	Apply

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					**S**							
CO2								**M**				
CO3			**S**									
CO4							**M**					
CO5										**S**		
CO6								S				

S-Strong; M-Medium; L-Low

UNIT I - Marine microorganisms **(10 Hours)**

Introduction of coastal, shallow and deep sea. Marine microorganisms- important and their significance. Marine micro and macro-organisms-Collection, enumeration, identification based

on morphological, physiological and biochemical characteristics and preservation. International and national collection centres.

UNIT-II- Extremophiles and Marine bio-diversity (10 Hours)

Thermopiles, basophiles, halophiles, psychrophiles, alkalinophiles, oligotroph, toxi tolerant, xero tolerant, endolith – Extremophiles and their environment. Coral reefs, Sea grass, Mangroves, Hydrothermal vents and water currents.

UNIT III- Marine food pathogens and microbial toxin (10 Hours)

Marine food pathogenic microorganisms, distribution, indicator organism's prevention and control. Microbiology of processed -finfish and shellfish products. Microbial diseases- diagnosis and control. Introduction, microbial toxin, algal blooms, types. Harmful effect- Human health, Economic impact and Environmental impact, Potential remedies.

UNIT IV – Xenobiotics and Marine nutrient cycles (8 Hours)

Microbiology of degradation of xenobiotic environment: Ecological considerations, decay behavior, degradative plasmids, hydrocarbons, oil pollution, surfactants, pesticides, plastics and heavy metals. Factors affecting bioremediation – role of microbes in the marine nutrient cycles.

UNIT V – Marine Microbes bioproducts (12 Hours)

Microalgae and seaweeds – Food products- Human food and animal feed, Biomedical Products- Antimicrobial, antioxidant, antiviral and anticancer activity. Aquaculture feed inoculants -Industrial Application-bioethanol production. Biopigment products - Phytoplanktons, Bioluminescence.

SUGGESTED READINGS

1. Colin Munn. (2011). Marine Microbiology: Ecology & Applications. (2nded.). Black Well Publishers.
2. David Sigee. (2005). Freshwater Microbiology: Biodiversity and Dynamic Interactions ofMicroorganisms in the Aquatic Environment. (1sted.). Black wellPublishers.
3. Joanne, M.W., Linda, S., and Christopher, J.W., (2008). Prescott, Harley, and Klein's Microbiology. (7thEd). McGraw-Hill Higher Education, UnitedStates.
4. Se-Kwon Kim. (2013). Bioactive compounds and biotechnological applications. CLSPublishers
5. Dube, H.C. (1994). A text book of fungi, bacteria and viruses. Vikas Publishing House, New Delhi.
6. Dale, J.W. (1994). Molecular genetics of Bacteria. John Wiley andStones.
7. Pelczar, M., JR., Chan, E.C.S., and Noel, R. K., (2006). Microbiology. Tata McGraw, Hill. Co. (5thed.).NewDelhi.
8. Presscott, L.N., Harley, J.P. and Klein, D.A., (1999). Microbiology. W.C. BrownPublishers.
9. Stanier, R.Y., Ingharam, J.L., Wheelis, M.L., and Painter, P.R., (1986). General Waste water engineeringTreatment, Disposal and Reuse. Metcaff and Eddy. Inc., Tata Mc Grew Hill, New Delhi.
10. Rheinheimer, G., 1980 Aquatic Microbiology-an Ecological Approach. Blackwell Scientific Publications
11. Kirchman, L Microbial Ecology of the Oceans 2000 John Wiley and Sons. Hans G. Truper et. al 1991.

B.Sc. Microbiology **2023-2024**

Semester –VIII

23MBU804 BIOMEDICAL RESEARCH AND ANIMAL MANAGEMENT (5H–4C)

Instruction Hours / week: L: 4 T: 1 P:0 Marks: Internal: **40** External: **60** Total:**100 End Semester Exam:** 3Hours

COURSE OBJECTIVES

- Aimed to provide training on various methods of handling.
- Concerning the care and use of laboratory animals.
- Laboratory animal care provides the proper handling and care for various species of animals used in research, testing, and in education.
- It extensively deals with the amended act on the Animal Welfare.
- It deals with the concept, availability and use of research or testing methods that limit the use of animals or minimize animal distress.
- To study the preclinical studies.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Laboratory animal care provides the proper handling and care for various species of animals used in research, testing, and in education.	Understand
CO2	It extensively deals with the amended act on the Animal Welfare and the concept, availability, and use of research or testing methods that limit the use of animals or minimize animal distress.	Apply
CO3	This course content will enhance the employment in drug testing field.	Understand
CO4	Validation for equipment, methods, cleaning and process	Analyze
CO5	Students can develop their entrepreneurial skills in analysis of pens design and environment.	Apply
CO6	Ethical knowledge for use of animals in research.	Apply

