B.Sc. MICROBIOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

Curriculum and Syllabus

Regular (2020 – 2021)

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 AND HUMANITIES

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University,Established Under Section 3 of UGC Act, 1956)
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 AND HUMANITIES

UNDER – GRADUATE PROGRAMMES

(REGULAR PROGRAMME)

REGULATIONS
(2020)

DEPARTMENT OF MICROBIOLOGY

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FACULTY OF ARTS, SCIENCE AND HUMANITIES
UNDER-GRADUATE PROGRAMMES
REGULAR MODE
REGULATIONS - 2020

The following Regulations are effective from the academic year 2020-2021 and are applicable to candidates admitted to Under Graduate Degree (UG) programmes in the Faculty of Arts, Science, and Humanities, Karpagam Academy of Higher Education (KAHE) from the academic year 2020-2021 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 with Cognitive Systems
11	BCA	Computer Application
12	B.Sc.	Applied Science (Material Science)
13	B.Sc.	Applied Science (Foundary Science)
14	B. Com.	Commerce
15	B.Com (CA)	Commerce with Computer Applications
16	B. Com. (PA)	Commerce with Professional Accounting
17	B. Com. (BPS)	Commerce with Business Process Services
18	B.B.A.	Business Administration

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 140 for UG Programmes.

3.2. Credits

Credit means the weightage given to each course of study by the experts of the Board of Studies concerned. Total credits 140 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, French, Sanskrit are offered as an additional course for Science Programme. Four credits are awarded for each course and the examinations will be conducted at the end of the each semester.

For Arts programme, there are two additional courses (English III and IV) offered during the Second year - third and fourth semesters. Six credits are awarded for each course, and the examinations will be conducted at the end of the respective 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 12 Core Courses compulsorily.

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.

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 opt that course. If less, the elective selected has to be studied as a self-study course only.

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 atleast 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.

Note: A particular elective course will be offered only if at least one third of the students in a class opt 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. HoD of the 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.

4.2.6. Ability Enhancement Course

Ability Enhancement Course-1

The course (English for Science Programme / Business Communication for Arts Programme) shall be offered during the first and second semester for which examinations shall be conducted at the end of the semester. And Business Communication for Arts Programme shall be offered during the first semester for which examinations shall be conducted at the end of the 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.

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 helping the students in getting placement. Students of all programmes are eligible to enroll for the value added course. 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 out 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 shall 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 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 the Department concerned and Dean to condone the shortage of attendance. The Head of the 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

- Analysing 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).

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 (20x1=20)
Part - B	Short Answer Type (3 x 2 = 6)
Part - C	3 Eight mark questions 'either – or' choice (3 x 8 = 24 Marks)

11.4 Attendance

Marks Distribution for Attendance

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

12. ESE EXAMINATIONS

12.1 End Semester Examination (ESE): 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 x 1 = 20 Marks) Question No. 1 to 20 Online Multiple Choice Questions
Part- B	5 Questions of 2 marks each(5 x 2 = 10 Marks) Covering all the five units of the syllabus Question No. 21 to 25
Part- C	5 six mark Questions of 6 marks each (5 x 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* examinations shall be kept in the KAHE library.

13. PASSING REQUIREMENTS

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

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

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

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

$$\textbf{CGPA of the entire programme} = \frac{\text{Sum of the product of the GPs by the corresponding credits of the courses offered for the entire programme}}{\text{Sum of the credits of the courses of the entire programme}}$$

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

where,

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

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

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

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

17. REVALUATION

A candidate can apply for revaluation and retotalling of his / her semester examination answer script (**theory courses only**), within 2 weeks from the date of declaration of results, on payment of a prescribed fee. For the same, the prescribed application has to be sent to the Controller of Examinations through the HoD. **A candidate can apply for revaluation of answer scripts not exceeding 5 courses at a time.** The Controller of Examination 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), HoD of the 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 Parts 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 **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 **First Class.**

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

21. PROVISION FOR WITHDRAWAL FROM END-SEMESTER EXAMINATION

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

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

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

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

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

The KAHE may from time to time revise, amend or change the Regulations, Scheme of Examinations and syllabi if found necessary.

