B.Sc. MICROBIOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

Curriculum and Syllabus

Regular (2022 – 2023)

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
Web: www.kahedu.edu.in

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FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT

UNDER – GRADUATE PROGRAMMES

(REGULAR PROGRAMME)

REGULATIONS

(2022)

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FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT

UNDER-GRADUATE PROGRAMMES

REGULAR MODE

REGULATIONS - 2022

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

1 PROGRAMMES OFFERED, MODE OF STUDY AND ADMISSION REQUIREMENTS

1.1 U.G. Programmes Offered

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

S. No.	DEGREE	DISCIPLINE
1.	B. Sc.	Biochemistry
2.	B. Sc.	Biotechnology
3.	B. Sc.	Computer Science
4.	B.Sc.	Mathematics
5.	B.Sc.	Physics
6.	B. Sc.	Chemistry
7.	B. Sc.	Microbiology
8.	B. Sc.	Information Technology
9.	B. Sc.	Computer Technology
10.	B.Sc.	Computer Science (Cognitive Systems)
11.	B.Sc.	Computer Science (Artificial Intelligence and Data Science)
12.	BCA	Computer Application
13.	B.Sc.	Applied Science (Material Science)
14.	B.Sc.	Applied Science (Foundry Science)
15.	B. Com.	Commerce
16.	B.Com (CA)	Commerce with Computer Applications
17.	B. Com. (PA)	Commerce with Professional Accounting
18.	B. Com. (BPS)	Commerce with Business Process Services

19.	B.B.A.	Business Administration
20.	B. Com	Financial Analytics
21.	B. Com	International Accounting and Finance

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 Tamil Nadu 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 U.G. Programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
B.Sc., B.Com, BCA, BBA	6	12

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 a total credit of 144 for UG Programme.

3.2. Credits

Credit means the weightage given to each course by the experts of the Board of Studies concerned. Total credits 144 as per UGC Guidelines for the UG programme (Three 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 additional course for Arts & Science Programmes. Four credits are awarded for each course and the examinations will be conducted at the end of each semester.

4.2. Core Course, Discipline Specific Elective, Generic Elective, Skill Enhancement Course, Project, Ability Enhancement Course are part of curricular structure.

4.2.1. Core Course

Core course consists of theory and practical for Department domains for which examinations shall be conducted at the end of each semester. The students have to study 23 Core Courses compulsorily. Students have to earn 74 Credits in Core Course.

4.2.2. Discipline Specific Electives (DSE)

DSE is offered in the fifth and sixth semesters of third year. The examination shall be conducted at the end of each semester. Final year students (V and VI Semesters) will have to choose the elective courses in V semester and VI Semester from the list of elective courses given in the curriculum, in addition to the project work. Students have to earn 24 Credits in Discipline Specific Electives.

4.2.3. Generic Elective

Generic elective is an elective course chosen generally from an unrelated discipline/subject, with an intention to provide exposure in other areas of interest also to students.

The students have to choose two Generic Electives- one each in the First year (3 or 4 courses) and second year (3 or 4 courses) of the programme from the list of elective courses given in the curriculum.

Note: A particular elective course will be offered only if at least one third of the students in a class choose that course. If less, the elective selected has to be studied as a self-study course only. Students have to earn 13 Credits in Generic Elective.

4.2.4. Skill Enhancement Courses

Skill Enhancement Courses are offered in the third and fourth semesters of second year programme and in the fifth and sixth semesters of the third-year programme. Second year students (III and IV Semesters) will have to choose atleast one elective course each in both III and IV Semesters from the list of elective courses given in the curriculum. Similarly final year students (V and VI Semesters) will have to choose at least one elective course each in both V and VI Semesters from the list of elective courses given in the curriculum.

The examination shall be conducted at the end of each semester. Students have to earn 10 Credits in Skill Enhancement Courses.

Note: A particular elective course will be offered only if at least one third of the students in a class choose that course. If less, the elective selected has to be studied as a self-study course only.

4.2.5. Project Work

The project work shall start at the beginning of sixth semester and the Project Report has to be submitted at the end of the sixth semester. The project may be an individual or group task**.** The Head of Department concerned shall assign a project supervisor who in turn shall monitor the project work of the student(s). A project/ dissertation work may be given *in lieu* of a discipline-specific elective paper. Maximum number of students per project batch is 4.

4.2.6. Ability Enhancement Course

Ability Enhancement Course-1

The course (English I & II for Science Programmes / Communicative English I & II for Arts Programmes) shall be offered during the first and second semester for which examinations shall be conducted at the end of the semester. Four credits are awarded for each course and the examinations will be conducted at the end of each semester.

Ability Enhancement Compulsory Course-2

Students shall study the course Environmental Studies in the First / Second Semester for which examinations shall be conducted at the end of the semester.

4.2.7. Internship

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

4.2.8. Soft Skill Development - I

The course Soft Skill Development - I shall be offered during the third semester for which examinations shall be conducted at the end of the semester and 100 marks is awarded through Continuous Internal

Assessment. Students have to earn 1 credit for this course.

Soft Skill Development - II

The course Soft Skill Development - I shall be offered during the fourth semester for which examinations shall be conducted at the end of the semester and 100 marks is awarded through Continuous Internal Assessment. Students have to earn 1 credit for this course.

Open Elective Course

He / She may select one of the open elective courses from the list given below offered by the other Departments in the fifth semester. Students have to earn 2 credits for this course. (The student cannot select a course offered by the parent department).

S.No	Name of the Department	Course Code	Name of the Course
1	B Com	22CMUOE501	Business Accounting
2	B Com Financial Analytics	22FAUOE501	Business Accounting
3	B Com Commerce with Computer Applications	22CCUOE501	Enterprise Resource Planning
4	B Com Commerce with Professional Accounting	22PAUOE501	Basics of Accounting
5	B Com Commerce with Business Process Services	22BPUOE501	Basics of Accounting
6	B Com International Accounting and Finance	22AFUOE501	Enterprise Resource Planning
7	BBA	22BAUOE501	Principles of Management
8	B.Sc Computer Science	22CSUOE501	Data Visualization
9	BCA	22CAUOE501	Animation Techniques
10	B.Sc Information Technology	22ITUOE501	Multimedia and its Applications

11	B.Sc Computer Technology	22CTUOE501	Multimedia and its Applications
12	B.Sc Computer Science (Cognitive Systems)	22CGUOE501	Web Designing
13	B.Sc Computer Science (Artificial Intelligence and Data Science)	22ADUOE501	E-Commerce Technologies
14	B.Sc Mathematics	22MMUOE501	Combinatorics
15	B.Sc Physics	22PHUOE501	Atmosphere and Weather
16	B.Sc Chemistry	22CHUOE501	Dairy Chemistry
17	B.Sc Microbiology	22MBUOE501	Bio Nanotechnology
18	B.Sc Biochemistry	22BCUOE501	Hygiene and Health
19	B.Sc Biotechnology	22BTUOE501	Golden Manure Preparation

5.0 Value Added Courses

Courses of varying durations but not less than 30 hours which are optional and offered outside the curriculum that add value and help the students for getting placement. Students of all programmes are eligible to enroll for the value-added courses. The student can choose one Value-added course per semester from the list of Value-added courses available in KAHE. The examinations shall be conducted at the end of the value-added course at the Department level and the student has to secure a minimum of 50% of marks to get a pass. The certificate for the value-added course for the passed students shall be issued duly signed by the HOD and Dean of the Faculty concerned.

6.0 Online Course

Student shall study at least one online course from SWAYAM / NPTEL / MOOC in any one of the first five semesters for which examination shall be conducted at the end of the course by the respective external agencies if any. The student can register to the courses which are approved by the Department. The student shall produce a Pass Certificate from the respective agencies before the end of the fifth semester. The credit(s) earned by the students will be considered as additional credit(s) over and above the credits minimum required to earn a particular degree.

7.0 Extension Activities

Every student is encouraged to participate in at least any one of the following Extension 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 Extension Activities along with the faculty mentor and the Head of the respective department on the following parameters.

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

8.0 Marks for Co-curricular and Extra-curricular shall be sent to the CoE before the commencement of the Sixth End Semester Examinations. The above activities shall be conducted outside the regular working hours of the KAHE.

5. 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.

6. MAXIMUM MARKS

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

Evaluation: Evaluation in the courses comprises two parts, one is the Continuous Internal Assessment (CIA) and the other one is the End Semester Examination (ESE).

7. REQUIREMENTS TO APPEAR FOR THE END SEMESTER EXAMINATION

a. Ideally, every student is expected to attend all classes and should secure 100% attendance. However, in order to allow for certain unavoidable

circumstances, the student is expected to attend at least 75% of the classes and the conduct of the candidate has been satisfactory during the course.

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

c. However, a candidate who has secured attendance less than 64% in the current semester due to any reason shall not be permitted to appear for the current semester examinations. But he/she will be permitted to appear for his/her supplementary examinations, if any and he/she has to re-do the same semester with the approval of the "Students' Affairs Committee" and Registrar.

8. a. FACULTY MENTOR

To help students in planning their courses of study and for general advice on the academic programme, the HoD shall allot twenty students to a faculty who will function as faculty mentor throughout their period of study. Faculty mentor shall advise the students and monitor their behavior and academic performance. Problems if any shall be counseled by them periodically. The faculty mentor is also responsible to inform the parents of their wards' progress. Faculty mentor shall display the cumulative attendance particulars of his / her ward students' periodically (once in 2 weeks) on the Notice Board to enable the students, know their attendance status and satisfy the **clause 7** of this regulation.

b. **ONLINE COURSE COORDINATOR**

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

students. Further, the coordinators shall advice the students regarding the online courses and monitor their course.

9. CLASS COMMITTEE

Every class shall have a Class Committee consisting of the faculty members of the 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

- Analyzing and solving problems experienced by students in the class room and in the laboratories.
- Analyzing the performance of the students of the class after each test and finding the ways and means to improve the performance.
- The Class Committee of a particular class of any department is normally constituted by the HoD / Chairperson of the Class Committee. However, if the students of different departments are mixed in a class, the Class Committee shall be constituted by the respective Dean of the Faculty.
- The class committee shall be constituted during the first week of each semester.
- The HoD / Chairperson of the Class committee is authorized to convene the meeting of the class committee.
- The respective Dean of the Faculty has the right to participate in any Class committee meeting.
- The Chairperson is required to prepare the minutes of every meeting, and submit the same to Dean 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.

10. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or department shall have a “Course Committee” comprising all the teachers handling the common course with one of them nominated as Course Coordinator. The nomination of the course coordinator shall be made by the respective Dean depending upon whether all the teachers handling the common course belong to a single department or to various other

departments. The 'Course Committee' shall meet in order to arrive at a common scheme of evaluation for the tests to ensure a uniform evaluation of the tests. If feasible, the course committee shall prepare a common question paper for the Internal Assessment test(s). Course Committee Meeting is conducted once in a semester.

11. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

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

11.2 **Continuous Internal Assessment (CIA)**: The performance of students in each course will be continuously assessed by the respective faculty as per the guidelines given below:

Theory Courses

S. No.	Category	Maximum Marks
1.	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

* Two Assignments (Assignment I before Internal Test – I and assignment II before Internal Test – II).

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 the conduct of Exercise/ Experiment and records maintained.

11.3 Pattern of 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)

Instruction	Remarks
Maximum Marks	50 marks
Duration	2 Hours
Part – A	Objective type (20*1=20)
Part - B	Short Answer Type (3*2 = 6)
Part - C	3 Eight mark questions 'either – or' choice (3*8 = 24 Marks)

11.4 Attendance

Marks Distribution for Attendance

S. No.	Attendance (%)	Maximum Marks
1	91 and above	5.0
2	81 - 90	4.0
3	76 - 80	3.0
4	Less than 75	0

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12. ESE EXAMINATIONS

12.1 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) or 29 (b), Question No. 30: Unit - V, either 30 (a) or 30 (b)

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

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

Record Notebooks for Practical Examination

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

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

12.3. Evaluation of Project Work

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

*Combined valuation of Internal and External Examiners.

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

12.3.3 The evaluation of the project will be based on the project report submitted and a *viva-voce* Examination by a team consisting of the supervisor, who will be the Internal Examiner and an External Examiner who shall be appointed by the COE. In case the guide is not available, the HoD shall act as an Internal Examiner for the same.

12.3.4 If a candidate fails to submit the project report on or before the specified date given by the Examination Section, the candidate is deemed to have failed in the Project Work and shall re-enroll for the same in a subsequent semester.

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

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

13. PASSING REQUIREMENTS

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

13.2 If a candidate fails to secure a pass in a particular course (either CIA or ESE or Both) as per clause 13.1, it is mandatory that the candidate

has to register and reappear for the examination in that course during the subsequent semester when examination is conducted for the same till, he / she receives a pass both in CIA and ESE (vide Clause 2.1).

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

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

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

14. IMPROVEMENT OF MARKS IN THE COURSES ALREADY PASSED

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

15. AWARD OF LETTER GRADES

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

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

16. GRADE SHEET

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

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

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

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

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

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

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

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

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

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

where,

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

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

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

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

17. REVALUATION

A candidate can apply for revaluation and re-totaling of his / her semester examination answer script (**theory courses only**), within 2 weeks from the date of declaration of results, on payment of a prescribed fee. 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.

18. TRANSPARENCY AND GRIEVANCE COMMITTEE

Revaluation and Re-totaling is allowed on representation (clause 17). Student may get the Xerox copy of the answer script on payment of prescribed fee, if he / she 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.

19. ELIGIBILITY FOR THE AWARD OF THE DEGREE

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

- Successfully completed all the components prescribed under Part I to Part IV in the CBCS pattern to earn the minimum required credits as specified in the curriculum corresponding to his / her programme within the stipulated period vide class 2.1.
- Not any disciplinary action pending against him / her.
- The award of the degree must be approved by the Board of Management.

20. CLASSIFICATION OF THE DEGREE AWARDED

20.1 Candidate who qualifies for the award of the Degree (vide clause 19) 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.**

20.2 Candidate who qualifies for the award of the Degree (vide clause 19) having passed the examination in all the courses within the specified maximum number of semesters (vide clause 2.1), securing a **CGPA not less than 6.5** shall be declared to have passed the examination in the **First Class**.

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

21. PROVISION FOR WITHDRAWAL FROM END-SEMESTER EXAMINATION

21.1 Candidate due to valid reasons and on prior application, be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination.

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

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

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

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

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

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

22. PROVISION FOR AUTHORISED BREAK OF STUDY

22.1 Break of Study shall be granted only once for valid reasons for a maximum of one year during the entire period of study of the degree programme**.** However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If a candidate intends to temporarily discontinue the programme in the middle of the semester for

valid reasons, and to rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he / she applies to the Registrar, but not later than the last date for registering for the end semester examination of the semester in question, through the Head of the Department stating the reasons therefore and the probable date of rejoining the programme.

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

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

22.4 The total period for completion of the Programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 2.1 irrespective of the period of break of study (vide clause 22.1) in order that he/she may be eligible for the award of the degree.

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

23. RANKING

A candidate who qualifies for the 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 to the programme shall be eligible for ranking. Such ranking will be confined to 10% of the total number of candidates qualified in that particular programme of study subject to a maximum of 10 ranks.

24. SUPPLEMENTARY EXAMINATION

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

25. DISCIPLINE

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

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

26. REVISION OF REGULATION AND CURRICULUM

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

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 is

- 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 well as 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 of biology.
- 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 other microbiology laboratories.

B.Sc. MICROBIOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

Curriculum and Syllabus

Regular (2022 – 2023)

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
Web: www.kahedu.edu.in

DEPARTMENT OF MICROBIOLOGY

FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT

UG PROGRAM (CBCS) – B.Sc. Microbiology (2022–2023 Batch)

Course code	Name of the course	Objective & outcomes		Instruction hours/ week			Credit(s)	Maximum Marks			Category	Page No.
		PEOs	POs	L	T	P		CIA	ESE	Total		
								40	60	100		
SEMESTER-I												
22LSU101	Language – I	VII	e	4	0	0	4	40	60	100	AECC	09
22ENU101	English - I	V, II	e	4	0	0	4	40	60	100	AECC	12
22MBU101	Introduction to Microbiology and Microbial Diversity	I	a	4	0	0	4	40	60	100	Core	14
22MBU102	Bacteriology	I	g	4	0	0	4	40	60	100	Core	15
22MBU103	Biochemistry - I	I	g	4	0	0	4	40	60	100	Allied	18
22MBU111	Basic Microbiology - Practical	VI	b	0	0	3	2	40	60	100	Core	20
22MBU112	Bacteriology - Practical	VI	b	0	0	4	2	40	60	100	Core	21
22MBU113	Biochemistry –I - Practical	VI	b	0	0	3	2	40	60	100	Allied	23
	Semester total			**20**	**0**	**10**	**26**	**320**	**480**	**800**		
SEMESTER-II												
22LSU201	Language –II	VII	e	4	0	0	4	40	60	100	AECC	24
22ENU201	English - II	V, II	e	4	0	0	4	40	60	100	AECC	27
22MBU201	Biochemistry – II	I	g	4	1	0	5	40	60	100	Allied	29
22MBU202	Microbial Physiology and Metabolism	II	g	5	1	0	6	40	60	100	Core	31
22MBU211	Biochemistry – II - Practical	VI	b	0	0	4	2	40	60	100	Allied	33
22MBU212	Microbial Physiology and Metabolism - Practical	VI	b	0	0	4	2	40	60	100	Core	34
22AEC201	Environmental Studies	IV	f	3	0	0	3	40	60	100	AECC	36
	Semester total			**20**	**2**	**8**	**26**	**280**	**420**	**700**		
SEMESTER – III												
22MBU301	Virology	I	g	4	0	0	4	40	60	100	Core	39
22MBU302	Microbial Genetics	II	g	4	0	0	4	40	60	100	Core	41
22MBU303	Industrial Microbiology	IV	g	4	0	0	4	40	60	100	Core	43
22MBU304A	Instrumentation and Biotechniques	VI	a,j	3	0	0	2	40	60	100	SEC	45
22MBU304B	Aquatic Microbiology And Algal Technology											47
22MBU311	Virology - Practical	VI	b	0	0	3	2	40	60	100	Core	49
22MBU312	Microbial Genetics - Practical	IV	g	0	0	3	2	40	60	100	Core	51
22MBU313	Industrial Microbiology - Practical	IV	g	0	0	4	2	40	60	100	Core	53