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						**S**						
CO2									**M**			
CO3				**S**								
CO4								**M**				
CO5											**S**	
CO6									S			

S-Strong; M-Medium; L-Low

UNIT – I - Responsibilities of institution and chief investigators (10 Hours)

General introduction - responsibilities of institution and chief investigators, Aspects of rabbit behaviour relevant to housing, Rabbit Group housing in pens, advantages and disadvantages, Pens, design of pens environment, Rabbit care management – Regrouping, catching and identification in pens and cages, Rabbit care management – food, water, health and breeding in pens and cages, Cage design and environment, Environment enrichment for rabbits in pens and cages, Ethical guidelines for use of animals in research.

UNIT – II – Mice **(10 Hours)**

Introduction-behaviour, anatomic and physiological features of mice in lab, Husbandry- Housing, nutrition and breeding requirements and management of lab mice, occupational health and zoonotic diseases, treatment of disease in mice, regulatory agencies and complain associates with management of lab mice, Restraining and sample collection methods from lab mice, Physical, examination of mice for disease conditions, anesthesia and analgesia -mice, Euthanasia in veterinary care.

UNIT – III – Rat **(10 Hours)**

Introduction to anatomical and physiological features of laboratory rat, major colour groups and varieties of rats, regulatory management housing of laboratory rats-equipment, feed formulation, ailments & disease management of laboratory rats, disease management and ailments of laboratory rats, restraining and sample collection in lab rats, anesthesia and analgesia of lab rats, breeding of laboratory rats.

UNIT – IV - Guinea pig **(8 Hours)**

Introduction – history and classification of guinea pigs, varieties and characteristics of guinea pigs used in labs, characteristics and behaviours of the guinea pig used in labs, housing, nutrition and feeding of guinea pigs, care and handling of guinea pigs in lab, zoonoses of guinea pigs, reproduction and breeding managements in guinea pigs –gnotobiotic animals.

UNIT – V- Role in microbiology **(12 Hours)**

Various routes of inoculation in mice & rats, various routes of inoculation in mice & rats, handling and routes of inoculation in rabbits, guinea pigs, laboratory use of animals –role in microbiology, antibody production in animals, disposal of animal house wastes, safety measures in animal house. National animal house Facilities in India.

SUGGESTED READINGS

1. The IACUC Handbook, 2nd ed., eds. Silverman, Murthy, Suckow. CRC Press, (2006).
2. Anesthesia and Analgesia in Laboratory Animals. American College of Laboratory Animal Medicine, second ed.)., eds. Richard Fish, Peggy Danneman, Marilyn Brown, and Alicia Karas. Academic Press, (2008.
3. The Mouse in Biomedical Research, second ed.)., eds. James G. Fox, Muriel T. Davisson, Fred W. Quimby, Stephen W. Barthold, Christian E. Newcomer and Abigail L. Smith. Elsevier,(2007.
4. The Laboratory Rat, (2nd ed.). American College of Laboratory Animal Medicine. eds. Suckow, weisbroth and Franklin. Elsevier,(2006).
5. Handbook on Genetically Standardized Mice. (6th ed.). Ed. Joanne Currer, The Jackson Laboratory, BarHarbor, Maine,(2009).
6. Laboratory Animal Medicine, (2nd ed.). American College of Laboratory Animal Medicine, eds. Fox, Anderson, Lowe, Quimby. Academic Press,(2002).
7. Percy, D.H., and Barthold, S.W., (2007). Pathology of Laboratory Rodents and Rabbits, (3rd ed.). Blackwell PublishingCompany.
8. Nalinasundari, M.S., and Santhi, R., (2006). Entomology. MJP Publishers,Chennai.

9. Pelczar, Jr. M.J., Chan, E.C.S., and Kreig, N.R., (1993). Microbiology McGraw-Hill Inc. NewYork.
10. Warren, D. M. (2002). Small Animal Care and Management. (2nd ed.). Delmar – Thomson Learning,Columbia,NY.
11. Yadav, M. (2004). Applied Entomology. (1st ed.). Discovery Publishing House, NewDelhi.