Annexure I

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

7	B. Sc.	Microbiology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Biology or Botany Zoology or chemistry as subjects at the Higher Secondary level.
8	B. Sc.	Information Technology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10th or 10+2 pattern of education taking computer science/maths as one of the subject.
9	B. Sc.	Computer Technology	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10th or 10+2 pattern of education taking computer science/maths as one of the subject.
11	B.Sc.	Computer Science with Cognitive Systems	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10th or 10+2 pattern of education taking computer science/maths as one of the subject.
12	BCA	Computer Application	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern preferably taking Mathematics/Statistics/Computer/Information Science being one of the subjects (OR) 3 year diploma after 10th or 10+2 pattern of education taking computer science/maths as one of the subject.
13	B.Sc.	Applied Science (Material Science)	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Physics as one of the subjects at the Higher Secondary level (OR) 3 year diploma after 10th or 10+2 pattern of education taking the respective subject as one of the subject.

14	B.Sc.	Applied Science (Foundary Science)	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern taking Physics as one of the subjects at the Higher Secondary level (OR) 3 year diploma after 10^{th} or 10+2 pattern of education taking the respective subject as one of the subject.
15	B. Com.	Commerce	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
16	B.Com (CA)	Commerce with Computer Applications	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
17	B. Com. (PA)	Commerce with Professional Accounting	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
18	B. Com. (BPS)	Commerce with Business Process Services	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level
19	B.B.A.	Business Administration	Candidates who have passed Higher Secondary Education (XII) or any equivalent Examination conducted by a State Government or a University or Board under the 10+2 pattern Commerce as a subject under the academic or vocational stream at the Higher Secondary level

B.Sc. MICROBIOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

Curriculum and Syllabus

Regular (2020 – 2021)

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 AND HUMANITIES

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University,Established Under Section 3 of UGC Act, 1956)
Eachanari(Post), Coimbatore – 641 021.
Phone No. 0422-2980011 – 15
Fax No: +91-422-2980022, 23
Web: www.kahedu.edu.in

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.

DEPARTMENT OF MICROBIOLOGY

FACULTY OF ARTS, SCIENCES AND HUMANITIES

UG PROGRAM (CBCS) – B.Sc. Microbiology (2020–2023 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												
20LSU101	Language – I	VII	e	4	0	0	4	40	60	100	AECC	01
20ENU101	English - I	V, II	e	4	0	0	4	40	60	100	AECC	05
20MBU101	Introduction to Microbiology and Microbial Diversity	I	a	4	0	0	4	40	60	100	CC	06
20MBU102	Bacteriology	I	g	4	0	0	4	40	60	100	CC	07
20MBU103	Biochemistry - I	I	g	4	0	0	4	40	60	100	Allied	09
20MBU111	Basic Microbiology - Practical	VI	b	0	0	3	2	40	60	100	CC	10
20MBU112	Bacteriology - Practical	VI	b	0	0	4	2	40	60	100	CC	11
20MBU113	Biochemistry –I - Practical	VI	b	0	0	3	2	40	60	100	Allied	13
	Semester total			**20**	**0**	**10**	**26**	**320**	**480**	**800**		
SEMESTER-II												
20LSU201	Language –II	VII	e	4	0	0	4	40	60	100	AECC	14
20ENU201	English - II	V, II	e	4	0	0	4	40	60	100	AECC	18
20MBU201	Biochemistry – II	I	g	4	1	0	5	40	60	100	Allied	19
20MBU202	Microbial Physiology and Metabolism	II	g	5	1	0	6	40	60	100	CC	20
20MBU211	Biochemistry – II - Practical	VI	b	0	0	4	2	40	60	100	Allied	22
20MBU212	Microbial Physiology and Metabolism - Practical	VI	b	0	0	4	2	40	60	100	CC	23
20AEC201	Environmental Studies	IV	f	3	0	0	3	40	60	100	AECC	25
Internship programme												
	Semester total			**20**	**2**	**8**	**26**	**280**	**420**	**700**		
SEMESTER – III												
20MBU301	Virology	I	g	4	0	0	4	40	60	100	CC	28
20MBU302	Microbial Genetics	II	g	4	0	0	4	40	60	100	CC	30
20MBU303	Industrial Microbiology	IV	g	4	0	0	4	40	60	100	CC	32
20MBU304A	Instrumentation and Biotechniques	IV	a,j	3	0	0	3	40	60	100	SEC	34
20MBU304B	Microalgal Technology											36
20MBU311	Virology - Practical	VI	b	0	0	4	2	40	60	100	CC	37
20MBU312	Microbial Genetics - Practical	IV		0	0	4	2	40	60	100	CC	38
20MBU313	Industrial Microbiology - Practical	IV	g	0	0	4	2	40	60	100	CC	40