22MBU314A	Instrumentation and Biotechniques-Practical	VI	a,j	0	0	3	1	40	60	100	SEC	55
22MBU314B	Aquatic Microbiology And Algal Technology- Practical											56
22SSD301	Soft Skill Development-I	VII	c,e	2	0	0	1	100	-	100	SEC	57
22MBU391	Internship Programme	V, VI	d,k	0	0	0	2	100	-	100	SEC	59
	Semester total			**17**	**0**	**13**	**24**	**520**	**480**	**1000**		
SEMESTER – IV												
22MBU401	Immunology	I	h	4	0	0	4	40	60	100	Core	60
22MBU402	Medical Microbiology	IV	j	4	0	0	4	40	60	100	Core	62
22MBU403	Recombinant DNA Technology	IV	g,h,i	4	0	0	4	40	60	100	Core	64
22MBU404A	Molecular Biology	V, VI, VII	b,d	3	0	0	2	40	60	100	SEC	66
22MBU404B	Biomathematics and Biostatistics											68
22MBU411	Immunology- Practical	I	h	0	0	3	2	40	60	100	Core	70
22MBU412	Medical Microbiology- Practical	IV	j	0	0	4	2	40	60	100	Core	71
22MBU413	Recombinant DNA Technology-Practical	IV	g,h,i	0	0	3	2	40	60	100	Core	73
22MBU414A	Molecular Biology- Practical	V, VI, VII	b,d	0	0	3	1	40	60	100	SEC	74
22MBU414B	Biomathematics and Biostatistics-Practical											75
22SSD401	Soft Skill Development-II	VII	c,e	2	0	0	1	100	-	100	SEC	76
	Semester total			**17**	**0**	**13**	**22**	**420**	**480**	**900**		
SEMESTER – V												
22MBU501	Environmental Microbiology	I	g	4	0	0	4	40	60	100	Core	78
22MBU502A	Microbes in Sustainable Agriculture and Development	V, IV	a,j	4	0	0	4	40	60	100	DSE	80
22MBU502B	Veterinary Microbiology											82
22MBU503A	Bioinformatics	V VII	c,d	4	0	0	4	40	60	100	DSE	84
22MBU503B	Drug design and development											86
22MBU504A	Cell Biology and Evolution	VI	b,g	3	0	0	3	40	60	100	DSE	88
22MBU504B	Bioprocess And Bioproduct Development											90
22MBU511	Environmental Microbiology-Practical	I	b,g	0	0	3	2	40	60	100	Core	92
22MBU512A	Microbes in Sustainable Agriculture and Development- Practical	V IV	a,j	0	0	3	1	40	60	100	DSE	94
22MBU512B	Veterinary Microbiology- Practical											96
22MBU513A	Bioinformatics - Practical	V VII	d	0	0	3	1	40	60	100	DSE	97
22MBU513B	Drug design and development-Practical											98
22MBU514A	Cell Biology and Evolution-Practical	VI	b,g	0	0	3	1	40	60	100	DSE	100
22MBU514B	Bioprocess And Bioproduct Development - Practical											101
22MBUOE501	Open Elective	IV	l	3	0	0	2	40	60	100	OE	102
22MBU591	Internship Programme	V,VI	d,k	0	0	0	2	100	-	100	SEC	104
	Semester total			**18**	**0**	**12**	**24**	**460**	**540**	**1000**		

SEMESTER – VI												
22MBU601	Food and Dairy Microbiology	IV	g	3	1	0	4	40	60	100	Core	105
22MBU602A	Microbial Biotechnology	IV VI	g	4	0	0	4	40	60	100	DSE	107
22MBU602B	Plant-Microbe Interaction and Biocontrol											109
22MBU603A	Microbial Diagnosis in Health Clinic	V, VI	a,b	3	0	0	3	40	60	100	DSE	111
22MBU603B	Biosafety and Intellectual Property Rights											113
22MBU611	Food and Dairy Microbiology - Practical	III	h	0	0	4	2	40	60	100	Core	115
22MBU612A	Microbial Biotechnology - Practical	IV VI	g	0	0	4	2	40	60	100	DSE	117
22MBU612B	Plant-Microbe Interaction and Biocontrol -Practical											118
22MBU613A	Microbial Diagnosis in Health Clinic - Practical	V, III	a,b,h	0	0	3	1	40	60	100	DSE	119
22MBU613B	Biosafety and Intellectual Property Rights - Practical											120
22MBU691	Project	IV	b,g	0	0	8	6	40	60	100	Core	121
ECA / NCC / NSS / Sports / General interest etc								Good				
	Semester total			**10**	**1**	**19**	**22**	**280**	**420**	**700**		
	PROGRAMME TOTAL			**102**	**3**	**75**	**144**	**2280**	**2860**	**5100**		

Ability Enhancement Courses (AEC)		
Semester	**Course Code**	**Name of the Course**
I	22LSU101	Language –I
	22ENU 101	English
II	22LSU201	Language –II
	22ENU201	English
	22AEC201	Environmental Studies

Generic Elective Courses (GE) / Allied Courses		
Semester	**Course Code**	**Name of the Course**
I	22MBU103	Biochemistry - I
	22MBU113	Biochemistry –I - Practical
II	22MBU202	Biochemistry – II
	22MBU212	Biochemistry – II - Practical
Core Courses (CC)		
Semester	**Course Code**	**Name of the Course**
I	22MBU101	Introduction to Microbiology and Microbial Diversity
	22MBU102	Bacteriology
	22MBU111	Basic Microbiology - Practical
	22MBU112	Bacteriology - Practical
II	22MBU202	Microbial Physiology and Metabolism
	22MBU212	Microbial Physiology and Metabolism - Practical
III	22MBU301	Virology
	22MBU302	Microbial Genetics
	22MBU303	Industrial Microbiology
	22MBU311	Virology - Practical
	22MBU312	Microbial Genetics - Practical
	22MBU313	Industrial Microbiology - Practical
IV	22MBU401	Immunology
	22MBU402	Medical Microbiology
	22MBU403	Recombinant DNA Technology
	22MBU411	Immunology - Practical
	22MBU412	Medical Microbiology - Practical
	22MBU413	Recombinant DNA Technology- Practical
V	22MBU501	Environmental Microbiology
	22MBU511	Environmental Microbiology- Practical
VI	22MBU601	Food and Dairy Microbiology
	22MBU611	Food and Dairy Microbiology- Practical
	22MBU691	Project

Skill Enhancement Courses(SEC)		
Semester	**Course Code**	**Name of the Course**
III	22MBU304A	Instrumentation and Biotechniques
	22MBU314A	Instrumentation and Biotechniques- Practical
	22MBU304B	Aquatic Microbiology And Algal Technology
	22MBU314B	Aquatic Microbiology And Algal Technology- Practical
	22SSD301	Soft Skill Development - I
	22MBU391	Internship Programme
IV	22MBU404A	Molecular Biology
	22MBU414A	Molecular Biology - Practical
	22MBU404B	Biomathematics and Biostatistics
	22MBU404B	Biomathematics and Biostatistics- Practical
	22SSD401	Soft Skill Development – II
	22MBU591	Internship Programme

Discipline Specific Elective Courses (DSE)		
Semester	**Course Code**	**Name of the Course**
V	22MBU502A	Microbes in Sustainable Agriculture and Development
	22MBU512A	Microbes in Sustainable Agriculture and Development- Practical
	22MBU502B	Veterinary Microbiology
	22MBU512B	Veterinary Microbiology- Practical
	22MBU503A	Bioinformatics
	22MBU513A	Bioinformatics- Practical
	22MBU503B	Drug design and development
	22MBU513B	Drug design and development- Practical
	22MBU504A	Cell Biology and Evolution
	22MBU514A	Cell Biology and Evolution- Practical
	22MBU504B	Bioprocess And Bioproduct Development
	22MBU514B	Bioprocess And Bioproduct Development - Practical
VI	22MBU602A	Microbial Biotechnology
	22MBU612A	Microbial Biotechnology- Practical
	22MBU602B	Plant-Microbe Interaction and Biocontrol
	22MBU612B	Plant-Microbe Interaction and Biocontrol-Practical
	22MBU603A	Microbial Diagnosis in Health Clinic
	22MBU613A	Microbial Diagnosis in Health Clinic- Practical
	22MBU603B	Biosafety and Intellectual Property Rights
	22MBU613B	Biosafety and Intellectual Property Rights- Practical

Open elective course

Course code	Name of the Course
22MBUOE501	Bio Nanotechnology

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 and to use high laboratory equipment. They are able to practice safe microbiology, using appropriate protective and emergency procedures.

c. Data analysis skills: Systematically collect, record, and analyze data, identify sources of error, interpret the results, and reach logical conclusions.

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 in microbiology.

e. Communication Skills: Microbiology majors 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.

i. Able to describe how microorganisms are used as model systems to study basic biology.

j. 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.

k. Graduates are expected to be team players, with productive cooperation involving members from diverse socio-cultural backgrounds.

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

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 use in 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

Semester I

22LSU101 **MIL-1** **4H-4C**

தமிழ், தாள் 1

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

EndSemester Exam: 3 hrs

அலகு – I : தமிழ் இலக்கிய வரலாறு – I (8 மணிநேரம்)

முச்சங்க வரலாறு - சங்க இலக்கியத்தொகுப்பு - பாட்டும் தொகையும் - சங்கஇலக்கியச் சிறப்பியல்புகள் - சங்கம் மருவிய காலம் - பதினெண்கீழ்க்கணக்கு நூல்கள் – திருக்குறள் -நாலடியார் - நான்மணிக்கடிகை - பழமொழி நானூறு – பிற்கால அறஇலக்கியங்கள் - கொன்றை வேந்தன் – நீதிநூல் - காப்பியங்கள் - தமிழில் காப்பிய இலக்கணம் - தமிழில் பெருங்காப்பியங்களும் சிறு காப்பியங்களும் - இரட்டைக்காப்பியங்களாகச் சிலம்பும் மேகலையும்.

அலகு - II: சங்க இலக்கியம் (12 மணிநேரம்)

அ). எட்டுத்தொகை

நற்றிணை : கொண்டல் மாமழை – குறிஞ்சி – தலைவன் கூற்று - 140

குறுந்தொகை : வாரார் ஆயினும், வரினும் –முல்லை– தலைவி கூற்று - 110

ஐங்குறுநூறு : மருதம் –தோழி கூற்று-வேட்கைப்பத்து: வாழிஆதன் வாழி அவினி - 6

பதிற்றுப்பத்து : சிதைந்தது மன்ற - 27

பரிபாடல்: புறத்திரட்டு- மதுரை நகர்ச்சிறப்பு – உலகம் ஒரு நிறையாத்தான்-7, மாயோன் கொப்பூழ்-8, செய்யாட்கு இழைத்த-9, கார்த்திகை காதில்-10, ஈவாரைக் கொண்டாடி-11.

கலித்தொகை : பாலைக்கலி- செவிலி – எறித்தரு கதிர்தாங்கி-9

அகநானூறு : அன்னை அறியினும் அறிக – தோழி - நெய்தல் - 110

புறநானூறு : யாதும் ஊரே யாவருங் கேளிர் –பொதுவியல்- 192

ஆ). பத்துப்பாட்டு: நெடுநல்வாடை - கார்காலச் சிறப்பு : வையகம் பனிப்ப -1-70

அலகு – III : அற இலக்கியம் (10 மணிநேரம்)

1.திருவள்ளுவர்- திருக்குறள்– அதிகாரம் 67 – வினைத்திட்பம்,

அதிகாரம் 100 - பண்புடைமை

2. முன்றுறையரையனார் – பழமொழி நானூறு 5 பாடல்கள் : உணற்கு இனிய 5, பரந்த திறலாரை 32, நெடியது காண்கிலாய் 46, இனி யாரும் 153, உரைசான்ற 195.

3. ஔவையார் – கொன்றை வேந்தன் (1- 50 பாடல்கள்)

அன்னையும் பிதாவும் – புலையும் கொலையும் களவும் தவிர்

4. வேதநாயகம்பிள்ளை - நீதிநூல் – (அதிகாரம்-7-தாய் தந்தையரைப் போற்றுதல்-

தேர்ந்தெடுக்கப்பட்ட 5 பாடல்கள்)

சின்னவோர் பொருள், கடவுளை வருந்தி, எப்புவிகளும், வைத்தவர், ஈன்றவர்

5. குமரகுருபரர்-நீதிநெறிவிளக்கம் – 1. உறுதி – உறுதிபயப்ப (254), 2. முயற்சி -முயலாது வைத்து (255), 3. உலையா முயற்சி (256), 4. காலம் – காலம் அறிந்தாங்கு (257), 5. மெய்வருத்தம் -மெய்வருத்தம் பாரார் (258).

அலகு - IV : காப்பிய இலக்கியம் (10 மணிநேரம்)

(அ). சிலப்பதிகாரம் (5 மணிநேரம்)

மங்கல வாழ்த்துப் பாடல்: (21-29) - நாக நீள் நகரொடு-கண்ணகி என்பாண் மன்னோ. வழக்குரை காதை, (48-56) - நீர்வார் கண்ணை-புகா ரென்பதியே .

வஞ்சின மாலை: (5-34) - வன்னிமரமும் – பிறந்த பதிப் பிறந்தேன்.

நடுகற் காதை: (207-234) - அருத்திற லரசர் – மன்னவ ரேறென்

வாழ்த்துக்காதை: (9) - என்னேயிஃ தென்னே – மீவிசும்பிற் றோன்றுமால்.

(ஆ). மணிமேகலை (5 மணிநேரம்)

பசியின் கொடுமை: பாத்திரம் பெற்ற காதை:

'போதி நீழல்' - 'பெருகியதன்றோ' , 'ஆற்றுநர்க்களிப்போர்' - 'நல்லறம் கண்டனை' (73-98).

சிறைக்கோட்டம் அறக்கோட்டமாக்கிய காதை: மாவண் கிள்ளிக்கு காவலன் உரைத்தவை:

'பைஞ்சேறு மெழுகாப் பசும்பொன் மண்டபத்து -
அறவோர்க் காக்கினன் அரசாள் வேந்தன்' (116-163).

இ). சூளாமணி - அரசியல் சருக்கம்- 1. நாவியே கமழும்(1131), 2. கண்மிசை கனிந்த (1132), 3. விரைசெல லிவுளித்(1133), 4. அரைசர்கள் வருக(1134), 5. அருளுமா றடிகள் (1135), 6. விஞ்சைய குலக (1136), 7. சொரிகதிர் (1137), 8. கரியவன் வளைந்த(1138), 9. மடித்தவா யெயிறு (1139),10. விஞ்சய ரதனைக் (1140).

துறவுச் சருக்கம் – பயாபதி மன்னனின் துறவு நெறி -1. மன்னிய புகழி (1840), 2. திருமகி ழலங்கன் (1841), 3. ஆங்கவ ரணைந்த (1842), 4. அலகுடன் விளங்கு (1843), 5. தன்னையோர் அரசனாக்கி (1844), 6. சென்றநாள் (1845), 7. எரிபுரை (1846.), 8. பிறந்தனர் (1847), 9. பிறந்த நாம் (1848), 10. தொகைமலர் (1849) 11. ஒழுகிய (1850).

அலகு- V : அடிப்படை இலக்கணமும் பயன்பாட்டுத்தமிழும் - I (8 மணிநேரம்)

அ). எழுத்து, சொல், பொருள் இலக்கணங்கள் (4 மணிநேரம்)

1. முதல் மற்றும் சார்பெழுத்துகள் - பெயர், வினை, இடை, உரிச்சொல் முதலான அடிப்படை

இலக்கண விளக்கப் பயிற்சிகள்

2). அகத்திணை மற்றும் புறத்திணை இலக்கணங்கள்

ஆ). கடிதப்பயிற்சி (4 மணிநேரம்)

1. வேலை வேண்டி விண்ணப்பம்
2. பல்கலைக்கழகப் பன்னாட்டுக் கருத்தரங்கச் செய்தியை நாளிதழில் வெளியிடவேண்டி நாளிதழின் பதிப்பாசிரியருக்குக் கடிதம்
3. கருத்தரங்கப் பங்கேற்புக்கு அனுமதிக் கடிதம்
4. பல்கலைக்கழக விழாவுக்குத் தலைமையேற்க வேண்டி, மாவட்ட ஆட்சியருக்கு விண்ணப்பம்
5. கல்விகடன் வேண்டி வங்கிமேலாளருக்கு விண்ணப்பம்
6. வசிப்பிடத்திற்கு அடிப்படை வசதி வேண்டி வட்டாட்சியருக்கு விண்ணப்பம்
7. தேசியவிருது பெற்ற நண்பனுக்குப் பாராட்டுக் கடிதம்
8. புத்தகங்கள் அனுப்பி உதவவேண்டி, பதிப்பகத்தாருக்குக் கடிதம்

இ). கட்டுரையை ஒருபக்க அளவில் பத்திகளாகச் சுருக்கி எழுதுதல்

முச்சங்க வரலாறு - சங்க இலக்கியத் தொகுப்பு - பாட்டும் தொகையும் – சங்க இலக்கியச் சிறப்பியல்புகள் - சங்கம் மருவிய காலம் - பதினெண்கீழ்க்கணக்கு நூல்கள் – திருக்குறள் –நாலடியார் – நான்மணிக்கடிகை - பழமொழிநானூறு – பிற்கால அற இலக்கியங்கள் – தமிழில் சிற்றிலக்கியக் காலமும் கருத்தும் - தொண்ணூற்றாறு வகைச் சிற்றிலக்கிய வரிசை – காப்பியங்கள் - தமிழில் காப்பிய இலக்கணம் - தமிழில் பெருங்காப்பியங்களும் சிறு காப்பியங்களும் - சிலம்பும் மேகலையும் **என்ற தலைப்பிலான கட்டுரையில் ஏதேனும் ஒன்றை ஒருபக்க அளவில் சுருக்கி எழுதுதல்.**

- **வினாத்தாளில் இதற்கென தனியே கட்டுரை வழங்கப்பெற வேண்டிய தேவை இல்லை.**
- குறிப்பிட்ட தலைப்பிலான கட்டுரையினைச் சுருக்கி எழுதுக என்று மட்டும் வினா அமையவேண்டும்.
- விடையானது, தலைப்பு (Title), பத்திக்காக வரிசைப்படுத்தப்பட்ட குறிப்புகள் (Hints), பத்தியின் திருத்தா படி (Rough Draft), பத்தியின் திருத்திய படி (Fair Draft) என்ற வகையில் அமைய வேண்டும்.

பாட நூல்: கற்பகச்சோலை – தமிழ் ஏடு.

கற்பகம் உயர்கல்விக்கழகத் தமிழ்த்துறை வெளியீடு.

Semester – I

22ENU101 **ENGLISH -I** **4H –4C**

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

End Semester Exam: 3 Hours

Course Objective:

- 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.
- To Identify and employ methods used for avoiding plagiarism.

Course Outcome:

- Retrieve fundaments of English language to construct error free sentences.
- Develop the knowledge of interpersonal skills.
- Establish and maintain social relationships.
- Develop communication skills in business environment.
- Refine communication competency through LSRW skills.
- Improving intrapersonal skills through literary works.