B.Sc. Microbiology **2023-2024**

Semester –VIII

23MBU805 MEDICAL CODING AND PHARMACOVIGILANCE (5H–4C)

Instruction Hours / week: L: 4 T: 1 P:0 **Marks:** Internal: **40** External: **60** Total:**100**

End Semester Exam: 3Hours

COURSE OBJECTIVES

- This program will train students to properly locate, document, and validate appropriate diagnostic and procedure codes using the current ICD-9-CM/ICD-10-CM, CPT, and HCPCS coding manuals for professional services.
- The medical coder reviews the patient's file and translates everything from that file into universal codes required by insurance companies.
- To motivate public to participate in environment protection and improvement.
- To Demonstrate proficiency in quantitative methods, qualitative analysis, critical thinking, and written and oral communication needed to conduct high-level work as interdisciplinary scholars and/or practitioners.
- Students will demonstrate understanding of appropriate workplace relationships by reading articles and responding to thought-provoking questions.
- This includes everything from diagnosis and treatment, to what supplies were used. The coder also indicates if there were any unusual circumstances during the visit or procedure.

COURSE OUTCOME

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

COs	Course Outcomes	Blooms Level
CO1	Students will also gain knowledge of medical legal and ethical responsibilities, as well as anatomy and medical terminology.	Apply
CO2	Students completing this program will be able to apply for employment opportunities in doctor's offices, clinics, nursing homes, hospitals, labs, public health facilities and insurance agencies.	Apply
CO3	Students will be required to complete and turn in one Hybrid Assignment each week to show they are working at home.	Understand
CO4	Students will show comprehension of anatomical and physiological information learned on multiple choice tests.	Apply
CO5	Students will demonstrate understanding of correct coding guidelines by completing coding simulations and reviews	Understand
CO6	Ethics in coding.	Apply

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					**S**							
CO2								**M**				
CO3			**S**									
CO4							**M**					

CO5										**S**		
CO6								S				

S-Strong; M-Medium; L-Low

UNIT I – Introduction to US Healthcare (10 Hours)

Healthcare in India and US, Patient, Provider and Payers Relationship, Importance and significance of coding in today's world

UNIT II - ICD-10-CM (10 Hours)

History, Volumes, Conventions, General Coding Guidelines, Chapter Specific Guidelines, Infections and Parasitic Diseases, Neoplasms, Endocrine, Nutritional and metabolic diseases and immunity disorders. Diseases of blood and blood forming organs. Mental disorders

UNIT III - Introduction to Pharmacovigilance (10 Hours)

History and development of Pharmacovigilance, Importance of safety monitoring of Medicine. WHO international drug monitoring programme, Pharmacovigilance Program of India (PvPI).

UNIT IV - Introduction to adverse drug reactions (8 Hours)

Definitions and classification of ADRs, Detection and reporting, Methods in Causality assessment, Severity and seriousness assessment, Predictability and preventability assessment Management of adverse drug reactions. Drug and disease classification Anatomical, therapeutic and chemical classification of drugs, International classification of diseases, daily defined doses International Non- proprietary Names for drugs.

UNIT V - Pharmacovigilance methods (12 Hours)

Passive surveillance – Spontaneous reports and case series Stimulated reporting. Active surveillance – Sentinel sites, drug event monitoring and registries Comparative observational studies – Cross sectional study, case control study and cohort study. Targeted clinical investigations.

SUGGESTED READINGS

1. Textbook of Pharmacovigilance: Ensuring the Safe Use of Medicines. SK Gupta, Sushma SrivastavaJaypeeBrothers Medical Publishers, 24-Dec-2018 - Medical - 638 pages

2. Current trends in pharmacovigilance. by Varun and Deepak pragi. 1 January 2020.

B.Sc. Microbiology **2023-2024**

Semester –VIII

23MBU811 BIOPROCESS ENGINEERING PRACTICAL (4H–2C)

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

End Semester Exam: 9 Hours

COURSE OBJECTIVES

- This course encompasses the use of microorganisms in the manufacture of food or industrial products.
- The use of microorganisms for the production of food, either human or animal, the microorganisms used in bio processes may be natural isolates; laboratory selected mutants or genetically engineered organisms.
- To know the basics and concepts of various biotechnological related terms
- Elucidate the significance of transgenic plants as bioreactors for the production of enzymes.
- Address bioethical and biosafety issues related to plant transgenics
- Elucidate the molecular techniques involved in gene manipulation and rDNA technology