20MBU314A	Instrumentation and Biotechniques- Practical	IV	a,j	0	0	3	1	40	60	100	SEC	41
20MBU314B	Microalgal Technology- Practical											42
	Semester total			**15**	**0**	**15**	**22**	**320**	**480**	**800**		
	SEMESTER – IV											
20MBU401	Immunology	I	h	4	0	0	4	40	60	100	CC	43
20MBU402	Medical Microbiology	IV	j	4	0	0	4	40	60	100	CC	45
20MBU403	Recombinant DNA Technology	IV	h,g,i	4	0	0	4	40	60	100	CC	47
20MBU404A	Molecular Biology	V, VI, VII	b,d	3	0	0	3	40	60	100	SEC	49
20MBU404B	Biomathematics and Biostatistics											51
20MBU411	Immunology- Practical	I	h	0	0	4	2	40	60	100	CC	53
20MBU412	Medical Microbiology- Practical	IV	j	0	0	4	2	40	60	100	CC	54
20MBU413	Recombinant DNA Technology- Practical	IV	h,g,i	0	0	4	2	40	60	100	CC	55
20MBU414A	Molecular Biology- Practical	V, VI, VII	b,d	0	0	3	1	40	60	100	SEC	56
20MBU414B	Biomathematics and Biostatistics- Practical											57
Internship programme												
	Semester total			**15**	**0**	**15**	**22**	**320**	**480**	**800**		
	SEMESTER – V											
20MBU501	Environmental Microbiology	I	g	4	0	0	4	40	60	100	CC	58
20MBU502A	Microbes in Sustainable Agriculture and Development	V IV	a	4	0	0	4	40	60	100	DSE	60
20MBU502B	Veterinary Microbiology											62
20MBU503A	Bioinformatics	V VII	c,d	4	0	0	4	40	60	100	DSE	64
20MBU503B	Drug design and development											66
20MBU504A	Cell Biology	VI	b	3	0	0	3	40	60	100	DSE	68
20MBU504B	Biopharmacy											70
20MBU511	Environmental Microbiology- Practical	I	b,g	0	0	4	2	40	60	100	CC	71
20MBU512A	Microbes in Sustainable Agriculture and Development- Practical	V IV	a,i	0	0	4	2	40	60	100	DSE	73
20MBU512B	Veterinary Microbiology- Practical											74
20MBU513A	Bioinformatics - Practical	V VII	d	0	0	4	2	40	60	100	DSE	75
20MBU513B	Drug design and development- Practical											76
20MBU514A	Cell Biology- Practical	VI	b	0	0	3	1	40	60	100	DSE	77
20MBU514B	Biopharmacy - Practical											78
	Semester total			**15**	**0**	**15**	**22**	**320**	**480**	**800**		
	SEMESTER – VI											
20MBU601	Food and Dairy Microbiology	IV	h	4	0	0	4	40	60	100	CC	79
20MBU602A	Microbial Biotechnology	IV VI	g	4	0	0	4	40	60	100	DSE	81
20MBU602B	Plant tissue and animal tissue culture											83
20MBU603A	Microbial Diagnosis in Health Clinic	V, VI	a,b	3	0	0	3	40	60	100		84