UNIT - I: **Grammar**

LISTENING: Listening –Types of Listening
SPEAKING: Basics of Speaking
READING: Reading – Types of Reading – Purpose of Reading
WRITING: Writing – Types of Writing – Components of Writing
LITERATURE: Poem- Ode on a Grecian Urn by John Keats
GRAMMAR: Parts of Speech

UNIT – II: Communication Exercise

LISTENING: Principles of Listening Skills – Tips for effective listening
SPEAKING: Telephone Skills
READING: Reading Techniques **–** Reading Newspaper, Magazine, Books and Articles
WRITING: Paragraph Writing
LITERATURE: Prose- Of Friendship by Francis Bacon
GRAMMAR: Articles

UNIT - III: **Interpersonal Skills**

LISTENING: Barriers of Listening – Problems of Listening
SPEAKING: Role Play (formal Context)
READING: Developing Analytical Skills, Skimming and Scanning
WRITING: Precise Writing
LITERATURE: Short Story: The Umbrella man by Roald Dahl
GRAMMAR: Tense

UNIT - IV: LSRW Skills

LISTENING: Note Taking

SPEAKING: Group Discussion
READING: Reading Comprehension
WRITING: Report Writing
LITERATURE: Poem: Tyger by Wiiliam Blake
GRAMMAR: Subject and Predicate – Question Tags

UNIT - V: Literature
LISTENING: Academic Listening – Listening to Radio and Television
SPEAKING: Interview Skills
READING: Tips for MOC- Anchoring
WRITING: Writing a Book Review
LITERATURE: Short story: Rapunzel by the Brothers Grimm
GRAMMAR: Framing Questions

Reference Books:
Wren & Martin, *High School English Grammar & Composition*, S.Chand & Company Ltd, 2008Board of Editors, *Vibrant* English for Enhancement, Emerald Publishers, 2012
Krashen, Stephen D (1982) Principles and practice in second language acquisition. New York: Pergamon Press.

Semester–I

22MBU101 INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY (4H–4C)

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- 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 why the study of fungi such as yeast and molds is within the discipline of microbiology
- To describe the unique characteristics of fungi
- To explain laboratory diagnosis, prevention and control of protozoa

COURSE OUTCOMES

1. After completion of this course paper, the students clearly understand the contributions of various scientists for development of microbiology field and skills associated with it.
2. This course will demonstrate the diversity of microbes and their applications.
3. Students will know about the various field of Microbiology
4. Students will know the role of microorganism in fermentation and spoilage
5. Able to understand the special features of algae, fungi and protozoa
6. Familiarize with morphologic criteria to differentiate the most common protozoan

Unit I- History of microbiology

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

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

Unit III- Classification of microorganisms

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

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

General properties of viruses – Structure , Genome, Replication and Cultivation. Morphology, classification, characteristics, pathogenesis, laboratory diagnosis, prevention and control of the following agents. *Entameoba histolytica*, *Trichomonas*, *Giardia*, *Leishmania donovani*, *Leishmania tropica*, *Plasmodium falciparum*, *Balantidium coli*, *Taenia saginata*, *Taenia solium*, *Echinococcus granulosus*, *Ancyclostoma duodenale*, *Ascaris lumbricoides* and *Wuchereria bancrofti.*

SUGGESTED READINGS

1. Tortora, G.J., Funke, B.R., and Case CL. (2014). Microbiology: An Introduction. 9th edition. Pearson Education.
2. Madigan, M.T., Martinko J.M., Dunlap, P.V., and Clark, D.P. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.
3. Cappucino, J., and Welsh CT. (2020). Microbiology: A Laboratory Manual. 12th edition. Pearson EducationLimited.
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. 2nd edition. 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.

Semester – I

22MBU102 **BACTERIOLOGY** **(4H–4C)**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To provide a strong base in the fundamentals of bacteria that improves their chances in employability.
- To learn techniques and methods used in the cultivation and isolation of bacteria.
- To learn various physical and chemical means of sterilization
- To prepare the specimen and identify the morphology of the bacteria
- To know about the culture media
- To obtain with the knowledge about the habitat and characteristics of various physiological groups of bacteria and archaea in detail.

COURSE OUTCOME

After completion of this course candidate able to:

1. Understand the basic microbial structure and function and this course provide an understanding of the concepts of bacteriology which is one of the basic requirements for their employability
2. Understand the structural similarities and differences among various physiological groups of bacteria and archaea
3. Demonstrate theory and practical skills in staining procedures
4. Understand various Culture media and their applications
5. Understand various physical and chemical means of sterilization
6. Know General bacteriology and microbial techniques for isolation of pure culture of bacteria

Unit I- Structure of bacteria

Cell shape and arrangement - Structure ,chemical compositions and functions of :Capsule and slime layer, Cell wall : Gram positive and Gram negative bacteria, Cell Membrane: Gram-positive and Gram-negative, Flagella : Arrangement, mechanism of flagellar movement, Chemotaxis, phototaxis, Magneto taxis, fimbriae, pili, Ribosomes, Nuclear material, Endospore – Structure, formation, stages of sporulation, Reserved food material: Poly beta hydroxy butyric acid granules, glycogen and polyphosphate granules.

Unit II – Microscopic staining

Dye and its types – Staining Techniques : Specimen Preparation for Light microscope and Electron microscope, Principle and types of staining techniques - Simple Staining, Negative Staining, Gram Staining, Endospore staining, Capsule Staining, Flagellar Staining, Nuclear Staining.

Unit III- Cultivation of Microorganism

Culture media-Classification based on consistency: Solid medium**,** Semisolid media**,** Liquid (Broth) medium - composition :Synthetic or chemically defined medium, Non synthetic or chemically undefined medium - purpose/ functional use/ application: General purpose media/ Basic media, Enriched medium (Added growth factors), Selective and enrichment media, Differential/ indicator medium, Transport media,

Anaerobic media, Assay media. Pure culture technique: Serial dilution, Streak plate, Pour plate ad spread plate technique -microbial preservation- cultivation of anaerobic bacteria.

Unit IV- Control of Microbial Growth and its and mode of action

Pattern of Microbial death – concepts. Sterilization by physical methods - High temperature, tyndallization and pasteurization. - Low temperature .Non ionizing and ionizing radiations - Bacteriological filters. Sterilization by chemical means; Disinfectants and antiseptics: Effectiveness, mode of action & application. Phenolics, alcohols, halogens, heavy metals, quaternary ammonium compounds, aldehydes. Sterilization using gases sulfur dioxide, ethylene oxide, Beta propiolactone. Control of microorganisms using sugars, nitrates, organic acids. Action of antibiotics and enzymes on the cell wall (sphaeroplasts, protoplasts, and L-forms).

Unit V- Archae, bacteria and Eubacteria

Archae bacteria and Eubacteria- General characteristics, Classification (Overview), Origin and evolution, Structure and composition, metabolism, Ecology and Significance in technology and industry. Difference between Archaebacteria and Eubacteria. Gram Positive and Gram Negative (Low G+C and High G+C)- General characteristics with suitable examples. Taxonomy, physiology and natural products of Actinobacteria. Cyanobacteria: Bioresource in agriculture & ecosystem.

SUGGESTED READINGS

1. Willey, J.M., Sherwood, L.M., and Woolverton, C.J. (2019). Prescott's Microbiology. 11th edition. McGraw Hill.
2. 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.
3. Benson's Microbiological Applications Laboratory Manual-Complete Version,2015, 13th Edition, McGraw Hill.
4. Kathleen Park Talaro and Barry Chess, 2018. Foundations in Microbiology: Basic Principles, 10th Edition, McGraw Hill
5. Joanne Willey and Kathleen Sandman and Christopher J. Woolverton and Linda Sherwood. 2019. Prescott's Principles of Microbiology. 2nd Edition. McGraw Hill
6. Pelczar, J.r M.J., Chan, ECS., and Krieg, N.R. (2004). Microbiology. 5th edition. Tata McGrawHill.
7. Tortora, G.J., Funke, B.R., and Case, C.L. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
8. Recent Advances in Microbiology 1st Edition *By Dana M. Santos* 2022. Apple Academic Press
9. Stanier, R.Y., Ingraham,J.L., Wheelis, M.L., and Painter, P.R. (2005). General Microbiology. 5thedition.McMillan.
10. Cappucino, J., and Sherman. N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson EducationLimited

    Srivastava, S., and Srivastava, P.S. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht

Semester – I

22MBU103 **BIOCHEMISTRY -I** **(4H-4C)**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To provide the knowledge on basics of biochemistry and its applications and to highlight the technical skill.
- 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 phospho glycerides
- To understand about storage and structural polysaccharides.

COURSEOUTCOME (CO'S)

Upon completion of this course students will be able to

1.Understand the structures of enzymes, proteins, carbohydrates and fats
2. Understand the functions of biomolecules
3. Analyze the process of metabolism
4. Understand of nucleic acids and their importance to combine and analyses information.
5. Structure and classification of enzymes, specificity of enzymes
6. Summarize the DNA & RNA structure and base pairing schemes

Unit I- Carbohydrates

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 and Haworth projections. Polysaccharides-storage and structural polysaccharides.

Unit II- Lipids

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

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

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

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

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, 4th edition. Published by Churchill Living

stone.
3. Tymoczko, J.L., Berg, J.M., and Stryer, L. (2012) Biochemistry: A short course, 2nd edition. W.H. Freeman.
4. Berg, J.M., Tymoczko, J.L., and Stryer, L. (2011) Biochemistry, W.H. Freeman and Company. Nelson, D.L and Cox, M.M. (2008) Lehninger Principles of Biochemistry, 5th edition. W.H. Freeman and Company.
5. Willey, M.J., Sherwood, L.M., & Woolverton, C. J. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill.

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.

Semester –I

22MBU111 **BASIC MICROBIOLOGY-PRACTICAL** **(3H –2C)**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

To develop skills related to

- Isolation and culture techniques of bacteria
- The external feature of bacteria by staining techniques and colony characteristics.
- Sterilization of heat sensitive materials
- Counting of microorganism in the environment
- Isolation of parasites from edible fruits.
- Biosafety measures.

COURSE OUTCOME (CO'S)

1. This practical paper will build the student to describe and distinguish the bacterial colonies.
2. They also will create knowledge on preparing permanent temporary mounts for fungi, protozoan's and algae.
3. Students will able to understand the parasites and its nature.
4. They can able to handle the pathogens safely.
5. Students able to describe the *Spirogyra, Chlamydomonas* and *Volvox*
6. Students able to handle the instruments in the microbiology laboratory

EXPERIMENTS

1. Microbiology Good Laboratory Practices and Good manufacture practices.
2. Biosafety and lab sterilization.
3. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, microscope, pH meter) used in the microbiology laboratory.
4. Preparation of culture media for bacterial cultivation.
5. Sterilization of heat sensitive material by membrane filtration and assessment for sterility
6. Perform Open plate technique and isolate the microbes present in environment.
7. Temporary mounts Lactophenol cotton blue mount – *Rhizopus, Penicillium, Aspergillus*.
8. Isolation of parasites from fruits and vegetables.
9. Study of *Spirogyra* and *Chlamydomonas, Volvox* using temporary mounts.
10. Study of the following protozoans using permanent mounts/photographs: *Amoeba, Entamoeba, Paramecium* and *Plasmodium.*

SUGGESTED READINGS

1. Tortora, G.J., Funke, B.R, and Case, C.L. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
2. Madigan, M.T., Martinko, J,M., Dunlap, P.V., and Clark,D.P. (2014). Brock Biology of Microorganisms. 14th edition. Pearson Internationaledition.
3. Cappucino, J., and Welsch CT. (2020). Microbiology: A Laboratory Manual. 12th edition. Pearson EducationLimited.

Wiley, J.M., Sherwood, L.M., and Woolverton, C.J. (2013) Prescott's Microbiology. 9th edition. McGraw

Hill International.

B.Sc. Microbiology **2022-2023**

Semester – I

22MBU112 **BACTERIOLOGY-PRACTICAL** **(4H – 2C)**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- 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 learn the method of measurement of bacteria

COURSE OUTCOME

After Completion of this course candidate can able to demonstrate:

1.Theory and practical skills in staining procedures
2.Various Culture media and their applications
3.Various microbial culture techniques to obtain isolation of pure cultures of bacteria
4.Bacterial endospore and capsule
5.Able to analyze the Bacterial size
6.Able explain the bacterial motility and flagella

EXPERIMENTS

1. Preparation of different media: synthetic media BG-11, Complex media - Nutrient agar, McConkey agar, EMB agar.
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. 11th edition.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, McGraw Hill.
5. Kathleen Park Talaro and Barry Chess, 2018. Foundations in Microbiology: Basic Principles, 10th Edition, McGraw Hill
6. Cappucino, J., and Sherman. N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited

Semester – I

22MBU113 **BIOCHEMISTRY-I PRACTICAL** **(3H –2C)**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVE

- 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

1. The practical knowledge and the skills associated about various techniques used in Biochemistry.
2. The skill in qualitative and quantity analysis of carbohydrates, protein and lipid
3. An understanding in protein secondary and tertiary structures
4. An insight in enzyme activity and its physical factors influence the activity
5. Knowledge on vitamin estimation
6. Cognitive skill and students able to solve the numerical problems

EXPERIMENTS

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/Quantitative tests for carbohydrates, reducing sugars, and non-reducing sugars.
5. Qualitative/Quantitative tests for lipids and proteins.
6. Study of protein secondary and tertiary structures with the help of models.
7. Study of enzyme kinetics–calculation of Vmax, Km, Kat values.
8. Study the effect of temperature, pH and heavy metals on enzyme activity.
9. Estimation of any four vitamins.

SUGGESTED READING

1. Campbell., M.K.(2012) Biochemistry,7th edition. Published by Cengage Learning.
2. Campbell, P.N., and Smith, A.D. (2011) Biochemistry Illustrated, 4th edition. Published by Churchill Livingstone.
3. Tymoczko, J.L., Berg, J.M., and Stryer, L. (2012) Biochemistry: A short course, 2nd edition.
4. Berg, J.M., Tymoczko, J.L. ,and Stryer, L.(2011) Biochemistry,W.H.Freeman and Company.
5. Nelson, D.L., and Cox, MM.. (2008) Lehninger Principles of Biochemistry,5th Edition. W.H.Freeman and Company.
6. Willey, M.J. Herwood, L.M. & Woolverton,C.J. (2013) Prescott ,Harley and Klein's Microbiology 9th Edition. McGrawHill
7. Voet,D,.and Voet,J.G. (2004) Biochemistry 3rd edition, John Wiley and Sons.
8. Donald voet, J.G. Voet, CW Pratt Fundamentals of Biochemistry, CBS Publishers.

பகுதி – I, தமிழ், தாள்-2

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

EndSemester Exam: 3 hrs

அலகு – I : தமிழ் இலக்கிய வரலாறு- II (7 மணிநேரம்)

தமிழ் இலக்கிய வரிசையில் திருமுறைகளும் நாலாயிரத் திவ்யப்பிரபந்தமும் - பன்னிரு திருமுறைகள் அறிமுகம் - திருமுறை ஆசிரியர்களின் இலக்கியப் பங்களிப்பு - திருமுறைகளில் பக்திநெறியும் சமுதாய நோக்கும் - சமயக்குரவரின் அருள்நெறி - பன்னிரு ஆழ்வார்கள் வரலாறு - ஆழ்வார்களின் இலக்கியப் பங்களிப்பு - திவ்யப் பிரபந்தத்தில் பக்திநெறியும் இலக்கிய நயமும் - தமிழில் சிற்றிலக்கியக் காலமும் கருத்தும் - தொண்ணூற்றாறு வகைச் சிற்றிலக்கிய வரிசை - தமிழ் மொழியின் நாவல், சிறுகதை - கட்டுரை – கவிதை - திறனாய்வு நூல்களின் தோற்றம் – வளர்ச்சி – உத்திகள் - நாட்டுப்புற இலக்கியங்கள் - கொங்குநாட்டார் வாய்மொழி வழக்காறுகள்.

அலகு – II : பக்தி இலக்கியமும் சிற்றிலக்கியமும்:

பக்தி இலக்கியம் (12 மணிநேரம்)

சைவ, வைணவ இலக்கியங்கள் - தோற்றம் , வளர்ச்சி, வரலாறு.

1. **சைவம் - (19 பாடல்கள்)** பெரியபுராணம் – இளையான்குடி மாறநாயனார் புராணம்.
2. **வைணவம் – ஆண்டாள் நாச்சியார் திருப்பாவை : (11 பாடல்கள்):** மார்கழித்திங்கள், வையத்து வாழ்வீர்காள், ஓங்கி உலகளந்த, ஆழி மழைக்கண்ணா, மாயனை மன்னுவட மதுரை, சிற்றம் சிறுகாலே, ஒருத்தி மகனாய், மாலே மணிவண்ணா, கூடாரை வெல்லும், கறவைகள் பின்சென்று, வங்கக்கடல் கடைந்த.

சிற்றிலக்கியம்

1. **முக்கூடற் பள்ளு** - 2 பாடல்கள் - சித்திரக் காலிவாலான் (நெல்வகைகள்)
   குற்றாலத் திரிகூட மால்வரை (மீன் வகைகள்)
2. **நந்தி கலம்பகம்** - 5 பாடல்கள் - என்னையே புகழ்ந்தேன், பதிதொறு புயல்பொழி,
   இந்தப்புவியில், அடிவிளக்கும் துகில், வானுறுமதியை
3. **மதுரைச் சொக்கநாதர் தமிழ்விடு தூது** – தமிழின் சிறப்பு
   பாடியருள பத்துப்பாட்டும் - விளம்பக்கேள்.
4. **தமிழலங்காரம்** – வண்ணச்சரபம் தண்டபாணி சுவாமிகள் - 10 பாடல்கள்

1. கடல் நீரில் கல் மிதக்கும், 2. வண்டமிழ் ஆற்றுதி, 3. கோளத்தை முட்டி

4. எக்காலம் என்று, 5. கடவூர் மயானத்தொர், 6. தேவாதி தேவன், 7. விண்மாரி,

8. தேவர் முனிவர், 9. அழுதேங்கி நஞ்சிட்ட, 10. அத்தனை பொத்து.

5. **அருள்தரும் பூங்கோதையன்னை பிள்ளைத்தமிழ் –** 1.காப்புப்பருவம் - கோத்தமிழ் குமரகுரு, 2. சப்பாணிப்பருவம் – பட்டிமுனி கோமுனி, 3. ஊசல்பருவம் – நாவரசர் நற்றமிழால்

அலகு – III: கவிதையும், சிறுகதையும் (14 மணிநேரம்)

அ). கவிதை இலக்கியம்

1. மகாகவி பாரதியார்	-	பகைவனுக்கு அருள்வாய்
2. புரட்சிக்கவிஞர் பாரதிதாசன்	-	இளையார்ஆத்திச்சூடி-அழுபவன்கோழை
3. கவிமணி தேசிக விநாயகம் பிள்ளை	-	கோயில் வழிபாடு
4. கவிக்கோ. அப்துல்ரகுமான்	-	பாருக்குள்ளே நல்ல நாடு
5. சிற்பி பாலசுப்பிரமணியன்	-	மலையாளக்காற்று
6. கவிஞர் சுகந்தி சுப்பிரமணியம்	-	புதையுண்ட வாழ்க்கை
7. கவிஞர் கரிகாலன்	-	விடுதலை
8. கவிஞர் அறிவுமதி	-	நட்புக்காலம்
9. கவிஞர் தாமரை	-	தொலைந்து போனேன்

ஆ). சிறுகதை இலக்கியம்

1. சாபவிமோசனம்	-	புதுமைப்பித்தன்
2. நகரம்	-	சுஜாதா
3. அந்நியர்கள்	-	ஆர். சூடாமணி
4. இந்நாட்டு மன்னர்	-	நாஞ்சில் நாடன்
5. வல்லூறுகள்	-	அம்பை

அலகு – IV : உரைநடை இலக்கியம் (8 மணிநேரம்)

1. ஆளுமைத்திறன் அறிவோம் – தன்னம்பிக்கை மாத இதழ்
2. திருக்குறளும் சமுதாயவியலும் – முனைவர் புரிசை நடராசன்
3. உயர்தனிச் செம்மாழி – முனைவர் இரா. குணசீலன்
4. நொய்யல் – முனைவர் ப.தமிழரசி
5. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் – தமிழ் நாடு அரசு தொல்லியல் துறையின் அறிக்கையிலிருந்து தொகுக்கப்பட்டது.