COURSE OUTCOME

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

COs	**Course Outcomes**	**Blooms Level**
CO1	This course will enable the students to design the various microbial fermentation products and their production, purification for various applications	Understand
CO2	To know the process protocol for the, synthesis and characterization of nanoparticles	Apply
CO3	Explain the gene transfer methods for the production of transgenic animals	Understand
CO4	Gain experimental knowledge to perform animal biotechnology related experiments	Analyze
CO5	Explain the application of biotechnology in medical and its allied fields, gene therapy, genetic counseling	Understand
CO6	Address the bioethical issues & concerned linked to medical biotechnology	Apply

Mapping with Programme Outcomes

Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1								**S**				
CO2											**M**	
CO3						**S**						
CO4										**M**		
CO5				**S**								
CO6											S	

S-Strong; M-Medium; L-Low

EXPERIMENTS **(40 Hours)**

1. Microbialfermentation – Production and estimation (qualitative and quantitative) of enzyme-Amylase,Protease, lipase and asparaginase.
2. Microbial fermentation –Production and estimation (qualitative and quantitative) of Aminoacid - Glutamicacid.
3. Microbial fermentation – Production and estimation (qualitative and quantitative) of Organic acid-Citricacid and DHA.
4. Microbial fermentation – Production and estimation (qualitative and quantitative) of Antibiotics - Penicillin, Bacitracin.
5. Microbial fermentation – Production and estimation (qualitative and quantitative) of Alcohol - Ethanol

SUGGESTED READINGS

1. NdukaOkafor, Benedict C. Okeke (2017) Modern Industrial Microbiology and Biotechnology, 2ndEdition, CRCPress.
2. StanburyPF,WhitakerAandHallSJ.(2006).PrinciplesofFermentationTechnology.2nd edition,Elsevier S cien ceLtd.
3. CruegerWandCruegerA.(2017).Biotechnology:AtextbookofIndustrialMicrobiology.3rd edition.Pan i ma PublishingCo.NewDelhi.
4. GeoffreyMGadd,SimaSariaslani(2015)AdvancesinAppliedMicrobiology,CRCPress.
5. E.MTEl-Mansi,JensNielsen,DavidMousdale(2009)FermentationMicrobiologyand Biotechnology, FourthEdition, CRCPress.
6. KarpG.(2010)CellandMolecularBiology:ConceptsandExperiments.6th edition.JohnWiley&Sons.In c
7. Nigam A and AyyagariA. (2007). Lab Manual in Biochemistry, Immunologyand Biotechnology.Tata McGraw Hill

B.Sc. Microbiology **2023-2024**

Semester –VIII

23MBU891 **RESEARCH PROJECT**

(18H-12C)

Instruction Hours / week: L:0 T: 0 P:18 Marks: Internal: **120** External: **180** Total:**300**

23VAC301 **HEALTH AND WELLNESS** **Semester –III (2H–2C)**

Instruction Hours / week: L: 2 T: 0 P:0 **Marks:** Internal: **40** External: **60** Total:**100**
End Semester Exam: 3Hours

Course Objective:

1. To introduce the fundamental concepts of physical education, health and wellness.
2. To provide a general understanding on nutrition, first aid and stress management. 3. To familiarize the students regarding yoga and other activities for developing fitness.
4. To create awareness regarding hypo-kinetic diseases, and various measures of fitness and health assessment.

Course Outcomes:

COs	Course Outcomes	Blooms Level
CO1	Able to describe the principles of health and wellness from an interdisciplinary perspective.	Understand
CO2	Able to think and act ethically in the context of health, nutrition and wellness.	Understand
CO3	Acquire knowledge about the benefits of physical activity, nutrition for health	Understand
CO4	Create awareness among the public about the importance of health and importance of yoga	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					**S**							
CO2								**M**				
CO3			**S**									
CO4							**M**					
CO5										**S**		
CO6								**M**				

S-Strong; M-Medium; L-Low

Unit 1: **(6)**

Definition and concept of health -biomedical concept, ecological concept, psyco social concept, holistic concept. Dimensions of health – physical, mental Health; causes and consequences of mental conflicts and frustrations; Introduction to common mental disorders: Insomnia, Depression, Stress, Anxiety disorders, Social, Spiritual, Emotional, Vocational and

other dimensions. Determinants of health - biological, environmental factors, behavioral and socio culture.

Unit II: **(6)**

Basic concept of nutrition. Food intake and regulations, calorific value of food, dietary need and recommended dietary allowances. Assessment of nutritional status - energy value of carbohydrates, proteins and fats. Balanced diet. Healthy foods: Healthy diet, for adults, infants and young children, aged adults. Food pyramid. Factors influencing eating behaviour. Concepts of food safety and standards, Food Preservation.