20MBU603B	Biosafety and Intellectual Property Rights										DSE	85
20MBU611	Food and Dairy Microbiology - Practical	III	h	0	0	4	2	40	60	100	CC	86
20MBU612A	Microbial Biotechnology - Practical	IV VI	g	0	0	4	2	40	60	100	DSE	87
20MBU612B	Plant tissue and animal tissue culture-Practical											88
20MBU613A	Microbial Diagnosis in Health Clinic - Practical	V, III	a,b,h	0	0	3	1	40	60	100	DSE	89
20MBU613B	Biosafety and Intellectual Property Rights - Practical											90
20MBU691	Project	IV	b,g	0	0	8	6	40	60	100	CC	91
ECA / NCC / NSS / Sports / General interest etc								Good				
	Semester total			**11**	**0**	**19**	**22**	**280**	**420**	**700**		
	PROGRAMME TOTAL			**96**	**2**	**82**	**140**	**1880**	**2820**	**4700**		

AECC:Ability Enhancement Compulsory Courses, CC:Core Courses, SEC: Skill Enhancement Courses, DSE: Discipline Specific Elective, ECA: Extra Curricular Activities, NCC: National Cadet Corps:, NSS: National Social Service, Employability courses – Theory.

Ability Enhancement Courses (AEC)		
Semester	**Course Code**	**Name of the Course**
I	20LSU101	Language –I
	20ENU 101	English
II	20LSU201	Language –II
	20ENU201	English
	20AEC201	Environmental Studies

Generic Elective Courses (GE) / Allied Courses		
Semester	**Course Code**	**Name of the Course**
I	20MBU103	Biochemistry - I
	20MBU113	Biochemistry –I - Practical
II	20MBU201	Biochemistry – II
	20MBU211	Biochemistry – II - Practical

Core Courses (CC)		
Semester	**Course Code**	**Name of the Course**
I	20MBU101	Introduction to Microbiology and Microbial Diversity
	20MBU102	Bacteriology
	20MBU111	Basic Microbiology - Practical
	20MBU112	Bacteriology - Practical
II	20MBU202	Microbial Physiology and Metabolism
	20MBU212	Microbial Physiology and Metabolism - Practical
III	20MBU301	Virology
	20MBU302	Microbial Genetics
	20MBU303	Industrial Microbiology
	19MBU311	Virology - Practical
	20MBU312	Microbial Genetics - Practical
	19MBU313	Industrial Microbiology - Practical
IV	20MBU401	Immunology
	20MBU402	Medical Microbiology
	20MBU403	Recombinant DNA Technology
	20MBU411	Immunology - Practical
	20MBU412	Medical Microbiology - Practical
	20MBU413	Recombinant DNA Technology- Practical
V	20MBU501	Environmental Microbiology
	20MBU511	Environmental Microbiology- Practical
VI	20MBU601	Food and Dairy Microbiology
	20MBU611	Food and Dairy Microbiology- Practical
	20MBU691	Project

Skill Enhancement Courses(SEC)		
Semester	**Course Code**	**Name of the Course**
III	20MBU304A	Instrumentation and Biotechniques
	20MBU314A	Instrumentation and Biotechniques- Practical
	20MBU304B	Microalgal Technology
	20MBU314B	Microalgal Technology- Practical
IV	20MBU404A	Molecular Biology
	20MBU414A	Molecular Biology - Practical
	20MBU404B	Biomathematics and Biostatistics
	20MBU404B	Biomathematics and Biostatistics- Practical

Discipline Specific Elective Courses (DSE)		
Semester	**Course Code**	**Name of the Course**
V	20MBU502A	Microbes in Sustainable Agriculture and Development
	20MBU512A	Microbes in Sustainable Agriculture and Development- Practical
	20MBU502B	Veterinary Microbiology
	20MBU512B	Veterinary Microbiology- Practical
	20MBU503A	Bioinformatics
	20MBU513A	Bioinformatics- Practical
	20MBU503B	Drug design and development
	20MBU513B	Drug design and development- Practical
	20MBU504A	Cell Biology
	20MBU514A	Cell Biology- Practical
	20MBU504B	Biopharmacy
	20MBU514B	Biopharmacy - Practical
VI	20MBU602A	Microbial Biotechnology
	20MBU612A	Microbial Biotechnology- Practical
	20MBU602B	Plant tissue and animal tissue culture
	20MBU612B	Plant tissue and animal tissue culture- Practical
	20MBU603A	Microbial Diagnosis in Health Clinic
	20MBU613A	Microbial Diagnosis in Health Clinic- Practical
	20MBU613B	Biosafety and Intellectual Property Rights
	20MBU603B	Biosafety and Intellectual Property Rights- Practical

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 equipments. 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, Students will have a major knowledge on concepts of immunology, biotechnology, molecular biology, biochemistry, genetics. Able to explain the beneficial and harmful role of microorganisms in environment.