அலகு- V : அடிப்படை இலக்கணமும் பயன்பாட்டுத் தமிழும் – II (7மணிநேரம்)

அ). இலக்கணப் பயிற்சி : அணி இலக்கணம்

உவமையணி - பிறிது மொழிதல் அணி - சிலேடை அணி - தீவக அணி - ஏகதேச உருவக அணி – வேற்றுமையணி - பின்வருநிலையணி விளக்கங்கள்.

ஆ). துறை சார் கலைச்சொல் பயன்பாட்டாக்கம்

இ). படைப்பிலக்கியப் பயிற்சிகள்

மரபுக்கவிதை, புதுக்கவிதை, சிறுகதை, கட்டுரை படைப்பாக்க உத்திகள் – பயிற்சிகள் - நேர்காணல் வினா நிரல் தயாரித்தல் நுட்பங்கள்

ஈ). மொழிபெயர்ப்புப் பயிற்சிகள்

தமிழ் - ஆங்கில மொழிபெயர்ப்புப் பயிற்சிகள் - 2.

ஆங்கிலம் - தமிழ் மொழிபெயர்ப்புப் பயிற்சிகள் - 2.

உ). கட்டுரையை ஒருபக்க அளவில் பத்திகளாகச் சுருக்கி எழுதுதல்

தமிழ் இலக்கிய வரிசையில் திருமுறைகளும் நாலாயிரத் திவ்யப்பிரபந்தமும் - பன்னிரு திருமுறைகள் அறிமுகம் - திருமுறை ஆசிரியர்களின் இலக்கியப் பங்களிப்பு - திருமுறைகளில் பக்திநெறியும் சமுதாய நோக்கும் - சமயக்குரவரின் அருள்நெறி - பன்னிரு ஆழ்வார்கள் வரலாறு - ஆழ்வார்களின் இலக்கியப் பங்களிப்பு - திவ்யப் பிரபந்தத்தில் பக்திநெறியும் இலக்கிய நயமும் - தமிழ் மொழியின் கவிதை, சிறுகதை, உரைநடை இலக்கியங்களின் தோற்றம் – வளர்ச்சி – வரலாறு - நாட்டுப்புற இலக்கியங்கள் **என்ற தலைப்பிலான கட்டுரையில் ஏதேனும் ஒன்றை ஒருபக்க அளவில் சுருக்கி எழுதுதல்.**

- **வினாத்தாளில் இதற்கென தனியே கட்டுரை வழங்கப்பெற வேண்டிய தேவை இல்லை.**
- குறிப்பிட்ட தலைப்பிலான கட்டுரையினைச் சுருக்கி எழுதுக என்று மட்டும் வினா அமையவேண்டும்.
- விடையானது, தலைப்பு (Title), பத்திக்காக வரிசைப்படுத்தப்பட்ட குறிப்புகள் (Hints), பத்தியின் திருத்தா படி (Rough Draft), பத்தியின் திருத்திய படி (Fair Draft) என்ற வகையில் அமைய வேண்டும்.

பாட நூல்: கற்பகச்சோலை – தமிழ் ஏடு.

கற்பகம் உயர்கல்விக்கழகத் தமிழ்த்துறை வெளியீடு.

B.Sc.Microbiology **2022-2023**

22ENU201 **ENGLISH-II** **Semester – II**

(4H – 4C)

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

End Semester Exam: 3 Hours

Course Objective:

- To refresh the grammar knowledge of the students to improvise their language.
- To make the students to speak and write error free English.
- To make the students understand different kinds of communication.
- To develop knowledge on the business environment 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 Outcome:

- Strengthen the foundation of the language to elevate the command of standard grammar.
- Inculcate the proper communication strategy.
- Formulate and communicate persuasive arguments for specific business outcome.
- Apply fundamentals of language for reading, writing and effective communication.
- Standardize and demonstrate understanding of LSRW skills.
- Introduce literature to enhance the moral and aesthetic values.

UNIT –I

Listening **:** Goals of listening
Speaking **:** Developing speaking skills
Reading **:** Reading strategies
Writing **:** Importance of professional writing-Developing a story with pictures
Grammar **:** Voice
Literature **:** Refuge Mother and Child by Chinua Achebe

UNIT –II

Listening **:** Dictation
Speaking **:** Public speaking and secrets of good delivery
Reading **:** Reading Passages-Reading Comprehension-Vocabulary skills
Writing : Essay writing
Grammar **:** Subject, verb, agreement
Literature **:** Prose: Diamond of Creativity by A.P.J. Abdul Kalam

UNIT –III

Listening **:** Electronic recordings and listening
Speaking **:** Oral presentation
Reading : Note Making- Fluency in reading
Writing **:** Layout of Business Letters-Letter writing
Grammar **:** Degrees of comparison
Literature **:** River by A.K. Ramanujan

UNIT –IV

Listening **:** Listening to instructions and announcements
Speaking **:** Video conferencing
Reading **:** Silent reading and methods of reading
Writing **:** Basic content writing
Grammar **:** Phrases and clauses
Literature **:** Two Gentlemen of Verona by A.J. Cronin

UNIT –V

Listening **;** Testing listening
Speaking **:** Dialogues
Reading **:** Developing reading activities
Writing **:** Writing agendas, memos and minutes
Grammar **:** Direct and indirect speech
Literature **:** Banquet Speech by Nadine Gordimer (Noble Prize Acceptance Speech)

Books for References

Oxford Handbook of Writing: St. Martins Handbook of Writing 2013 CU Press
Sound Business, Julian Treasure 2012OUP
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.

(5H – 5C)

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

End Semester Exam: 3 Hours

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

COURSEOUTCOMES

1. A candidate can able to understand the metabolic pathways of carbohydrates, proteins, Lipids and Nucleic acid that improve their skills.
2. This course will provide clear understanding about the Biological oxidation.
3. Students able to categorize the biochemical compounds
4. Students able to demonstrate the carbohydrate, protein and nucleic acid
5. Students able to comment on metabolism of carbohydrate, protein and lipid.
6. Students will analyze structural functional relationships of genes and proteins from bacteria to eukaryotes.

Unit I- Introduction to metabolism

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.

Unit II- Carbohydrate metabolism

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

Unit III- Lipid metabolism

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

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

Unit V- Nucleic acid metabolism and Biological oxidation

Biosynthesis and degradation of purine and pyrimidine nucleotides. Integrated Carbohydrate, Protein and lipid metabolism.

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 edition, Prentice Hall International. Inc.
4. Principles of Biochemistry, Geoffrey L. Zubay, 3rd edition William W. Parson, Dennis E. Vance, W.C. Brown Publishers, 1995.
5. Principles of Biochemistry, David L. Nelson, Michael M.Cox, Lehninger, 4th edition, W.H. Freeman and company.
6. Biochemistry, LubertStryer, 4th edition, W.H. Freeman & Co, 1995.
   Fundamentals of Biochemistry (1999) by Donald Voet, Judith G.Voet and Charlotte W Pratt, John Wiley & Sons, NY.

Semester – II

22MBU202 MICROBIAL PHYSIOLOGY AND METABOLISM (6H –6C)

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

End Semester Exam: 3 Hours

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

1. The students will be able to understand and predict the various metabolic reactions in microbial cell.
2. This will make them predict the intermediate products which can be employed in industrial production processes.
3. Students will understand the microbial growth, nutrition and environmental factors
4. Students will be able to assess the prokaryotes by observing the biochemical reaction
5. This course will support them to interpret the fermentation using microbes
6. Able to summarize the nutrients uptake system in the prokaryotes

Unit I- Microbial nutrition

Microbial nutrition– Nutritional groups of microorganisms, Nutrient requirements: Macro and micronutrients with their physiological features. 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

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

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

Nitrogen Fixation – Nitrogen fixers, Physiology of nitrogen cycle and mechanism of nitrogen fixation. 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

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. 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, McGraw Hill.
5. Kathleen Park Talaro and Barry Chess, 2018. Foundations in Microbiology: Basic Principles, 10th Edition, McGraw Hill
6. Moat, A.G., and Foster, J.W. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.
Reddy, S.R., and Reddy, M. (2007). Microbial Physiology. Scientific Publishers India

B.Sc.Microbiology **BIOCHEMISTRY– II PRACTICAL** **2022-2023**

22**MBU**21**1** **Semester – II**

(4H – 2C)

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

End Semester Exam: 3 Hours

COURSE OBJECTIVE

- To familiarize the students with the some basic analytical techniques in Biochemistry that improve their skills associated 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

1. Students will get practical knowledge about various techniques used in Biochemistry.
2. Students will evaluate the protein and cholesterol
3. Able to purify the compounds using chromatography
4. Students able to separate the amino acid and sugar using thin layer chromatography
5. Able to discuss about biochemical compound and its estimation using standard method
6. Students able to separate the plant pigments

EXPERIMENTS

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's method
6. Estimation of Cholesterol by Zak's method
7. Estimation of Phosphorus by Fiske Subbarow method
8. Determination of effect of pH, temperature and substrate concentration of salivary amylase
9. Demonstration of HPLC

SUGGESTED READING

1. Biochemical Methods 1992, by S. Sadasivam and A. Manickam, Second Edition, New Age International Publishers, New Delhi
2. Laboratory Manual in Biochemistry, 1981. J. Jayaraman, New Age International publishers, New Delhi

Semester – II

22MBU212 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 Hours

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

Upon successful completion of this practical course

1. The students will be able to analyze the bacterial growth and growth condition
2. Able to identify the various factors for optimal growth of *E.coli.*
3. Understand the basic microbial structure and functions of various physiological groups of prokaryotes.
4. Able to utilize the various Culture media in the proper physical condition for fermentation
5. Able to explain the microbial metabolism – Autotroph and heterotroph modes of nutrition
6. Students able to understand the physical and chemical growth requirements of bacteria and thermal death time of bacteria.

EXPERIMENTS

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 salt on growth of *E.coli*
7. Biochemical Characterization:
    a. Indole Test
    b. Methyl Red Test
    c. Voges Proskauer Test
    d. Citrate Utilization Test
    e. Triple Sugar Iron Test
    f. Nitrate reduction Test
    g. Urease production Test
    h. Catalase Test

i. Oxidase Test
j. Carbohydrate fermentation Test

8. Demonstration of alcoholic fermentation
9. Demonstration of the thermal death time and decimal reduction time of *E.coli.*

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., McGraw Hill.
4. Benson's Microbiological Applications Laboratory Manual-Complete Version,2015, 13th Edition, McGraw Hill.
5. Reddy, S.R., and Reddy, S.M. (2007). Microbial Physiology. Scientific Publishers India

Semester – II

22AEC201 **ENVIRONMENTAL STUDIES** **(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 create the 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 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.
- To create awareness among the students to know about various renewable and nonrenewable resources of the region, enables environmentally literate citizens (by knowing the environmental acts, rights, rules, legislation, etc.)
- To make appropriate judgments and decisions for the protection and skills associated with improvement of the earth.

COURSE OUTCOMES

1. Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
2. Master core concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
3. Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
4. Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.
5. Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
6. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
7. 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.

Unit I – INTRODUCTION - ENVIRONMENTAL STUDIES & ECOSYSTEMS

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

Unit II - NATURAL RESOURCES - RENEWABLE AND NON-RENEWABLE RESOURCES

Natural resources - Renewable and Non – Renewable resources. Land resources and land use change, Land degradation, soil erosion and desertification. Forest resources -Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water resources- Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water. Use of alternate energy sources, growing energy needs, case studies. Role of an individual in conservation of natural

resources. Equitable use of resources for sustainable lifestyles. Human population and growth- Impacts on environment human health and welfares- Women and Child welfare.

Unit III - BIODIVERSITY AND ITS CONSERVATION

Levels of biological diversity - genetic, species and ecosystem diversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value. Bio-geographical classification of India. Biodiversity patterns (global, National and local levels). Hot-spots of biodiversity. India as a mega-diversity nation. Endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Conservation of biodiversity: *In-situ* and *Ex-situ* conservation of biodiversity.

Unit IV - ENVIRONMENTAL POLLUTION

Definition, causes, effects and control measures of Air pollution – Carbon Foot print. Water pollution, Soil pollution, Noise pollution. Nuclear hazards and human health risks. Solid waste management and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Case studies.

Unit V - SOCIAL ISSUES AND THE ENVIRONMENT

Concept of sustainability and sustainable development. Water conservation -Rain water harvesting, watershed management. 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). International agreements (Montreal and Kyoto protocols). Resettlement and rehabilitation of project affected persons. Wasteland reclamation, consumerism & waste product management. Disaster management (floods, earthquake, cyclones and landslides). Environmental Movements (Chipko, Silent valley, Bishnois of Rajasthan). Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). Role of information technology in environment and human health.

Suggested Readings

1. Anonymous. 2004. A textbook for Environmental Studies, University Grants Commission and Bharat Vidypeeth Institute of Environmental Education Research, New Delhi.
2. Anubha Kaushik., and Kaushik, C.P. 2004. Perspectives in Environmental Studies. New Age International Pvt. Ltd. Publications, New Delhi.
3. Arvind Kumar. 2004. A Textbook of Environmental Science. APH Publishing Corporation, New Delhi.
4. Daniel, B. Botkin., and Edward, A. Keller. 1995. Environmental Science John Wiley and Sons, Inc., New York.
5. Mishra, D.D. 2010. Fundamental Concepts in Environmental Studies. S.Chand & CompanyPvt. Ltd., New Delhi.
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. (2004). Fundamentals of Environmental Studies (2nded.). Vrianda Publications Private Ltd, New Delhi.
11. Verma, P.S., and Agarwal V.K. 2001. Environmental Biology (Principles of Ecology).S.Chand and Company Ltd, New Delhi.
12. Uberoi, N.K. 2005. Environmental Studies. Excel Books Publications, New Delhi.
13. Wagner K.D., 1998. Environmental management. W.B.Saunders Co, Philadelphia, USA.

Semester – III

22MBU301 **VIROLOGY** **(4H –4C)**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To study general aspects of viral morphology and classification, replication, interactions and immunity to viruses
- To discuss the application of various immunological and molecular diagnostic tools.
- To explain the students about the virus classification
- To distinguish the architecture of viruses and their features
- To Know the methods used in studying viruses
- Discern the replication strategies of representative viruses from the seven Baltimore classes

COURSE OUTCOMES

1. This paper will have clear understanding the role of various in plant, animal and human disease
2. Candidate able to understand their skill based various mechanisms to enter and escape from host.
3. Comprehend the intricate interaction between viruses and host cells
4. Understand the interactions between viruses and the host immune system
5. It will explain the terms Oncogenes and tumor suppressor genes, and how tumor viruses interact with these products and their intersecting pathways and cause oncogenesis.
6. Explain vaccine strategies and mechanisms of antiviral drugs and interferons

Unit I- History of viruses

History of viruses. Structure, Classification, nomenclature of viruses. Isolation, purification and cultivation of viruses.Viral assay. Concept of viroids, virusoids, satellite viruses, Virophage and Prions.

Unit II- Bacteriophages

Diversity, classification, one step multiplication curve, lytic and lysogenic phages (lambda phage) concept of early and late proteins, regulation of transcription in lambda phage

Unit III- Transmission of virus

Modes of viral transmission, Salient features of viral Nucleic acid-unusual bases, overlapping genes, splicing genes, terminal redundancy, cohesive ends, capping and tailing. Viral genome organization.

Unit IV- Viral multiplication and replication

Viral multiplication and replication-Interaction, and entry, assembly, maturation and release of virions. Oncogenic viruses and its types, mechanism. Viral replication strategies as per Baltimore classification. Prevention and control of viral diseases. Laboratory diagnosis of emerging respiratory virus.

Unit V- Antiviral compounds

Plant virus – TMV and CMV, Animal Virus-Adeno virus and Papova virus, Antiviral compounds and their mode of action. Interferon and their mode of action. General principles of viral vaccination. Immunization schedule. Use of viral vectors in viral Vaccines, cloning and expression, gene therapy and phage display.

SUGGESTED READINGS

1. Dimmock, N.J., Easton., A.L., Leppard, K.N. (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.
2. Carter J., and Saunders, V. (2007). Virology: Principles and Applications. John Wiley and Sons.
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. 2nd edition. ASM press Washington DC.
4. Levy, J.A., Conrat, H.F., Owens, R.A. (2000). Virology. 3rd edition. Prentice Hall publication, NewJersey.
5. Wagner, E.K., Hewlett, M.J. (2004). Basic Virology. 2nd edition. Blackwell Publishing.
6. Mathews. (2004). Plant Virology. Hull R. Academic Press, New York.
7. Nayud, M.V. (2008). Plant Viruses. Tata McGraw Hill, India.

Semester – III

22MBU302 **MICROBIAL GENETICS** **(4H –4C)**

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

End Semester Exam: 3 Hours

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:

1.This course will provide candidates with basic awareness and outline of Molecular Biology with unique reference to microbial genome.
2.Students will be able to describe the nature of molecular world and its application in modern Microbiological sectors.
3.Students will be able to understand the process of Mutation and mutagenesis.
4.This paper provided the knowledge about the central dogma of biology.
5. This course provided the concepts of genetic recombination techniques.
6.Students will gain the awareness about the transposons and it applications.

Unit I- History of genetics

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

Unit II- Plasmids

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

Unit III- Genetic code

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

Unit IV- Mutations

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

Unit V- Transposons

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, 3rd edition, Jones and Bartlett Learning.
3. Pierce, B.A. (2011) Genetics: A Conceptual Approach, 4th edition, Macmillan Higher Education Learning.
4. Watson, J,D., Baker, T.A., Bell, S.P., et al. (2008) Molecular Biology of the Gene, 6thedition, BenjaminCummings.
5. Gardner, E.J., Simmons, M.J., Snustad, D,P. (2008). Principles of Genetics. 8th edition, Wiley-India.
6. Molecular genetics 3RD edition by David P.Clark, Michelle R. McGehee, and Nanette J. Pazdernik. 2018.
7. Molecular CELL BIOLOGY AND EVOLUTIONAND EVOLUTIONAND EVOLUTIONsixth edition 2016 by Lodish, Berk, Kaiser, Krieger, Scott, Bretscher, Ploegh, Matsudaira

Semester – III

22MBU303 INDUSTRIAL MICROBIOLOGY (4H – 4C)

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To encompasses the employability use of microorganisms in the manufacture 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 activities.
- It will deliver the large scale production of microbial products techniques in advanced level.