Unit III: **(6)**

Lifestyle Disease and its Management: Types, Risk Factors, Diagnosis, and Prevention - Heart Disease, Obesity, Type 2 Diabetes, Stroke, Hypertension. Stress management, Prevent Lifestyle Diseases - Maintaining a Balance Between Physical Activity and Food Consumption. Opting for Periodic Health Check-ups. Consequences of alcohol and drug misuse

Unit IV: **(6)**

Importance and Scope of Physical Education -Modern concept of health, physical fitness and wellness. Exercise and weight loss, Exercises for a healthy heart, regular exercise for mental health - workout plan - myths about exercise and aging, Tips for using a fitness device. Cardiorespiratory Fitness, Musculoskeletal Fitness.

Unit V: **(6)**

Benefits and Importance of yoga in our life – Pranayama – Surya Namaskar-Padmasana-Pachimothasana- Bhujangasana- Dhanurasana - Sarvangasana -Matsyasana- SalabhasanHalasana-Chakrasana- Vrikshasana- Padahastasana – Savasana

Suggested Reading:

1. Benu Gupta, Mukesh Agarwal and Sunita Arora (2019). A Textbook on Physical Education and Health Education: Fitness, Wellness and Nutrition.

2. Manjari Chandra (Author) (2020). Eat Up, Clean Up: Your Personal Journey to A Healthy Life

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

4. Yogeswar (2021). Everyday Yoga: An Illustrated Guide to H: An Illustrated Guide to Healing

B.E COMPUTER SCIENCE AND ENGINEERING **2022-2023**

SEMESTER V

22BEMC551 MOBILE APPLICATION DEVELOPMENT 1H-0C

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

PRE-REQUISITES: Java Programming

COURSE OBJECTIVES

The goal of this course for the students is to

- Develop knowledge about mobile application development.
- Understand the building blocks of mobile apps.
- Gain knowledge about graphics and animations in mobile apps.
- Know about testing of mobile apps.
- Learn the advantages and limitations of development frameworks. Understand more about how to distribute apps on mobile market place.

COURSE OUTCOMES

Upon completion of this course the students will be able to

- Explain the overview of android with its states and lifecycle.
- Apply the mobile applications for e-marketing in Android and iPhone.
- Analyze mobile databases and various types of testing.
- Develop the simple android applications.
- Evaluate alternative mobile frameworks, and contrast different programming platforms.
- Implement the android applications in different field with modern tools.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					L							
CO2								L				
CO3			L									
CO4							L					
CO5										L		
CO6								M				

S-Strong; M-Medium; L-Low

UNIT I

Mobility landscape – Mobile platforms – Mobile apps development – Overview of android platform – Setting up the mobile app development environment along with an emulator – A case study on mobile app development.

UNIT II

App user interface designing – Mobile UI resources (Layout, UI elements, Draw- able, Menu) – Activity – States and life cycle – Interaction amongst activities – App functionality beyond user interface – Threads, async task, services – States and lifecycle, Notifications, Broadcast receivers.

UNIT III

Telephony and SMS APIs – Native data handling – On-device file I/O – Shared preferences – Mobile databases such as SQLite, and enterprise data access (via Internet/Intranet). Graphics and animation –Custom views – Canvas – Animation APIs – Multimedia – Audio/video playback and record – Location awareness and native hardware access (sensors such as accelerometer and gyroscope).

UNIT IV

Debugging mobile apps – White box testing – Black box testing and test automation of mobile apps –JUnit for android, robotium and monkey talk. Versioning – Signing and packaging mobile apps – Distributing apps on mobile market place. Introduction to objective C – iOS features

UNIT V

UI implementation – Touch frameworks – Location aware applications using core location and map kit – Integrating calendar and address book with social media application – Using WIFI – iPhone market place – Drawbacks on iOS over Android – Various stores available in online market – Configuration of mobile app – Online ecommerce transaction – E-booking transaction.

TEXT BOOK

1. Anubhav Pradhan and Anil V Deshpande, Composing Mobile Apps Wiley, First Edition 2014

REFERENCE BOOK

1. Barry Burd,Android Application Development All-in-one for Dummies, John Wiley,First Edition 2012

WEB URLs:

1. www.impetus.com/mobility
2. www.cise.ufl.edu/~helal/classes/f10/notes/intro_to_mobile.ppt
3. www.diva– portal.org/smash/get/diva2:626531/FULLTEXT01.pdf
4. www.law.fsu.edu/library/databases/ppt/Androidapps.ppt
5. www.infosys.com/flypp/resources/Documents/mobile-application- testing.pdf

23BTFTOE04 AGRICULTURAL WASTE AND BYPRODUCTS UTILIZATION 3H-3C

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

End Semester Exam:3 Hour

Course Objectives

The goal of this course is for students,

- To categorize the types of agricultural wastes.
- To outline the production and utilization of biomass.
- To explain the various parameters considered to be important in the designing of biogas units.
- To discuss the methods employed in the production of alcohol from agricultural wastes / byproducts.
- To summarize the overall aspects involved in the production of paperboards and particle boards from agricultural wastes.

Course Outcomes

Upon successful completion of this, students will be able to,

- Outline the types of agricultural wastes.
- Illustrate the collection and generation of value-added products from agricultural wastes
- Demonstrate the techniques involved in the production and utilization of biomass.
- Discuss the various parameters considered to be important in the designing of biogas units.
- Illustrate the various methods employed in the production of alcohol from the byproducts of agricultural wastes.
- Discuss the appropriate materials to produce paperboards and particleboards from agricultural wastes.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					S							
CO2								M				
CO3			S									
CO4							M					
CO5										S		
CO6								M				

S-Strong; M-Medium; L-Low

UNIT I - TYPES OF AGRICULTURAL WASTES 9

Introduction and Background Agricultural Waste, Crop Waste, Agricultural Residues (annual crops), Technical terms, properties of agricultural waste- storage and handling

- rice by-products utilization-rice bran and germ, rice bran oil, economic products from agriculture waste/by-products.

UNIT II - BIOMASS PRODUCTION AND UTILIZATION 9

Biomass – types – production and utilization Technology used for the utilization of agricultural wastes: Biomass Gasifier, Nimbkar Agricultural Research Institute (NARI)Gasifier, Rice-Husk Based Gasifier, Heat and Steam from Sugarcane Leaf and Bagasse.

UNIT III - BIOGAS DESIGN AND PRODUCTION 9

Biogas: Definition, composition, history of biogas, Production of biogas – factors affecting the efficiency; types of biogas plant (floating drum type and fixed dome type) and their components (inlet, outlet, stirrer, slanting pipe, digester, gas holder and gas outer pipe), Selection and Design of biogas plant.

UNIT IV - PRODUCTION OF ALCOHOL FROM WASTE MATERIALS 9

Production of Alcohol from waste materials: Introduction, Production methods, Cellulolysis (biological approach): Pretreatment, Cellulolytic processes (Chemical and Enzymatic hydrolysis), Microbial fermentation, Gasification process (thermochemical approach).

UNIT V – PRODUCTION OF PAPERBOARD AND PARTICLEBOARDS FROM AGRICULTURAL WASTE 9

Biodegradable packing materials: merits and demerits, Production and testing of Paperboards and Particleboards from Agricultural Waste: Introduction, History, Terminology and classification, Raw materials, Production steps- Pulping, Classifications of pulp, Bleaching, Plies, Coating, Grades.

TOTAL: 45

Text Books:

Efthymia Alexopoulou. Bioenergy and Biomass from Industrial Crops on Marginal Lands. Elsevier, 1st Edition, 2020. (ISBN: 9780128188644).

1. Navanietha Krishnaraj Rathinam, Rajesh Sani. Biovalorisation of Wastes to Renewable Chemicals and Biofuels. Elsevier, 1st Edition, 2019. (ISBN:9780128179529).
2. Simona Ciuta, Demetra Tsiamis, Marco J. Castaldi. Gasification of Waste Materials. Academic Press, 1st Edition, 2017. (ISBN: 9780128127162).
3. Nicholas E. Korres, Padraig O'Kiely, John A.H. Benzie, Jonathan S. West.Bioenergy Production by Anaerobic Digestion: Using Agricultural Biomass and Organic Wastes. Routledge, 1st Edition, 2013. (ISBN-13: 9780415698405).
4. Albert Howard, Yashwant Wad. The Waste Products of Agriculture. BenedictionClassics, 1st Edition, 2011. (ISBN-13: 9781849025).

23BEEEOE01 **RENEWABLE ENERGY SYSTEMS** **3H-3C**

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

End Semester Exam:3 Hours

Course Objectives

- To gain the knowledge about environmental aspects of energy utilization.
- To understand the basic principles of solar cells, photovoltaic conversion.
- To understand the basic principles of wind energy conversion.
- To gain the knowledge about hydro and ocean energy.
- To understand the basic principles of Biomass, fuel cell, Geo thermal powerplants and MHD.