COURSE OUTCOME

1. Provides knowledge in the large scale production of industrial product, providing the trends to cater the needs of industry.
2. This will help the students to enhance their employment knowledge on microbiology based commercial products.
3. The aim of the course is to give the students broad theoretical and practical skills in industrial microbiology.
4. This course covers the principles of various processes associated with the production
5. Students are able recover the different bio-products from microorganisms.
6. The students will be able to discuss the role of microorganisms in industry, as well as to carry out experiments to produce microbial metabolites.

Unit I

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).

Unit II

Preservation and maintenance of industrial strains. Cell growth kinetics- Kinetics of Substrate utilization, Buffers. Media formulation (molasses, corn- steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates). Characteristics and treatments of waste of sugar industry and dairy industry.

Unit III

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 IV

Downstream 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 V

Microbial production of industrial products-Citric acid, Ethanol, Penicillin, Bacitracin, Chlorempenicol, monoclonal antibodies, Glutamic acid, Vitamin B_{12}, Enzymes (DHA, amylase, protease, lipase, chitinase) Wine, Beer, probiotics (*Lactobacillus, Bacillus* and yeast) Development of designer microbes for food, energy and health care products.

SUGGESTED READINGS

1. Nduka Okafor, Benedict C. Okeke (2017) Modern Industrial Microbiology and Biotechnology, 2nd Edition, CRC Press.
2. Stanbury PF, Whitaker A and Hall SJ. (2016). Principles of Fermentation Technology. 3nd edition, Elsevier Science Ltd.
3. Crueger W and Crueger A. (2017). Biotechnology: A textbook of Industrial Microbiology. 3rd edition. Panima Publishing Co. New Delhi.
4. Geoffrey M Gadd, Sima Sariaslani (2015) Advances in Applied Microbiology, CRC Press.
5. Mansi El-Mansi (2012) Fermentation Microbiology and Biotechnology, CRC Press.
6. E M T El-Mansi, Jens Nielsen, David Mousdale (2009) Fermentation Microbiology and Biotechnology, Fourth Edition, CRC Press
7. Nduka Okafor, Benedict C. Okeke (2022). Modern Industrial Microbiology and Biotechnology 2nd Edition. CRC Press.
8. David B. Wilson, Hermann Sahm, Klaus-Peter Stahmann, Mattheos Koffas (2019). Industrial Microbiology 1st Edition. Wiley-VCH.

22MBU304A INSTRUMENTATION AND BIOTECHNIQUES (3H-2C)

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- Understand the principles of various instruments used in the life sciences
- Ability to operate the instruments
- Data analysis and interpretations
- Introduce the basic concept of qualitative and quantitative analysis of a given sample
- Study various spectroscopic techniques and its instrumentation.
- Study the concept of separation science and its applications.
- To learn the fundamentals of research methodology, working principles and applications of instruments used in biology

COURSE OUTCOME

1. The students with an opportunity to develop skill on the bioinstrumentation and concepts of principles and applications.
2. Define and explain various fundamentals of spectroscopy, qualitative and quantitative analysis and characterize functionalities of biomolecules by using spectroscopic techniques.
3. Explain the various separation techniques and its instrumentation.
4. Describe the principle and working of various radiation detectors.
5. Evaluate the various types & applications of chromatography and electrophoresis.
6. Appreciate the working principles and applications of Microscopy

Unit I

Brightfield and darkfield microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Confocal Microscopy, Electron Microscopy (Scanning and Transmission Electron Microscopy) Micrometry.

Unit II

Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column Chromatography - packing types (IEC, AC, SEC), fraction collection. GLC, LCMS, HPLC and Gel filtration chromatography.

Unit III

Principle and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gel electrophoresis (SDS-PAGE), 2D gel electrophoresis, Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis.

Unit IV

Principle, Instrumentation and application of spectrophotometer, colorimeter and turdibometer. MALDI-TOF, FTIR, MS, Nuclear Magnetic Resonance, ESR.

Unit V

Filtration types-Micro and Ultra filtration, Preparative and analytical centrifugation, Principles of centrifugations – RCF and sedimentation coefficient. Types of centrifuges – rotors - fixed angle and swinging bucket rotors. Types of Centrifugation – differential, density gradient and ultracentrifugation.

SUGGESTED READINGS

1. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press.
2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.
3. Willey MJ, Sherwood LM & Woolverton CJ. (2013). Prescott, Harley and Klein's Microbiology. 9th Ed., McGraw Hill.
4. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
5. De Robertis EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
6. Cooper G.M. and Hausman R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington D.C., Sinauer Associates, MA.
7. Nigam A and Ayyagari A. 2007. Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw Hill.

Semester – III

22MBU304B AQUATIC MICROBIOLOGY AND ALGAL TECHNOLOGY (3H-2C)

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To enhance the students' knowledge on the algal culture aspects
- To make them clear about microalgae culture technology and their application
- To acquire an overall knowledge on the morphology, functions and biological applications
- To know about the growth pattern of the algae
- To develop the commercially important products
- To understand the algal nutrition

COURSE OUTCOME

- Students understand the importance of microalgae
- Students know the characteristics of microalgae
- They will identify the type of algae
- Acquire knowledge on microalgae culture production technologies
- Students know the applications of microalgae biotechnology
- Students know the cultivation methods of different microalgae culture technology

UNIT I

Sources of Microbial contamination of water. Factors influencing microbial Contamination of water. Sampling of water for microbiological analyses. Types of water samples. Collection, transport and processing of samples. Detection of microbial populations in water – Phenotypic detection. Determination of microbial members: Direct count and viable count procedures

UNIT II

Detection methods for water-borne pathogens-multiple tube fermentation method, membrane filter method, P-A technique, rapid detection of coliforms. Detection of indicators of pathogenic bacteria-enterococci, bacteriophages. Water disinfection methods. Safe limits for drinking water. Water Quality standards.

UNIT III Phytoplankton and Microalgae

Phytoplankton- Classification and their importance-primary production. Phytoplankton-collection, identification, isolation, stages of phytoplankton culture and development of pure culture techniques. Culture maintenance – Mass culture production of phytoplankton-culture media and preparation methods. Biochemical composition of micro algae- Microalgae growth promoting factors.

UNIT IV Agricultural and Pharmaceutical Applications

Pharmaceutical applications of Marine Microalgae-Biotic analysis of Microalgae-Algal compounds uses of pharmaceuticals- Antitumor activity of Microalgae-Medicinal uses of microalgae. Algae fertilizer preparation techniques- Types of algae fertilizer- Effect of growth and yield of Agricultural crops- Biological Application of active metabolite from microalgae against pesticide- Economical importance of algae biofertilizer to agriculture people.

UNIT V Industrial Applications

Industrial Application of Microalgae- Green food culture preparation and applications- processing of algae food- cosmetic- animal feed- bioremediation- Microalgae energy production- Biodiesel and Biogas.

SUGGESTED READING

1. Amos Richmond and Qiang Hu. 2013. Handbook of Microalgal Culture: Applied Phycology and Biotechnology, 2nd Edition John Wiley & Sons, Ltd Publication.
2. Gokare A. Ravishankar, Ranga Rao Ambati. 2020. Handbook of Algal Technologies and Phytochemicals. CRC press,Taylor & Francis Group.
3. Faizal Bux, Yusuf Chisti, Algae Biotechnology: Products and Processes (Green Energy and Technology) 2016. Springer Publication.
4. Alcamo, I.E. 1997. Fundamentals of Microbiology, 5th edition, An imprint of Addison Wesley Longman, New York.
5. Batzing, B.L. 2002. Microbiology (An Introduction), Brooks/Cole Thamson Learining, Canada.
6. Bauman, R. 2007. Microbiology (With diseases by Taxonomy), 2nd edition, Pearson Benjamin Cummings Publishers, San francisco.
7. Cappucino, J.G. and Sherman, N. 2005. Microbiology, A Laboratory Manual, 7th edition, Pearson Education INC. Delhi, India
8. Patnail, P. 1997. Hand Book of Environmental Analysis. CRC Press, Inc., USA. 6. Willey, J.M., Sherwood, L.M and Woolverton, C.J.2008. Prescott, Harley, and Klein's Microbiology, McGraw-Hill, New York.

Semester – III

22MBU311 **VIROLOGY–PRACTICAL** **(3H –2C)**

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

End Semester Exam: 6 Hours

COURSE OBJECTIVES

- Describe the structure and replication strategies of the individual viruses discussed, including the processes of entry into cells, control of gene transcription.
- Define the process of virus latency and describe in molecular terms control of the process and activation of viral genomes during reactivation.
- Describe the growth behavior differences between normal cells and cells transformed by oncogenic DNA and RNA viruses.
- To study general aspects of viral morphology and classification.
- Cultivation of viruses and various methods of propagation.
- To discuss the application of various immunological and molecular diagnostic tools.

COURSE OUTCOME (CO'S)

1. Upon paper completion, students will have skill-based knowledge on structure of plants, animal, bacteria and viruses.
2. This paper also enables the student on isolation, propagation of various viruses.
3. It will help the students to understand the plant and animal viruses.
4. Students can distinguish the viruses According to their characteristic features.
5. It will explain the research activities involved in virology studies.
6. Skill based viral analysis can be performed in medical research.

EXPERIMENTS2

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. Studying isolation and propagation of animal viruses by chick embryo technique
6. Study of cytopathic effects of viruses using photographs
7. Perform local lesion technique for assaying plant viruses.
8. Viral transport media preparation.
9. Stability of viral compounds.

SUGGESTED READING

1. Dimmock, N.J., Easton, A.L., Leppard, K.N. (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.
2. Carter, J., and Saunders, V. (2007). Virology: Principles and Applications. John Wiley and Sons.
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. 2nd edition. ASM press Washington

DC.
4. Levy, J.A., Conrat, H.F., Owens, R.A. (2000). Virology. 3rd edition. Prentice Hall publication, New Jersey.
5. Wagner, E.K., Hewlett, M.J. (2004). Basic Virology. 2nd edition. Blackwell Publishing.
6. Mathews. (2004). Plant Virology. Hull R. Academic Press, New York.
7. Nayudu, M.V. (2008). Plant Viruses. Tata McGraw Hill, India.
8. Bos, L. (1999) Plant viruses-A text book of plant virology by Backhuys Publishers.
9. Versteeg, J. (1985). A Color Atlas of Virology. Wolfe Medical Publication.

Semester – III

22MBU312 **MICROBIAL GENETICS- PRACTICAL** **(3H –2C)**

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

End Semester Exam: 6 Hours

COURSE OBJECTIVES:

- To focus on the basic principles of genetics incorporating the concepts of classical, molecular and population genetics.
- Compilation is required for recent advances in genetic principles for strong foundation in Biotechnology that improve their chances of employability in biotechnological industries
- To study the effect of chemical and physical mutagens on prokaryotic cell
- To isolate the extra chromosomal DNA from bacteria
- To Interpret the DNA quality and quantity
- To identify the mutant strains using appropriate techniques

COURSE OUTCOME (CO'S)

1. Students undertaking this practical shall be able to describe the key concept in the basic Microbial Genetics
2. Effectively understand the implication of mutation and its characteristics.
3. Further, the experiments would allow students to recall and relate the information gained from Microbial Genetics theory paper and skills associated with it
4. Students able to demonstrate the gene transfer techniques
5. Students can estimate the genetic materials
6. Students can able to distinguish the plasmid and Genomic DNA

EXPERIMENTS

1. Preparation of Master and Replica Plates.
2. Study the effect of chemical (HNO_2) and physical (UV) mutagens on bacterial cells.
3. Study survival curve of bacteria after exposure to ultraviolet (UV) light.
4. Isolation of Plasmid DNA from *E.coli.*
5. Estimation of DNA
6. Perform AMES test.
7. Study different conformations of plasmid DNA through Agarose gel electrophoresis.
8. Perform quantitative PCR for bacterial DNA sample.
9. Perform Bacterial Conjugation.
10. Perform bacterial transformation.
11. Perform transduction with bacteriophage.

SUGGESTED READINGS

1. Klug, W.S., Cummings, M.R., Spencer, C., Palladino, M. (2011). Concepts of Genetics, 10th edition, Benjamin Cummings
2. Krebs, J., Goldstein, E., Kilpatrick, S. (2013). Lewin's Essential Genes, 3rd edition, Jones and Bartlett Learning.
3. Pierce, B.A. (2011) Genetics: A Conceptual Approach, 4th edition, Macmillan Higher

Education Learning.
4. Watson, J.D., Baker, T.A., Bell, S.P., et al. (2008) Molecular Biology of the Gene, 6th edition, Benjamin Cummings.
5. Gardner, E.J., Simmons, M.J., Snus tad, D.P. (2008). Principles of Genetics. 8th edition, Wiley-India.
6. Sambrook, J., and Russell, D.W. (2001). Molecular Cloning: A Laboratory Manual. 4thedition, Cold Spring Harbour Laboratorypress.
7. Maloy, S.R., Cronan, J.E., and Friefelder, D. (2004) Microbial Genetics 2nd edition, Jones and Barlett Publishers.
8. Peter J. Russell, i Genetics – A molecular approach, 7th edition, 2010. Pearson Benjamin Cummings Publishers, Boston,USA.
9. David Freifelder, Microbial Genetics. Narosa Publishing House, 10th edition, 2004. New Delhi, India.

Semester – III

22MBU313 INDUSTRIAL 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 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
- Understand the rationale in medium formulation & design for microbial fermentation, sterilization of medium and air.

COURSE OUTCOME

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

EXPERIMENTS

1. Study of different parts of fermenter
2. Microbial fermentation – Production and estimation (qualitative and quantitative) of
    a) Enzymes : Amylase, Protease, lipase and DHA
    b) Amino acid : Glutamic acid
    c) Organic acid : Citric acid
    d) Alcohol : Ethanol
    e) Antibiotics : Penicillin
3. Assess quality of probiotics in tablets and nutritional supplements; stability of vials at different time
4. A visit to any educational institute/industry to see an industrial fermenter, and other downstream processing operations.
5. Purification of organic acids.
6. Purification of Enzymes.
7. To perform Growth Kinetics

SUGGESTED READINGS

1. Nduka Okafor, Benedict C. Okeke (2017) Modern Industrial Microbiology and Biotechnology, 2nd Edition, CRC Press.

2. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
3. Crueger W and Crueger A. (2017). Biotechnology: A textbook of Industrial Microbiology. 3rd edition. Panima Publishing Co. New Delhi.
4. Geoffrey M Gadd, Sima Sariaslani (2015) Advances in Applied Microbiology, CRC Press.
5. Mansi El-Mansi (2012) Fermentation Microbiology and Biotechnology, CRC Press.
6. E.M T El-Mansi, Jens Nielsen, David Mousdale (2009) Fermentation Microbiology and Biotechnology, Fourth Edition, CRC Press

Semester-III

22MBU314A INSTRUMENTATION AND BIOTECHNIQUES - 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

- Understand the principles of various instruments used in the life sciences.
- Ability to operate the instruments.
- Data analysis and interpretations.
- Appreciate the working principles and applications of Microscopy.
- Understand the mechanics of thesis writing
- To understand working of different laboratory equipment used in microbiological laboratories

COURSE OUTCOME

1. Offers the students with an opportunity to gain practical skills on the bioinstrumentation and concepts of principles and applications.
2. Evaluate the various types & applications of chromatography and electrophoresis.
3. Evaluate the various types & phase contrast microscopy and Electron microscopy
4. Explain the various separation techniques and its instrumentation.
5. Hand on training of the general equipment used in microbiology laboratory
6. Comprehend the major spectrophotometric and titrimetric approaches of quantification in biological and environmental samples

EXPERIMENTS

1. Study of fluorescent micrographs to visualize bacterial cells – Demonstration
2. Ray diagrams of phase contrast microscopy and Electron microscopy – Demonstration
3. Separation of mixtures by paper / thin layer chromatography.
4. Demonstration of column packing in any form of column chromatography.
5. Separation of protein mixtures by any form of chromatography.
6. Separation of protein mixtures by Polyacrylamide Gel Electrophoresis (PAGE).
7. Determination of λmax for an unknown sample and calculation of extinction coefficient.
8. Separation of components of a given mixture using a laboratory scale centrifuge.
9. Understanding density gradient centrifugation with the help of pictures.

SUGGESTED READINGS

1. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th edition, Cambridge University Press.
2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5th edition, W.H. Freeman and Company.
3. Willey MJ, Sherwood LM & Woolverton CJ. (2013). Prescott, Harley and Klein's Microbiology. 9th edition, McGraw Hill.
4. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
5. De Robertis EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
6. Cooper G.M. and Hausman R.E. (2009). The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington D.C., Sinauer Associates, MA.
7. Nigam A and Ayyagari A. (2007). Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw Hill

Semester – III

22MBU314B AQUATIC MICROBIOLOGY AND ALGAL TECHNOLOGY- 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 enhance the students' knowledge on the algal culture aspects
- To make them clear about microalgae culture technology and their application
- To acquire an overall knowledge on the morphology, functions and biological applications
- To know about the growth pattern of the algae
- To develop the commercially important products
- To understand the algal nutrition

COURSE OUTCOME

1. Students understand the importance of microalgae
2. Students know the characteristics of microalgae
3. They will identify the type of algae
4. Students know the applications of microalgae biotechnology
5. Students know the cultivation methods of different microalgae culture technology
6. Students know the cultivation methods of different microalgae culture technology

EXPERIMENTS

1. Isolation of microalgae from soil sample
2. Isolation of microalgae from water sample
3. Different algal medium media preparation
4. Mass cultivation of Spirulina
5. Algal biomass and harvesting techniques
6. Preparation of single cell protein
7. Preparation of algal liquid biofertilizer
8. Lipid production of algal dry biomass
9. Aquaculture feed preparation

SUGGESTED READING

1. Amos Richmond and Qiang Hu. 2013. Handbook of Microalgal Culture: Applied Phycology and Biotechnology, 2nd Edition John Wiley & Sons, Ltd Publication,

2.Gokare A. Ravishankar, Ranga Rao Ambati. 2020. Handbook of Algal Technologies and Phytochemicals. CRC press,Taylor & Francis Group.

3.Faizal Bux, Yusuf Chisti, Algae Biotechnology: Products and Processes (Green Energy and Technology) 2016. Springer Publication.

Semester – III

22SSD301 SOFT SKILL DEVELOPMENT-I (2H – 1C)

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

Course Objectives

- To understand the main concepts of Employability and Skill Development
- To escalate the knowledge in Analytical and Mathematical Skills
- To devolop and nurture the soft skills for the students through individual and group activities
- To stimulate the all-round development of the students by emphasizing on Soft skills and Aptitude
- To embellish self-esteemed individuals by mastering inter-personal skills, team management skills and leadership skills.
- To steer and bestow right module of training that meets the industry needs and ameliorate their employability skills.

Course Outcomes (Cos)

Upon culmination of this course the students will be able to:

1. Understand the basic concepts of Quantitative Aptitude and Logical reasoning.
2. Solve the real-time problems to accomplish job functions easily.
3. Understand the basic grammar and utilize it for their language enhancement.
4. Communicate in genuine circumstances acquiring basic grammatical structure and vocabulary.
5. Articulate efficiently with others as well within a group or a team catalyzing in building a rapport with the team members.
6. Intensify their professionalism at work by acquiring knowledge on job roles and responsibilities.