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Discuss remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources.	Apply
CO2	Selection, Operation and Operation of Solar PV System for different types of applications	Apply
CO3	Selection and Operation of Wind Turbine system	Understand
CO4	Selection and Operation of Hydroelectric Plant and Ocean Energy	Understand
CO5	Biomass Power Generation Types, Applicability and Limitations, Selection and Operation of Fuel Cell, Geo thermal plants and MHD	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				**M**								
CO2								**M**				
CO3			**M**									
CO4							**M**					
CO5										**L**		
CO6								**M**				

S-Strong; M-Medium; L-Low

UNIT I INTRODUCTION (9)

Energy scenario - Different types of Renewable Energy Sources - Environmental aspects of energy utilization - Energy Conservation and Energy Efficiency - Needs and Advantages, Energy Conservation Act 2003.

UNIT II SOLAR ENERGY (9)

Introduction to solar energy: solar radiation, availability, measurement and estimation–Solar Thermal conversion devices and storage – solar cells and photovoltaic conversion –PV systems – MPPT. Applications of PV Systems – solar energy collectors and storage.

UNIT III WIND ENERGY (9)

Introduction – Basic principles of wind energy conversion- components of wind energy conversion system - site selection consideration – basic–Types of wind machines. Schemes for electric generation – generator control, load control, energy storage – applications of wind energy – Inter connected systems.

UNIT IV HYDRO ENERGY (9)

Hydropower, classification of hydro power, Turbine selection, Ocean energy resources, Ocean energy routes. Principles of ocean thermal energy conversion systems, ocean thermal power plants. Principles of ocean wave energy conversion and tidal energy conversion.

UNIT V OTHER SOURCES (9)

Bio energy and types –Fuel cell, Geo-thermal power plants; Magneto-hydro-dynamic (MHD) energy conversion.

SUGGESTED READINGS

1. Rai.G.D, Non-conventional sources of energy Khanna publishers,2011
2. Khan.B.H, Non-Conventional Energy Resources , The McGraw Hills, Second edition,2012
3. John W Twidell and Anthony D Weir , Renewable Energy Resources , Taylor and Francis – 3rd edition ,2015
4. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 : 9390385636.

B. **Tech. – Food Technology 2023 - 2024**

23BTFTOE02 NUTRITION AND DIETETICS 3H-3C

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

Course objectives

The goal of this course is for students,

- To explain the basic concepts of food and nutrition.
- To define the overall classification, function, and source of carbohydrates, lipids and proteins.
- To summarize the availability, source, deficiency and physiological role of fat and water-soluble vitamins.
- To outline the role of health and nutritional importance of micro and macro minerals.
- To discuss the recent trends and developments in nutrition.

Course outcomes

Upon successful completion of this, students will be able to

1. Explain the basics in the area of nutritional assessment in health and disease.
2. Outline the biological functions of various macromolecules in terms of food and health.
3. Discuss the balanced diet for healthy life to avoid or prevent the deficiency disorders.
4. Infer an appropriate diet, products that prevent vitamin deficiency disorders.
5. Identify the proper foods rich in minerals to live a healthy life.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					S							
CO2								M				
CO3			S									
CO4							M					
CO5										S		
CO6								M				

S-Strong; M-Medium; L-Low

UNIT I - HUMAN NUTRITION **9**

Six classes of nutrients - Historical perspective of nutrient requirements – Assessment of nutritional status - recommended dietary allowances of macronutrients for all age groups - Assessment of protein quality - Malnutrition and related disorders –Balanced Diet. Factors influencing dietary intake: Food habits, food fads and fallacies, their influence on health and wellbeing.

UNIT II - BIOMOLECULES **9**

Carbohydrates- Definition, classification, Functions, Sources of Carbohydrates, Deficiency. Lipids – Definition, classification, function, sources, Properties of fats and oils, Refined & Hydrogenated fats process. Proteins - Definitions, Classification, Function, Amino Acids, Sources of Proteins, Texturized proteins.

UNIT III - VITAMINS **9**

Physiological role, bio-availability, requirements, sources and deficiency of Fat Soluble Vitamins:

Vitamin A, Vitamin D, E & K. *f* Water soluble vitamins: Vitamin C, Thiamine, Riboflavin, Niacin, Pantothenic acid, Biotin, Folic acid, Vitamin B12, VitaminB6. Stability under different food processing conditions.

UNIT IV – MINERALS AND WATER **9**

Physiological role, bio-availability, requirements, sources and deficiency of Macro minerals: Calcium, Phosphorus Magnesium, Sodium, Potassium chloride. Micro minerals: Iron, Zinc, copper, selenium, chromium, iodine, manganese, Molybdenum and fluoride - Chemistry and physical properties of free, bounded and entrapped water, water activity, quality parameters of drinking and mineral water.