UNIT I- BASIC APPROACHES TO NUMBERS

- Number system
- Problems on numbers
- Number series
- Simplifications

UNIT II- PROBLEMS RELATED TO TIME

- Time and work
- Pipes and cisterns
- Time, speed, distance and problems on trains
- Boats and streams
- Clocks
- Calendar

UNIT III- PROBLEMS ON PARTITIONS

- Ratio and Proportion
- Average
- Inequalities
- Allegation and Mixture
- Elementary Statistics

UNIT IV- INTRODUCTION TO GRAMMAR AND PREREQUISITES FOR INTERVIEW

- Parts of Speech
- Tense
- Subject Verb Agreement
- Articles and Prepositions
- Resume Building
- Self-Introduction

UNIT V- EMPHASIZING THE FUNCTIONS OF GRAMMAR AND LIFE SKILLS

- Active and Passive Voice
- Direct and Indirect Speech
- Idioms and Phrases
- Degrees of Comparison and Conditional clause
- Prefix, suffix and Question tags
- Group discussion
- Extempore Speech

REFERENCE

1. Quantitative aptitude for competitive exams by S.Chand, Dr. R.S. Aggarwal
2. A modern Approach to Logical Reasoning by S.Chand, Dr. R.S. Aggarwal
3. Verbal Aptitude for competitive exams by S. Chand, Dr. R.S. Aggarwal
4. Objective English for Competitive Examinations by Edgar Thorpe, Showick Thorpe
5. Communication skills and soft skills an integrated approach by E. Suresh kumar, P.Sreehari, J Savithri.

Semester – IV

22MBU391 **INTERNSHIP PROGRAMME** **(2C)**

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

Semester – IV

22MBU401 **IMMUNOLOGY** **(4H – 4C)**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To strengthen the knowledge of students in immunodiagnostics.
- To learn the latest trends in immunology.
- 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

1. Introducing the employment aspect of immunology and to study various types of immune systems their classification structure and mechanism of immune activation.
2. Upon completion students will gain knowledge of immune system, cells involved along with complement system and autoimmunity
3. Develop understanding about immune system, antigen antibody interactions.
4. Gain theoretical knowledge of various diseased conditions generated due to interplay of immune system components.
5. Students can able to perform basic immunological assays.
6. It will distinguish fundamental knowledge on immunology and its advancement

Unit I

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

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

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

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. Types of tumors, tumor Antigens, causes and therapy for cancers. Types of vaccine and their vaccination schedule in Practice.

Unit V

Principles of precipitation, agglutination, complement fixation, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT, Western blotting, Immunofluoresence, Flow cytometry, Immunoelectron microscopy.

SUGGESTED READINGS

1. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition. W.H. Freeman and Company, New York.
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. 7th edition Garland Science Publishers, New York.
4. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition, Saunders Publication, Philadelphia.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg

Semester – IV

22MBU402 **MEDICAL MICROBIOLOGY** **(4H – 4C)**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

- The aim of Medical Microbiology course is to introduce basic principles and application relevance 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 address the fundamental mechanisms of their pathogenicity.

COURSE OUTCOME:

1. 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.
2. It will develop the student's knowledge on medically important microorganism's morphology with the main focuses being the characterization based on physiological factors.
3. It will give improved knowledge on current antimicrobial chemotherapy, antibiotics towards target sites, drug resistance mechanisms and spectrum evaluation methods in the clinical settings.
4. Student can be able to safeguard the society.
5. Able to work for advanced clinical diagnostics practices.
6. It will render the prophylaxis measures and strategies of deadly microorganisms upon the completion of this study.

Unit I

Normal micro flora of the human body: skin, throat, gastrointestinal tract, urogenital tract. Gut Microbial Flora. 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 and Urine.

Unit II

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 pneumoniae.*

Unit III

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 swine flu, Ebola, Chikungunya, Japanese Encephalitis, Coronavirus (COVID-19), Omicron virus.

Unit IV

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

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 infections.

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. 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 Press Publication.
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. Elsevier.
7. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education

22MBU403 **RECOMBINANT DNA TECHNOLOGY** **(4H–4C)**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- 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

1. Imparts the entrepreneurial concepts of rDNA technology and their applications and Acquire knowledge on the applications of genetic engineering.
2. Understand the difference between old biotechnology and modern biotechnology.
3. Provide examples of current applications of biotechnology and advances in the different areas like medical, microbial, environmental, bioremediation, agricultural, plant, animal, and forensic sciences.
4. Explain the general principles of generating transgenic plants, animals and microbes.
5. Technical know-how on versatile techniques in recombinant DNA technology.
6. An understanding on application of genetic engineering techniques in basic and applied experimental biology

Unit I

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

Cloning Vectors: Definition and Properties Plasmid vectors: pBR and pUC series Bacteriophage lambda 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 SV40-based expression vectors

Unit III

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

Unit IV

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

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. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA.
3. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
4. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.
5. Wiley JM, Sherwood LM and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education.
6. Brown TA. (2007). Genomes-3. Garland Science Publishers

Primrose SB and Twyman RM. (2008). Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K.

Semester-IV

22MBU404A **MOLECULAR BIOLOGY** **(3H –2C)**

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

End Semester Exam: 3 Hours

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)

1. Explores technologies using molecular biology, embryo manipulation, cell and tissue culture.
2. Manipulate the genomes of animals for ways to improve the livestock for food production and biomedical purpose.
3. Develop the skills in molecular biology.
4. Executing concept of RNA splicing and mRNA and its significance.
5. Students able to be inferring various model of DNA replication
6. Students able to contrast translational machinery.

Unit I DNA Structure

DNA Structure: Miescher to Watson and Crick- historic perspective, DNA Structure, Salient features of double helix, Types of DNA, Types of genetic material, Organization of DNA Prokaryotes, Viruses, Eukaryotes. RNA Structure, Organelle DNA -- mitochondria and chloroplast DNA.

Unit II DNA Replication

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

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

Unit IV DNA Translation

Translational machinery, Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides 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 *lac* operon and *trp* operon.

Unit V Molecular Biology Techniques

Extraction of DNA, Extraction of RNA, Isolation of plasmid, DNA purification and estimation, PCR, Gel electrophoresis, Blotting techniques, SDS-PAGE.

SUGGESTED READINGS

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication.
2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco.
3. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia.
4. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
5. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
6. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning.
7. Gardner EJ, Simmons MJ, Snustad DP (2008).). Principles of Genetics.8th Ed. Wiley-India.

Semester – IV

22MBU404B BIOMATHEMATICS AND BIOSTATISTICS (3H – 2C)

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- This course has been intended to provide the learner insights into helpful areas of Statistics which plays an essential role in present, future use and applications of Biology.
- This course provides an introduction to a variety of statistical methods of use in describing and analyzing biological data.
- It includes a laboratory component in which biological data are analyzed using statistical software. No prior knowledge of the software will be assumed.
- Statisticians help to design data collection plans, analyze data appropriately and interpret and draw conclusions from those analyses.
- To develop students' skills in algebraic manipulation, the calculus of linear and non-linear differential equations, mathematical modelling, matrix algebra and statistical methods.
- To introduce students to the application of mathematical modeling in the analysis of biological systems including populations of molecules, cells and organisms.
- To show how mathematics, statistics and computing can be used in an integrated way to analyze biological systems.

COURSE OUTCOMES

1. Students get an idea about collection, interpretation and presentation of statistical data.
2. Statistics, a branch of applied Mathematics, is regarded as mathematics applied to observational data.
3. Conceivably everything dealing with the collection, processing, analysis and interpretation of numerical data belongs to the domain of statistics.
4. To introduce students to the use of R for the analysis of biological processes and data, including simple computer programming.
5. have an enhanced knowledge and understanding of mathematical modeling and statistical methods in the analysis of biological systems.
6. To analyse data from experiments and draw sound conclusions about the underlying processes using their understanding of mathematics and statistics be better able to assess biological inferences that rest on mathematical and statistical arguments.

UNIT I

Sets. Functions and their graphs: polynomial, sine, cosine, exponential and logarithmic functions. Motivation and illustration for these functions through projectile motion, simple pendulum, biological rhythms, cell division, muscular fibers etc. Simple observations about these functions like increasing, decreasing and, periodicity. Sequences to be introduced through the examples arising in Science beginning with finite sequences, followed by concepts of recursion and difference equations. For instance, the Fibonacci sequence arising from branching habit of trees and breeding habit of rabbits.

UNIT II

Intuitive idea of algebraic relationships and convergence. Infinite Geometric Series. Series formulas for ex, log (1+x), sin x, cos x. Step function. Intuitive idea of discontinuity, continuity and limits. Differentiation. Conception to be motivated through simple concrete examples as given above from Biological and Physical Sciences. Use of methods of differentiation like Chain rule, Product rule and Quotient rule. Second order derivatives of above functions. Integration as reverse process of differentiation. Integrals of the functions introduced above. Differential Equations of first order, Linear

Differential Equations. Points in plane and space and coordinate form. Examples of matrices arising in Biological Sciences and Biological networks. Sum and Produce of matrices upto order 3.

UNIT III

Definitions-Scope of Biostatistics Principles of statistical analysis of biological data - Variables in biology, Data collection, classification and tabulation of data - Graphical and diagrammatic representation. Measures of Central Tendency – Arithmetic Mean, Median and Mode. Measures of Dispersion- Range, Standard Deviation, Coefficient of variation. Skewness and Kurtosis.

UNIT IV

Elementary Probability and basic laws; Discrete and Continuous Random variable, Mathematical Expectation; Emphasis on examples from Biological Sciences. Mean and Variance of Discrete and Continuous Distributions namely Binomial, Poisson and Normal distribution.

UNIT V

Sampling parameters: Difference between Sample and Population, difference between parametric and non-parametric statistics. Sampling Design: Meaning – Concepts – Steps in sampling – Criteria for good sample design. Scaling measurements - Types of scale.

SUGGESTED READINGS

1. Bear H.S.,(2003).Understanding Calculus, John Wiley and Sons (2^{nd} ed.));
2. Batschelet E.,(1979).Introduction to Mathematics for Life Scientists(3^{rd} ed.), Springer Verlag, International Student Edition, Narosa Publishing House, New Delhi.
3. Edmondson and D. Druce.,(1996).Advanced Biology Statistics, Oxford University Press.
4. Danial W.,(2013).Biostatistics: A foundation for Analysis in Health Sciences(10^{th} ed.), John Wiley and Sons Inc.

Semester – IV

22MBU411 **IMMUNOLOGY–PRACTICAL** **(3H – 2C)**

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

End Semester Exam: 6 Hours

COURSE OBJECTIVES

- To strengthen the knowledge of students in immunodiagnostics on skill basis.
- To learn the latest trends in immunology.
- 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

1. Introducing the science of immunology and to study various types of immune systems their classification structure and mechanism of immune activation.
2. Upon completion students will gain knowledge of immune system, cells involved along with complement system and autoimmunity
3. Develop understanding about immune system, antigen antibody interactions.
4. Gain theoretical knowledge of various diseased conditions generated due to interplay of immune system components.
5. After course completion, students can apply the knowledge in further studies and higher education.
6. Knows the concepts of advanced immunological assays

EXPERIMENTS

1. Identification of human blood groups.
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 (demonstration).
5. Perform immunodiffusion by Ouchterlony method.
6. Perform DOT ELISA.
7. Perform immune electrophoresis.

SUGGESTED READINGS

1. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition, W.H. Freeman and Company, New York.
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. 7th edition, Garland Science Publishers, New York.
4. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition, Saunders Publication, Philadelphia.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

22MBU412 **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

1. It provides the entrepreneurial ability to characterize, isolate and identify different microbes.
2. It includes a detailed study of characterization, etiology, pathogenicity, clinical systems, and laboratory diagnosis of disease-causing Microorganisms.
3. 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.
4. Comprehend the various methods for identification of unknown microorganisms.
5. Recall the relationship of this infection to symptoms, relapse and the accompanying pathology.
6. 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.

EXPERIMENTS

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, chicken pox, HPV warts, AIDS (candidiasis), dermatomycoses (ring worms).
7. Study of various stages 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. 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 Press Publication.
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. Elsevier Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education

Semester – IV

22MBU413 RECOMBINANT DNA TECHNOLOGY–PRACTICAL (3H–2C)

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

End Semester Exam: 6 Hours

COURSE OBJECTIVES

- To learn the entrepreneurial basic tools in recombinant technology
- To understand the various concepts of cloning vectors and cloning strategies
- To emphasize the knowledge in biotechnology and techniques.
- Provide idea about DNA, protein purification from samples and quantification.
- To learn the techniques pertaining to amplification of biological molecules.
- To impart knowledge on basic microbial isolation and identification approaches

COURSE OUTCOME

1. Imparts the concepts of rDNA technology and their applications and Acquire knowledge on the applications of genetic engineering.
2. Students will develop understanding about isolation and enumeration of microorganisms from various samples.
3. Microbial identification and characterization using a number of approaches will be well understood.
4. Acquainted with molecular modification approaches that encompass extraction, purification, quantification and augmentation.
5. To give basic understanding of microbial genetic manipulations.
6. To understand working of different laboratory equipment used in microbiological laboratories

EXPERIMENTS

1. Preparation of competent cells for transformation.
2. Demonstration of Bacterial Transformation and calculation of transformation efficiency.
3. Digestion of DNA using restriction enzymes and analysis by agarose gel electrophoresis
4. Ligation of DNA fragments.
5. Cloning of DNA insert and Blue white screening of recombinants.
6. Interpretation of sequencing gel electropherograms.
7. Designing of primers for DNA amplification.
8. Demonstration of PCR for DNA amplification
9. Demonstration of Southern blotting.

Suggested reading

1. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA.
3. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
4. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press
5. Wiley JM, Sherwood LM and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education
6. Brown TA. (2007). Genomes-3. Garland Science Publishers
7. Primrose SB and Twyman RM. (2008). Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K.

Semester-IV

22MBU414A **MOLECULAR BIOLOGY– 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 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.
- To obtain knowledge in resolution and visualization of proteins
- To evaluate genetic material in different samples.
- The student will receive hands-on training in various culturing and molecular techniques for studying microbial diversity and microbial activity.
- To introduce the student to the advanced concepts in molecular biology

COURSE OUTCOME

1. Explores technologies using molecular biology, cell and tissue culture to manipulate the genomes of animals for ways.

2. Develop the skills in molecular biology.

3. Students are capable of explaining process involved in genetic changes and mutations
4. The identification of genetic regulatory mechanism
5. Students are able to distinguish different mechanism of gene regulation
6. The design of different techniques based on utilizing the genetic mechanism of microbes.

EXPERIMENTS

1. Isolation of genomic DNA from *E. coli.*
2. Isolation of plasmid from *E. coli.*
3. Estimation of RNA using UV spectrophotometer (A260 measurement).
4. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
5. Estimation of protein by Lowry's method
6. Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE).
7. Competent cell preparation
8. Bacterial transformation

SUGGESTED READINGS

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication

2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco

3. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia

4. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.

5. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.

6. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning.

Semester – IV

22MBU414B BIOMATHEMATICS AND BIOSTATISTICS– 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

- This course has been intended to provide the learner insights into helpful areas of Statistics which plays an essential role in present, future use and applications of Biology.
- Statisticians help to design data collection plans, analyze data appropriately and interpret and draw conclusions from those analyses.
- Statistics helps in the proper and efficient planning of a statistical inquiry in any field of study.
- Statistics helps in providing a better understanding and exact description of a phenomenon of nature.
- To develop students' skills in algebraic manipulation, the calculus of linear and non-linear differential equations, mathematical modelling, matrix algebra and statistical methods.
- To introduce students to the application of mathematical modeling in the analysis of biological systems including populations of molecules, cells and organisms.

COURSE OUTCOMES

1. Students get an idea about collection, interpretation and presentation of statistical data.
2. Statistics help in providing data as well as tools to analyze the data.
3. Some powerful techniques are index numbers, time series analysis, and also forecasting.
4. Statistical knowledge helps you use the proper methods to collect the data, employ the correct analyses, and effectively present the results.
5. To show how mathematics, statistics and computing can be used in an integrated way to analyze biological systems.
6. Conceivably everything dealing with the collection, processing, analysis and interpretation of numerical data belongs to the domain of statistics.

Experiments (any 10 from the following using any software)

1. Word Problems based on Differential Equations
2. Calculation of Mean
3. Calculation of Median
4. Calculation of Mode
5. Finding Standard Deviation and Coefficient of Variation
6. Calculation of Correlation Coefficient using Karl Pearson Methods
7. Calculation of Correlation Coefficient using Spearman
8. Problems based on Regression Coefficient
9. Finding area under the curve using normal probability
10. Testing of Hypothesis for large sample Z-test
11. Testing of Hypothesis for small sample t-test
12. Testing of Hypothesis using Chi-Square-test

SUGGESTED READINGS

1. Bear H.S.,(2003).Understanding Calculus, John Wiley and Sons (2nd ed.));
2. Batschelet E.,(1979).Introduction to Mathematics for Life Scientists (3rd ed.), SpringerVerlag, International Student Edition, Narosa Publishing House, New Delhi.
3. Edmondson and D. Druce.,(1996).Advanced Biology Statistics, Oxford University Press.
4. Danial W.,(2013).Biostatistics: A foundation for Analysis in Health Sciences(10th ed.), John Wiley and Sons Inc.

Semester – IV

22SSD401 SOFT SKILL DEVELOPMENT-II (2H – 1C)

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

Course Objectives (CO)

- To understand the prime concepts of Employability and Skill Development.
- To augment the knowledge in Analytical and Mathematical Skills
- To develop and nurture the soft skills of the students through individual and group activities
- To vitalize the all-round development of the students by emphaizing on Soft skills and Aptitude
- To embellish self-esteemed individuals by mastering inter-personal skills, team management skills and leadership skills
- To steer and bestow right module of training that meets the industry needs and improve their employability accomplishments.

Course Outcomes (COs)

Upon culmination of this course the students will be able to:

1. To promote communication skills as well as optimistic personality traits.
2. Enhance their employability quotient and thrive in the professional space.
3. Understand the progression in grammar and verbal reasoning.
4. To elevate and enrich their personal and professional efficacies.
5. To sketch their goals and also gets to know diversities in the field of their career planning.
6. To pertain learning in different competitive exams/entrance exams for placement/ Higher studies.

UNIT I- INDUCTIVE AND DEDUCTIVE CALCULATIONS

- Geometry and Mensuration
- Coding and Decoding
- Odd Man Out and Analogy
- Logical Sequence of Words
- Direction

UNIT II-SELECTION AND ARRANGEMENT

- Permutation and Combination
- Probability
- Data Arrangement
- Cube and Dice
- Image Analysing
- Puzzles

UNIT III- UNDERSTANDING AND ANALYSING DATA

- Problems on Ages
- Data Interpretation
- Logarithms
- Syllogism

- Data Sufficiency
- Blood Relation

UNIT IV- BANKING PROBLEMS

- Percentage
- Profit and Loss
- Interest Calculation

UNIT V- ADVANCEMENT TOWARDS GRAMMAR AND BEHAVIOURAL SKILLS

- Statement and Assumption
- Verbal Analogy
- Jumbled Sentence
- Error Spotting
- Sentence Completion
- Sentence Correction
- Implementing and Enhancing Soft Skills

REFERENCE:

1. Aptitude by Er. Rapid Quantitative Deepak Agarwal and Mr. D.P Gupta
2. Numerical Ability and Quantitative Aptitude for Competitive examinations by P.K.Mittal.
3. Quantitative Aptitude - Quantum CAT bySarvesh K Verma
4. Personal Development and Soft Skills by BARUN K MITRA, Oxford Higher Education
5. Soft skills an integrated approach to maximize personality by Sangeetha sharma, gajendra singh chauhan, and Wiley Publishing.

Semester-V

22MBU501 **ENVIRONMENTAL MICROBIOLOGY** **(4H – 4C)**

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

COURSE OBJECTIVES

- 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 nonrenewable 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 OUTCOMES

1. Make appropriate judgments and decisions for the protection and improvement of the earth.
2. Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
3. Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
4. 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.
5. Clarify application of microorganisms in varied fields of environmental microbiology like bioremediation, biofertilizers and waste water treatment.
6. Describe role of microorganism in recycling soil nutrients, biodegradation of complex plant polymers, sustaining and improving plant growth through improving nutrient availability.

UNIT I: Microbes in Environment

Terrestrial Environment- soil profile and soil microflora. 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

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.

Unit III: Waste Management

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

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

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., (2005). Environmental Studies, Excel Books Publications, New Delhi, India.
3. Tripathy, S.N., and Panda, S., (2004). Fundamentals of Environmental Studies; 2nd Edition, Vrianda Publications Private Ltd., New Delhi.
4. Kumar, A., (2004). A Textbook of Environmental Science; APH Publishing Corporation, New Delhi.
5. Verma, P.S., Agarwal, V.K., (2001). Environmental Biology (Principles of Ecology); S.Chand and Company Ltd., New Delhi.
6. Kaushik, A., Kaushik, C.P., (2004). Perspectives in Environmental Studies, New Age International Pvt. Ltd. Publications, New Delhi.
7. Maier RM, Pepper IL, Gerba CP (2019). Environmental microbiology, Elsevier
8. Brock Biology of Microorganisms, Prentice Hall, USA.
9. Environmental Biotechnology: Principles and Applications by Bruce E Rittmann and Perry L McCarty, McGraw-Hill International edition
10. Ljungdahl LG, Adams MW, Barton LL, Ferry JG, Johnson MK (2003). Biochemistry and Physiology of Anaerobic Bacteria, Springer. 8. Madigan MT, Martinko JM, Dunlap PV, Clark DP (2012)

Semester – V

22MBU502A MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT (4H-4C)

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

End Semester Exam: 3 Hours

COURSE OBJECTIVE

- 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

1. Develops the programmatic activities in sustainable agriculture and food systems
2. Able to relate their knowledge about ecology to its relevance in sustainable agriculture
3. Provides detailed idea about biofertilizer production and develop entrepreneur skill related to agriculture field**.**
4. Understand on soil characteristics and biogeochemical cycling.
5. Students able to the uses of microorganisms as bio control agents.
6. Understand transgenic crops and their use in agriculture**.**

Unit I

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, potassium

Unit II

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

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

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

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. Noureddine Benkeblia (2019) Sustainable Agriculture and New Biotechnologies, 1st Edition 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.

Semester – V

22MBU502B **VETERINARY MICROBIOLOGY** **(4H-4C)**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

- 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:

1. Students will be able to understand the importance of commercialization in veterinary industry
2. Students will be able to develop, investigation, pharmacy and vaccine production is offering various career opportunities for the Veterinary professionals.
3. Students will be able to analyze the morphology and crystallographic structure of animal virus.
4. Students will be able to predict cytocidal changes in animal due to virus infection.
5. Demonstrate an understanding at an advanced level of microbial virulence mechanisms
6. Candidate able to explain the host response to infection.

UNIT I: Introduction to Veterinary Microbiology

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

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: Veterinary Virology

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

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, Nemathelminthes and Acanthocephala.

UNIT V: Livestock Management

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 of Animal 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 Publications.
4. C.L. Gyles, J. .F Prescott, J.G. Songer, C.O. Thoen. Pathogenesis of Bacterial Infections in Animals. 2004 Wiley
5. Fenner.S,2016. Veterinary virology (5 th Edition). Academic Press.
6. Veterinary Microbiology 2013. D.Scott, Melissa.K, M M. Chengappa, 3rd Edition. Wiley-Blackwell Publications.
7. Veterinary Parasitology 2012. Zajac AM, Gary A, 8th edition. Wiley-Blackwell Publications.

Semester–V

22MBU503A **BIOINFORMATICS** **(4H – 4C)**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- 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

1. Provides computational skill on search engines and various software tools involved in bioinformatics
2. It will impart computational based techniques which includes genomics and proteomics in Bioinformatics.
3. Retrieve information from available databases and use them for microbial identifications and drug designing
4. Gain ability to modify gene and protein structures in simulated systems.
5. Introduction to the basics of sequence alignment and analysis.
6. Describe about the different types of Biological databases

Unit I

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

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

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

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

Unit V

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

22MBU503B **DRUG DESIGN AND DEVELOPMENT** **(4H – 4C)**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- 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

1. The course will impart knowledge on detection, selection, and validation of new antibacterial targets,
2. Candidates able to involve in the vaccines
3. The use of gene technology in pharmaceutical industry
4. Students could understand the significance of tolerability, side effects at different doses
5. Can contribute to the upstream process
6. Gain the knowledge on the drug development process and engineering technology in drug development

UNIT-I

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

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 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, Nanoscaffolds 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- 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

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, Povl Krogsgaard-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, Povl Krogsgaard-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.

Semester – V

22MBU504A **CELL BIOLOGY AND EVOLUTION** **(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 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 obtain knowledge in cell death and cell renewal.
- To gain knowledge in structural aspects of cells.

COURSE OUTCOME

1. Basic concept of cell structure, membrane, cellular functions of different types of cell, modes of cellular signaling and signal amplification.
2. Students able to annotate cell organization of prokaryotic and Eukaryotic.
3. Students able to paraphrase cell death and cell renewal.
4. Able to bullet pointing protein sorting and transport
5. Expertise in interpreting cell internal organelles.
6. Knowledge in induced pluripotent stem cells

Unit I Cell organization

Cell Organization – Eukaryotic (Plant and animal cells) and prokaryotic. Plasma membrane: Structure and transport of small molecules. Cell wall: Eukaryotic cell wall, Extra cellular matrix and cell matrix interactions, Cell-Cell Interactions - adhesion junctions.

Unit II Membrane bound Organelles

Structure and Functions of Mitochondria, Peroxisomes, chloroplasts, Nucleolus, Ribosomes, Endoplasmic Reticulum, Golgi Apparatus Lysosomes

Unit III Cell communication and signalling

Neurotransmission & its regulation, integrins, extracellular matrix, gap junctions, roles of cell adhesion molecules and types, the general principle of cell communication, hematopoiesis regulation. Quorum sensing, bacterial chemotaxis, light signaling in plants, plant & bacterial two-component systems, regulation of signaling pathways, second messengers, signal transduction pathways, G-protein couple receptors mediated signaling, cell surface receptors, hormones & their receptors.

Unit IV Origins of Unicellular & Cellular Evolution:

Aerobic & anaerobic metabolism, photosynthesis, the evolution of unicellular eukaryotes, the origin of eukaryotic cells, the evolution of prokaryotes, the first cell, Miller's experiment, Haldane & Oparin's concept, abiotic synthesis of organic polymers and monomers, the origin of fundamental biomolecules.

Unit V **Emergence of Evolutionary Thoughts**

The evolutionary synthesis, spontaneity of mutations, Mendelism, natural selection & fitness, struggle, adaptation, Variation in Darwin's & Lamarck's concepts.

SUGGESTED READING

1. Hardin J, Bertoni G and Kleinsmith LJ. (2010). Becker's World of the Cell. 8th edition. Pearson.

2. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.

3. De Robertis, EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.

4. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

5. Essential CELL BIOLOGY AND EVOLUTION4th edition 2015 by Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander D.Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter

Semester–V

22MBU504B BIOPROCESS AND BIOPRODUCT DEVELOPMENT (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 provide a strong, fundamental knowledge about the use of beneficial microorganism in industry.
- Produce and develop the value added products using microbial sources
- Understand the production methods in industrial field
- To provide the basics of probiotics and its applications.
- To familiarize the students with the basic manufacturing and production knowledge.
- Understand the International guidelines for manufacturing and development.

COURSE OUTCOME

1. This course will enable the students to design the various microbial fermentation products and their production, purification for various applications
2. To know the process protocol for the, synthesis and characterization of biological products.
3. Gain different types of fermentation process used in industry.
4. Gain experimental knowledge to perform animal biotechnology related experiments
5. Explain the application of biotechnology in medical and its allied fields, gene therapy, genetic counseling
6. Address the bioethical issues & concerned linked to industrial biotechnology

Unit I- Introduction to Bioprocess/Fermentation Technology

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).

Unit II- Types of fermenter and fermentation processes

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- Agricultural Bioproducts

Definition and Importance -Benefits of bioproducts- Agricultural bioproducts-Types of agricultural bioproducts- biopesticides, biofertilizers and bio stimulants – Development of agricultural bioproducts –production and mass cultivation of industrially important strain used in agriculture. Carrier material used for agricultural bioproducts- storage and packaging of products- Applications of agricultural bioproducts – Examples of agricultural bioproducts. Carrier material used for the products- Product storage and packaging.

Unit IV Probiotic Bioproducts

Functional products for gut health – Probiotics and prebiotics- Beneficial effects of probiotic micro-organisms- Desirable probiotic characteristics- Applications of probiotics-Examples of probiotics. Carrier material used for the products- Product storage and packaging.

Unit V Quality Assurance for Bioproducts

Quality control of bioproducts- Serial dilution technique- Development of COA (Certificate of Analysis) for the bioproducts- Guidelines for national authorities on quality assurance for biological products (FDA, NCL)- Procedures for approval of manufactures and products.

SUGGESTED READINGS

1. Nduka Okafor, Benedict C. Okeke (2017) Modern Industrial Microbiology and Biotechnology, 2nd Edition, CRC Press.
2. Stanbury PF, Whitaker A and Hall SJ. (2016). Principles of Fermentation Technology. 3nd edition, Elsevier Science Ltd.
3. Crueger W and Crueger A. (2017). Biotechnology: A textbook of Industrial Microbiology. 3rd edition. Panima Publishing Co. New Delhi.
4. Mansi El-Mansi (2012) Fermentation Microbiology and Biotechnology, CRC Press.
5. E M T El-Mansi, Jens Nielsen, David Mousdale (2009) Fermentation Microbiology and Biotechnology, Fourth Edition, CRC Press
6. N. Ramanathan., Biofertilizers Technology. Kalyani Publisher, First edition. 2019.
7. P.Hyma.. Biofertilizers: Commercial Production Technology and Quality Control (First Edition) – Random Publication 2017.
8. Frazier William and **Dennis C. Westoff**, Food Microbiology, McGraw Hill Education India. 5th edition 2017.

Web References

1. https://www.researchgate.net/publication/299694163.
2. https://www.who.int/publications/m/item/annex2-who-trs-822.
3. https://www.researchgate.net/publication/323424893

Semester-V

22MBU511 ENVIRONMENTAL MICROBIOLOGY- PRACTICAL (3H – 2C)

Instruction Hours/week: L: 0 T: 0 P: 3 **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
- Competently explain various aspects of environmental microbiology and microbial ecology and to become familiar with current research in environmental microbiology.
- Understand various biogeochemical cycles – Carbon, Nitrogen, Phosphorus cycles etc and microbes involved

COURSE OUTCOME

1.Provides a comprehensive overview of biogeochemical processes relevant to environmental scientists and engineers mediated by microorganisms.

2.Understand various plant microbes' interactions especially rhizosphere and their applications especially the biofertilizers and their production techniques

3.Understand the basic principles of environment microbiology

4.Able to apply these principles to understanding and solving environmental problems wastewater treatment and bioremediation

5. Know the Microorganisms responsible for water pollution especially Water-borne pathogenic microorganisms and their transmission

6.Comprehend the various methods to determine the Sanitary quality of water and sewage treatment methods employed in wastewater treatment.

EXPERIMENTS

1. Analysis of soil-pH, moisture content, water holding capacity, percolation, capillary action.
2. Isolation of microbes (bacteria &fungi) from soil (28ºC&45ºC).
3. Study of air flora by petriplate method.
4. Isolation of microbes (bacteria &fungi) from rhizosphere and rhizoplane.
5. Analysis of potable water- MPN method.
6. Determination of BOD of wastewater sample.
7. Isolation of phosphate solubilizing bacteria from soil and study.
8. Determination of pesticide residues in water sample.

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, New York.
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 Thomson Learning.
6. Madigan MT, Martinko JM and Parker J. (2014).Brock Biology of Microorganisms. 14th edition. Pearson/Benjamin Cummings.
7. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.
8. Singh A, Kuhad, RC & Ward OP (2009). Advancesin Applied Bioremediation. Volume17, Springer-Verlag, Berlin Hedeilberg.

Semester – V

22MBU512A **(3H-1C)**

MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT- PRACTICAL

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

1. Able to relate their knowledge about ecology to its relevance in sustainable agriculture
2. Provides detailed idea about biofertilizer production and develop entrepreneur skill related to agriculture field**.**
3. Able to device biogas plant
4. Students will be annotating various zone in soil profile
5. Students will be isolate various degrading microorganisms for agricultural use.
6. Understand the role of soil microbes in crop production.

EXPERIMENTS

1. Study soil profile
2. Study 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- CO_2 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, 1st Edition 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.

Semester – V

22MBU512B **VETERINARY 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 designed for candidates who wish to enhance their understanding of the role of micro- organisms in animal health.
- To understand animal disease and gives a brilliant grounding in immunology, molecular biology, microbiology and epidemiology.
- 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.
- To understand the infectious disease cycle of the pathogens enables to solve the epidemics. The territory covered by infections and the immune response.

COURSE OUTCOME:

1. Students will be able to understand the importance of commercialization in veterinary industry
2. Students will be able to develop, investigation, pharmacy and vaccine production is offering various career opportunities for the Veterinary professionals.
3. Students will be able to analyze the morphology and crystallographic structure of animal virus.
4. Students will be able to predict cytocidal changes in animal due to virus infection.
5. Demonstrate an understanding at an advanced level of microbial virulence mechanisms
6. Candidate able to explain the host response to infection.

EXPERIMENTS

1. Preparation of Media, solutions , buffers and sterilization
2. Demonstration of primary cell culture, preparation and subculturing of the cell line
3. Chick Embryo inoculation and harvesting of virus: Allantoic and Chorioallantoic route
4. Chick Embryo inoculation and harvesting of virus: Amniotic; yolk sac routes
5. Animal Inoculation for cultivation of viruses
6. Infection of cell cultures with virus and study of cytopathic effects Demonstrations
7. Study of viral inclusions: Detection of Negri bodies in brain impress. smears stained by Seller's Stain
8. Collection and preservation and transport of clinical specimen for virological investigations.

SUGGESTED READING

1. Ashok V. Bhonsle and A.G.Karpe, 2016. Laboratory Manual VMC 322 Systematic Veterinary Virology.
2. http://kanadadilokulu.xyz/Systematic-Veterinary-Virology-A-Practical-Manual-ebook.pdf
3. Malik B.S 2006. A Laboratory Manual of Veterinary Microbiology 4th edition.

Semester–V

22MBU513A **BIOINFORMATICS- 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

- Students get an idea about collection, interpretation and presentation of bioinformatics data.
- Develop competence to integrate biological information with computational software
- Impart basic understanding of bioinformatics approaches for bacterial/viral/fungal identifications and drug design
- Bioinformatics is the application of computer technology to get the information that's stored in certain types of biological data.
- Bioinformatics provides central, globally accessible databases that enable scientists to submit, search and analyze information.
- A sound knowledge on procedural repertoire allows students to innovatively apply these in basic and applied fields of biological research

COURSE OUTCOME

1.This course has been intended to provide the learner insights into helpful areas of Bioinformatics which plays an essential role in application-oriented biology.
2.Provides computational skill on search engines and various software tools involved in bioinformatics
3.Learning methods for designing primers and in-silico PCR
4.Develop competence to retrieve information from biological databases and integrate this biological information with computational software.
5.Design an experiment with step-by-step instructions to address a research problem
6.Technical know-how on versatile techniques in bioinformatics techniques

EXPERIMENTS

1. Introduction to different operating systems - UNIX, LINUX and Windows
2. Introduction to bioinformatics databases (any three): NCBI/PDB/DDBJ, Uniprot, PDB
3. Sequence retrieval using BLAST
4. Sequence alignment & phylogenetic analysis using CLustalW & Phylip
5. Picking out a given gene from genomes using Genscan or other softwares (promoter region identification, repeat in genome, ORF prediction). Gene finding tools (Glimmer, GENSCAN), Primer designing, Genscan/Genetool
6. Protein structure prediction: primary structure analysis, secondary structure prediction using psi- pred, homology modeling using Swiss model. Molecular visualization using jmol, Protein structure model evaluation (PROCHECK)
7. Prediction of different features of a functional gene

SUGGESTED READINGDS

1. Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing House
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

22MBU513B 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

1. The course will impart knowledge on detection, selection, and validation of new antibacterial targets
2. Candidates able to involve in the vaccines
3. The use of gene technology in pharmaceutical industry
4. Students could understand the significance of tolerability, side effects at different doses
5. Can contribute to the upstream process
6. Gain the knowledge on the drug development process and engineering technology in drug development

EXPERIMENTS

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, Povl Krogsgaard-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, Povl Krogsgaard-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.

22MBU514A CELL BIOLOGY AND EVOLUTION- 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 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.
- The course will facilitate in understanding of cell biology and evolutionand evolutionand evolution by examining common processes and principles in cells.
- Knowledge about detailed structure of cell organelles and electron micro graphs.

COURSE OUTCOME

1. To understand the basic concept of cell structure, membrane, cellular functions of different types of cell
2. Able to analyses modes of cellular signaling and signal amplification.
3. Able to categorize cell internal organs.
4. Able to retrieve polypoid stage in vegetables
5. Able to predict cancer cells through photomicrograph
6. Knowledge about detailed structure of cell organelles and electron micro graphs.

EXPERIMENTS

1. Study a representative plant and animal cell by microscopy.
2. Study of the structure of cell organelles through electron micrographs.
3. Cytochemical staining of DNA – Feulgen.
4. Demonstration of the presence of mitochondria in striated muscle cells/cheek epithelial cell using vital stain Janus Green B.
5. Study of polyploidy in Onion root tip by colchicine treatment.
6. Identification and study of cancer cells by photomicrographs.
7. Study of different stages of Mitosis.
8. Study of different stages of Meiosis.
9. Extraction of Tyrosinase enzyme.
10. Isolation of Chloroplasts from Spinach Leaves
11. Isolation of Mitochondria from Animal sample (rat)
12. Isolation of Actin and Myosin Filaments from chicken gizzards.