UNIT V - RECENT TRENDS IN NUTRITION **9**

Principles of dietary management in gout, rheumatism, AIDS/HIV - Cancer-risk factors, symptoms, dietary management, role of food in prevention of Cancer. Role of functional foods Health foods and novel foods, organically grown foods, personalized nutrition, recent concepts in human nutrition like nutrigenomics, nutraceuticals etc.

TOTAL: 45

Text Books:

Sunetra Roday. Food Science and Nutrition. Oxford Higher Education/Oxford University Press. 3rd edition 2018. (ISBN-13: 9780199489084).

2. Charis Galanakis. Nutraceutical and Functional Food Components. Academic Press, 1st Edition, 2017. (ISBN: 9780128052570).
3. Ashley Martin. Nutrition and Dietetics. Syrawood Publishing House. 1st Edition,2016. (ISBN:9781682860588).
4. Robert E. C. Wildman. Handbook of Nutraceuticals and Functional Foods. CRC Press, 2nd Edition, 2016. (ISBN-10: 9781498770637).
5. Srilakshmi. B. Nutrition Science. New Age International Pvt. Ltd, Publishers. 6th Edition. 2017. (ISBN-13: 9789386418883).

22BECSOE01 INTERNET OF THINGS 3H-3C

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

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course is for the students is to Understand the basics of Internet of Things.

- Identify an idea of some of the application areas where Internet of Things can be applied.
- Infer the middleware for Internet of Things.
- Express the concepts of Web of Things .
- Examine the concepts of Cloud of Things with emphasis on Mobile cloud computing. Inspect the IOT security protocols.

COURSE OUTCOMES

Upon completion of this course the students will be able to: Explain about IoT architecture and its applications.

- Identify the feasibility and potential impact of IoT solutions in different industries.
- Apply a systematic and structured approach to designing IoT solutions.
- Summarize techniques to secure the elements of an IoT device.
- Illustrate security protocols in various domains of industrial applications.

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					L							
CO2								L				
CO3			L									
CO4							L					
CO5									L	L		
CO6								M				

S-Strong; M-Medium; L-Low

UNIT I INTRODUCTION TO IOT 9

Introduction to IoT – IoT Architectures – Core IoT Functional Stack, Sensors and Actuators Layer, Communications Network Layer, Applications and Analytics Layer – IoT Data Management and Compute Stack, Fog Computing, Edge Computing, Cloud Computing – Sensors, Actuators, Smart Objects, Sensor networks. Middleware for IoT: Overview – Communication middleware for IoT – IoT Information Security, WSN and Sensing Model.

UNIT II IOT COMMUNICATION 9

Communications Criteria – Access Technologies – IP as IoT Network Layer – Business case – Optimization – Profiles and compliances – Application Protocols – Transport Layer – Application Transport Methods.

UNIT III DESIGN METHODOLOGY **9**

Design Methodology – Case study – Basic blocks of IoT device – Raspberry Pi – Board, Interfaces, Linux, Setting up, Programming – Arduino – Other IoT Devices.

UNIT IV DATA ANALYTICS FOR IOT **9**

Data Analytics for IoT – Big Data Analytics Tools and Technology – Edge Streaming Analytics – Network Analytics Applications. Security history, challenges, variations – Risk Analysis Structures – Application in Operational Environment.

UNIT V IOT IN INDUSTRY **9**

Manufacturing, Architecture, Security Protocols – Utilities, Grid Blocks - Smart Cities, Architecture, Use cases – Transportation, Architecture, Use cases.

Total: 45

TEXT BOOKS

1. Honbo Zhou "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2013
2. Dieter Uckelmann, Mark Harrison, Florian Michahelles, "Architecting the Internet of Things", Springer Berlin, 2011
3. David Easley, Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010

REFERENCE BOOKS:

1. Olivier Hersent, Omar Elloumi and David Boswarthick,"The Internet of Things: Applications to the Smart Grid and Building Automation", Wiley, 2018
2. Olivier Hersent, David Boswarthick, Omar Elloumi,"The Internet of Things – Key applications and Protocols", Wiley, 2019

WEBSITES:

1. https://www.javatpoint.com/iot-internet-of-things
2. https://www.geeksforgeeks.org/introduction-to-internet-of-things-iot-set-1/
3. https://www.tutorialspoint.com/internet_of_things/index.htm
4. https://www.startertutorials.com/blog/physical-design-of-iot.html
5. https://www.guru99.com/iot-tutorial.html