SUGGESTED READINGS

1. Hardin J, Bertoni G and Kleinsmith LJ. (2010). Becker's World of the Cell. 8th edition. Pearson.
2. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
3. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Molecular cell biology and evolutionand evolutionand evolutionsixth edition 2016 by Lodish,Berk, Kaiser, Krieger, Scott, Bretscher,Ploegh, Matsudaira.

Semester – V

22MBU514B BIOPROCESS AND BIOPRODUCT 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 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
- Understand the rationale in medium formulation & design for microbial fermentation, sterilization of medium and air.

COURSE OUTCOME

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

EXPERIMENTS

1. Study of different parts of fermenter
2. Microbial fermentation – Production and estimation (qualitative and quantitative) of
    a. Enzymes : Amylase, Protease, lipase and DHA
    b. Amino acid : Glutamic acid
    c. Organic acid : Citric acid
    d. Alcohol : Ethanol
    e. Antibiotics : Penicillin
    f. Probiotics

SUGGESTED READINGS

7. Nduka Okafor, Benedict C. Okeke (2017) Modern Industrial Microbiology and Biotechnology, 2nd Edition, CRC Press.
8. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
9. Crueger W and Crueger A. (2017). Biotechnology: A textbook of Industrial Microbiology. 3rd edition. Panima Publishing Co. New Delhi.
10. Geoffrey M Gadd, Sima Sariaslani (2015) Advances in Applied Microbiology, CRC Press.
11. Mansi El-Mansi (2012) Fermentation Microbiology and Biotechnology, CRC Press.
12. E.M T El-Mansi, Jens Nielsen, David Mousdale (2009) Fermentation Microbiology and Biotechnology, Fourth Edition, CRC Press

Semester - V

BIO NANOTECHNOLOGY

22MBUOE501 3H –2C

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

End Semester Exam: 3 Hours

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 (CO'S)

1. Students get an idea about application of nanotechnology in biology.
2. It provides analytical knowledge of trends and developments in the field of nanotechnology
3. Acquire knowledge in nanotechnology and how it will support the employment greatly.
4. Students able to construct hierarchy strategy in machine.
5. Able to describe self-application and machine phase biotechnology.
6. Students have an enhanced knowledge and understanding of chemical transformation and biomolecular sensing

UNIT – I Nano particles

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

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

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

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

UNIT – V Ethics of Nanotechnology

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, nanosurveillance – ethical consideration.

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-Blackwell Publishers
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*. (4^{th} ed.). Wiley, New York.

Semester – V

22MBU591	**INTERNSHIP PROGRAMME**	**(2C)**

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

Semester-VI

22MBU601 **FOOD AND DAIRY MICROBIOLOGY** **(4H–4C)**

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

COURSE OBJECTIVES

- To encode the employability importance of the role of microorganisms in food industries both in beneficial and harmful ways.
- This course aims to provide instruction in the general principles of food microbiology.
- Hands on practicals complimented with an industry-based project, give a real-world perspective to microbiological challenges faced by the food industry.
- The course covers the microbiology of food preservation and food commodities; principles and methods for the microbiological examination of foods and microbiological quality control.
- To develop an understanding of the major principles of and current issues in the several topical areas that collectively constitute Food Microbiology
- It will help the students to understand the dairy Technology.

COURSE OUTCOME

1. Provides job-oriented information about the role of microorganisms in many foods, and beverage industries both in production and spoilage processes.
2. Develop job-based output on industrial based technologies on Food microbiology.
3. It will explain the interactions between microorganisms and the food environment, and factors influencing their growth and survival.
4. Discuss the microbiology of different types of food commodities.
5. Students are able to identify the pathogens from spoiled food
6. Explain why the microbiological quality control programmes are necessary in food production.

Unit I

General introduction of foods related microorganisms. Natural flora and source of contamination of foods in general. Important microorganisms in food (Bacteria, mold and yeasts). Intrinsic and extrinsic factors that affect growth and survival of microbes in foods. Beneficial role of bacteria and fungi in food production.

Unit II

Principles of food preservation. Physical methods of food preservation: temperature (low, high, canning, and drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging. Chemical methods of food preservation: salt, sugar, organic acids, SO_2, nitrite and nitrates, antibiotics and bacteriocins, sterilization of dry heat, moist heat, chemical, physical and radiation.

Unit III

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

Unit IV

Spoilage of foods -cereals, vegetables, fruits, egg and milk. 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).

Unit V

Cultural and rapid detection methods of food borne pathogens in foods and introduction to predictive microbiology. HACCP, FSSAI (ISO 9001:2008) Indices of food sanitary quality (record maintenance and standards) sanitizers and Biosensors in food.

SUGGESTED READINGS

1. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and 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. 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. Springer Publishers.
7. Robinson R.K. (2018) Dairy Microbiology: Milk and Milk Products, 6rd Edn. Wiley Publishers.

Semester – VI

22MBU602A **MICROBIAL BIOTECHNOLOGY** **(4H – 4C)**

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

End Semester Exam: 3 Hours

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

1. This paper imparts knowledge on applications of microorganisms in various fields and helps to gain employability in pharmaceutical industries
2. Describe about different sewage treatment methods employed in waste water treatment.
3. Learn about the global environmental problems.
4. To provide a fundamental knowledge about the various scopes in environmental and industrial studies.
5. Learn about the applications of microbes in biotransformation, therapeutic and industrial biotechnology
6. Describe aspects of genetically engineered microbes for industrial application

Unit I

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

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

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

Unit IV

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

Unit V

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

SUGGESTED READINGS

1. Ratledge, C and Kristiansen, B. (2001). Basic Biotechnology, 2nd edition, Cambridge University Press.
2. Swartz, J.R. (2001). Advances in Escherichia coli production of therapeutic proteins. Current Opinion in Biotechnology, 12, 195–201.
3. Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, Woolverton CJ (2014), 9th edition, Mc Graw Hill Publishers.
4. Gupta PK (2009) Elements of Biotechnology 2nd edition, Rastogi Publications.
5. Glazer AN and Nikaido H (2007) Microbial Biotechnology, 2nd edition, Cambridge University Press
6. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press.
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.

22MBU602B PLANT-MICROBE INTERACTION AND BIOCONTROL (4H – 4C)

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

COURSE OBJECTIVE

- To provides detailed idea about basic techniques in plant-microbe interaction.
- To learn the principle of genetic transformations in plants
- To understand the plant genetic engineering
- To understand the various vector in plant gene transfer
- To know the green house technology in plant development observation
- To know the importance of industrial products.

COURSE OUTCOME

Upon completion of this course the candidate able to know the

1. Conservation of plants in laboratory condition through tissue culture techniques.
2. Genetic transformations in plants, and other plant genetic engineering
3. Plant based industrial products production.
4. Provide fundamental knowledge for the development of genetically modified crop
5. Expression of genes related to water deficit tolerance and pest resistance
6. Insect resistance and cold resistance plant development

UNIT-I

Introduction to microbial interactions with plants. Pre-penetration, Penetration and Postpenetration of microorganisms with plants. Nature of plant-microbe interaction: Symbiotic relationship of microorganisms with plants: Rhizobium and mycorrhizal fungi.

UNIT-II

Plant-pathogen interactions: Biology of Agrobacterium, Peronospora, Alternaria and TMV interactions with their hosts. Role of receptors, elicitors, lectins, cell wall surface components, suppressors, enzymes, toxins, PR-proteins and growth regulators in plant-microbe nteractions.

UNIT-III

Molecular approaches in the study of plant-microbe interactions, genetic basis of pathogenicity and parasitism, signal transduction, compatibility and incompatibility, gene-for-gene concept. Plant interaction with endophytic bacteria and fungi, Use of Avirulent mutants in control of bacterial, fungal and viral disease of plants. Interactions of plants with soil pathogens and their antagonists in natural ecosystem

UNIT-IV

Transgenic approaches for crop protection pathogen derived resistance, plantibodies, over expressing defence genes, use of cloned resistance genes, expression of vaccines in plants, engineering broad spectrum resistance.

UNIT-V

Systemic acquired resistance in plants: Hypersensitive response and associated defense reactions in plants, induced structural and biochemical defense mechanisms.

SUGGESTED READINGS

1. Agrios, G. 2005. Plant Pathology, 5th edition, Reed Elsevier India Private Limited, New Delhi, India.

2. Ayres, P.G. 1992. Pests and Pathogens (Plant Responses to foliar Attack), Bioscientific Publishers.

3. Ayres, P.G. 1992. Pests and Pathogens (Plant Responses to foliar Attack), Bioscientific Publishers.

4. Carlile, M.g., Watkinson, S.C and Gooday, G.W. 1994. The Fungi, Academic Press, UK.

5. Geger, M.J. and Stence, M.J. 2001. Biotic interactions in plant pathogen association. CAB-International, United Kingdom.

6. Gow, N.A.R and Gadd, G.M. 1996. The growing fungus, Chapman and Hall Publishers, London.

Semester – VI

22MBU603A **MICROBIAL DIAGNOSIS IN HEALTH CLINIC** **(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 provide an employment understanding of the natural history of infectious diseases in order to deal with the etiology, laboratory diagnosis, treatment and control of infections in the community.
- This course is aimed to identify the species of pathogenic bacteria and fungi
- Determine the modes of transmission of infectious diseases and pathogenesis
- Know of the theoretical foundations for the differentiation of the major pathogenic groups
- To determine the antimicrobials to be used in the sensitivity testing of different types of pathogens.
- Analyze and solve case studies involving bacterial and fungal agents

COURSE OUTCOME

1. Provides employment knowledge to identify the common infectious agents with the help of laboratory procedures and use antimicrobial sensitivity tests to select suitable antimicrobial agents.
2. It describes the basic mechanisms of pathogenesis of infectious diseases.
3. It explains the basic principles of diagnosis, antimicrobial treatment, prevention and control of infectious diseases in the hospital and community.
4. It help the students to understand the host immune system and explain the host response to infection
5. Understand and interpret basic laboratory tests for the diagnosis of infectious diseases.
6. Apply the principles of molecular and immunological techniques for the diagnosis of infectious diseases.

Unit I Pathogenesis

Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis.

Unit II Sampling & Collection

Collection of clinical samples (throat swab, tissue sample, skin, Blood, CSF, sputum, urine and faeces) and precautions required. Method of transport of clinical samples to laboratory and storage.

Unit III Clinical diagnosis

Examination of sample by staining – Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa-stained thin blood film for malaria. Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, distinct colony properties of various bacterial pathogens.

Unit IV Serological Methods

Serological Methods- Agglutination, ELISA, immunefluorescence, Nucleic acid based methods– PCR, Nucleic acid probes. Diagnosis of Typhoid, HBV, HCV, HIV, Dengue and VDRL. Vaccination and schedule

Unit V Antibiogram

Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method (Kirby Bauer Method) Determination of minimal inhibitory concentration (MIC) of an antibiotic by broth dilution method (LC_{50}, LC_{90}).

SUGGESTED READINGS

1. Ananthanarayan R and Paniker CKJ (2009). Textbook of Microbiology, 8th edition, Universities Press Private Ltd.
2. 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.
3. Randhawa, VS, Mehta G and Sharma KB (2009) Practicals and Viva in Medical Microbiology. 2nd edition, Elsevier India Pvt Ltd.
4. Tille P (2013) Bailey's and Scott's Diagnostic Microbiology, 13th edition, Mosby
   Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and Mccartney Practical Medical Microbiology, 14th edition, Elsevier.

Semester – VI

22MBU603B 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: 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

1. Able to understand safety aspects in biological laboratory.
2. To create awareness on the Intellectual property rights and patenting of biotechnological processes.
3. To equip students with a basic understanding of the underlying principles of quantitative and qualitative patenting methods.
4. Provide students with in-depth training on the conduct and management of patent filing from inception
5. Enable students to acquire expertise in the use and application of the methods of data collection and analysis.
6. Enable students to be reflexive about their role and others' roles as researchers.

Unit I

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

Unit II

Biosafety Guidelines: 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 for using radioisotopes in laboratories and precautions. Agreements and Treaties: GATT, TRIPS Agreements; Role of Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest 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: Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge, Geographical Indications- importance of IPR – patentable and non patentable – patenting life – legal protection of biotechnological inventions – World Intellectual Property Rights Organization (WIPRO).

Unit V

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. Bare Act, (2007).Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi.
2. Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.
3. Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.
4. Singh K K (2015). Biotechnology and Intelectual Property Rights: Legal and Social Impliications, Springer India.

Semester-VI

22MBU611 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: 6 Hours

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

1. Provides necessary entrepreneurial information on the food, dairy Microbiology in safety and quality perspective.
2. It will help to study the importance in the prevention of contamination that might be caused by the microorganisms.
3. To Learn various methods for their isolation, detection and identification of microorganisms in food and employ in industries
4. Identify ways to control microorganisms in foods and thus know the principles involving various methods of food preservation
5. 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
6. Acquire, discover, and apply the theories and principles of food microbiology in practical, real-world situations and problems.

EXPERIMENTS

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. 7th edition, CBS Publishers and 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. 9th edition. Pearson Education.
4. Diane Roberts (2013). Practical Food Microbiology, Third Edition, Print ISBN:9781405100755, Blackwell Publishing Ltd.

Semester – VI

22MBU612A **MICROBIAL BIOTECHNOLOGY-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 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 OUTCOME

1.Impart knowledge on applications of microorganisms in various fields
2.Provides skill development on microbial products.
3.To study the immobilization techniques and fungal pigment production.
4.Develop a xylanase and lipase production technology.
5.Demonstration of algal single cell proteins.
6.State of art knowledge about various methodological and analytic approaches that are used within the specialization.

EXPERIMENTS

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. Study of algal Single Cell Proteins.

SUGGESTED READINGS

1. Ratledge, C and Kristiansen, B. (2001). Basic Biotechnology, 2nd edition, Cambridge University Press.
2. Swartz, J. R. (2001). Advances in Escherichia coli production of therapeutic proteins. Current
3. Opinion in Biotechnology, 12, 195–201.
4. Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, Woolverton CJ (2014), 9th edition, Mc Graw Hill Publishers.
5. Gupta PK (2009) Elements of Biotechnology 2nd edition, Rastogi Publications.
6. Glazer AN and Nikaido H (2007) Microbial Biotechnology, 2nd edition, Cambridge University Press.
7. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press.
8. Corinne Whitby, Torban Lund Skovhus (2018). Applied Microbiology and molecular biology in oil field systems, 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

Semester – VI

22MBU612B PLANT-MICROBE INTERACTION AND BIOCONTROL-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 OBJECTIVE

- To provides detailed idea about basic techniques in tissue culture
- To learn the principle of genetic transformations in plants
- To understand the plant genetic engineering
- To understand the various vector in plant gene transfer
- To know the green house technology in plant development observation
- To know the importance of industrial products.

COURSE OUTCOME

Upon completion of this course the candidate able to know the

1. Conservation of plants in laboratory condition through tissue culture techniques.
2. Genetic transformations in plants, and other plant genetic engineering
3. Plant based industrial products production.
4. Provide fundamental knowledge for the development of genetically modified crop
5. Micropropagation and Embryo culture
6. Protoplast isolation and animal tissue culture

EXPERIMENTS

1. Isolation of plant saprophytes-bacteria and fungi
2. Isolation of plant pathogens-bacteria and fungi
3. Isolation of plant pathogens form seeds by standard blotter method and seed wash method
4. Effect of plant saprophytic bacteria on seed germination and seedling vigour
5. Effect of plant saprophytic fungi on seed germination on seedling vigour
6. Effect of plant pathogenic bacteria on seed germination on seedling vigour
7. Effect of plant pathogenic fungi on seed germination on seedling vigour
8. Selective isolation of plant growth promoting rhizobacteria Rhizobium/Pseudomonas

SUGGESTED READINGS

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

22MBU613A MICROBIAL DIAGNOSIS IN HEALTH CLINIC-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 provide employment-oriented understanding of the natural history of infectious diseases in order to deal with the etiology, laboratory diagnosis, treatment and control of infections in the community.
- This course provides learning opportunities in the basic principles of medical microbiology and infectious disease.
- It covers mechanisms of infectious disease transmission, principles of aseptic practice, and the role of the human body's normal microflora.
- The course provides the conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body.
- It also provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.
- To understand the importance of pathogenic bacteria in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.

COURSE OUTCOME

1 Acquire knowledge to identify the common infectious agents with the help of laboratory procedures and use antimicrobial sensitivity tests to select suitable antimicrobial agents on the basis of employment.

2 Helps to understand the use of lab animals in medical field.

3 Recall the relationship of this infection to symptoms, relapse and the accompanying pathology.

4 Explain the methods of microorganism's control, e.g. chemotherapy & vaccines. Solve problems in the context of this understanding.

5 Demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures.

6 It will help the students to understand the general bacteriology and microbial techniques for isolation of pure cultures of Microorganisms.

EXPERIMENTS

1. Collection and processing of clinical specimen – Sputum.
2. Collection and processing of clinical specimen – Urine.
3. Collection and processing of clinical specimen – Blood.
4. Collection and processing of clinical specimen – Stool.
5. Antibiotic sensitivity testing by Kirby-Bauer method
6. Determination of minimal inhibitory concentration- broth dilution technique.

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. Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and Mccartney Practical Medical Microbiology, 14th edition, Elsevier.
3. Greenwood D, Slack R, Barer M, and Irving W. (2012). Medical Microbiology, 18th Edition. Churchill Livingstone. Ryan KJ and Ray CG. (2014). Sherris Medical Microbiology, 6th Edition. McGraw-Hill Professional

Semester – VI

22MBU613B 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: 6 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

1. Able to understand safety aspects in biological laboratory.
2. To create awareness on the Intellectual property rights and patenting of biotechnological processes.
3. To equip students with a basic understanding of the underlying principles of quantitative and qualitative patenting methods.
4. Provide students with in-depth training on the conduct and management of patent filing from inception
5. Enable students to acquire expertise in the use and application of the methods of data collection and analysis.
6. Enable students to be reflexive about their role and others' roles as researchers.

EXPERIMENTS

1. Study of components and design of a BSL-III laboratory
2. Filing applications for approval from biosafety committee
3. Filing primary applications for patents
4. Study on steps of a patenting process

SUGGESTED READINGS

1. Bare Act, 2007. Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi.
2. Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.
3. Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.
4. Singh K K (2015). Biotechnology and Intelectual Property Rights: Legal and Social Implications, Springer India.
5. Goel D & Prashar S (2013). IPR, Biosafety and Bioethics. Pearson.

Semester – VI

22MBU691 **PROJECT** **(8H-6C)**

Instruction Hours/week: L: 0 T: 0 P: 8 **Marks:** Internal: **40** External: **60** Total: **100**

DEPARTMENT OF MICROBIOLOGY

KARPAGAM ACADEMY OF HIGHER EDUCATION

LIST OF VALUE ADDED COURSE (2022- 2023)

LIST OF VALUE ADDED COURSE

S.NO	TITLE OF THE COURSE
01	Probiotics
02	Quality Assurance and Quality Control
03	Bioproduct Development
04	Vermicomposting and Biofertilizer
05	Personal Health Care