Programme Specific Outcomes (PSOs)

h Students will have a major knowledge on concepts of immunology, biotechnology, molecular biology, biochemistry, genetics. Able to explain the beneficial and harmful role of microorganisms in environment. Able to understand the importance of microorganisms in various industries such as pharmaceuticals, food, biofertilizers and biopesticides etc,

i Describe how microorganisms are used as model systems to study basic biology, genetics, metabolism and ecology.

j. Identify ways microorganisms' play an integral role in disease, and microbial and immunological methodologies are used in disease treatment and prevention.

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
PEO I	X							X		X
PEO II	X							X	X	
PEO III				X			X	X		
PEO IV				X			X		X	
PEO V	X					X				X
PEO VI		X	X	X						
PEO VII	X		X	X	X					

கற்பகம் உயர்கல்வி கலைக்கழகம்

தமிழ்த்துறை

பகுதி - I தமிழ்ப் பாடத்திட்டம் (2020 - 2021)

(இளநிலை அறிவியல் பட்ட வகுப்புகளுக்குரியது)

(For I-UG Science Degree Classes)

பாடத்திட்டப் பொதுநோக்கம்

- கற்றல் வழி சிந்தனைத் திறனையும், கருத்து வெளிப்பாட்டுத் திறனையும், ஆய்வுநோக்கையும் மேம்படுத்துதல்.
- இலக்கியங்கள் உணர்த்தும் வாழ்வின் நுட்பமான பகுதிகளை உணர்த்துதல்.
- மனித மனத்தினைப் பக்குவப்படுத்துதலில் இலக்கியம் தரும் பங்கினை உணர்த்துதல்.
- வளர்ந்து வரும் சமூகத்தில் அறஉணர்வு, பண்பாடு போன்றவை குறித்து அறிவூட்டல்.
- அரசுத் தேர்வுகளுக்கு மாணவர்களை ஆயத்தமாக்குதல்.

பாடத்திட்டப் பயன் விளைவு

- இந்திய குடியுரிமைப் பணி முதலான போட்டித் தேர்வுகளில், விருப்பப் பாடமாக இடம்பெறுகின்ற, 'தமிழ் இலக்கிய வரலாறு' குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்.
- கல்வெட்டியல், ஓலைச்சுவடியியல் மற்றும் தொல்லியல் சார்ந்த ஆவணத் தேடலுக்குரிய ஆய்வுமனப்பான்மையுடன், இலக்கியங்களை அணுகுதல்.
- தமிழின் வளர்ச்சித் துறையாகிய, 'அறிவியல் தமிழ்' ; 'இணைய தமிழ்' குறித்த பன்நோக்கு அணுகுமுறையிலான ஆய்வுச் சிந்தனை மேம்பாடு.
- வேலைவாய்ப்புக்குரிய சுயதிறன் மேம்பாட்டுடன், படைப்பாக்கத்திறன் மேம்பாடும் பெற்றிருத்தல் .
- சமுதாய மற்றும் வாழ்வியல் மதிப்புகளைப் பேணுவதற்கு உறுதுணையாக இலக்கியங்களை நாடுகின்ற மனப்பான்மை.

தாள்கள் வரிசையும் தேர்வுச் செயல்திட்டமும்

பகுதி-I தமிழ்

இளநிலைப் பட்ட அறிவியல் வகுப்புகள்

பருவம்	தாள்	கற்பிக்கும் நேரம்/வாரம்	தேர்வு மணிகள்	மதிப்பெண்	மொத்தம்	மதிப்பீடு
				அகமதிப்பீடு / எழுத்துத்தேர்வு		
ஒன்று	I	4 மணி	3	40 / 60	100	4

கற்பகம் உயர்கல்வி கலைக்கழகம்

தமிழ்த்துறை

பகுதி - I தமிழ்ப் பாடத்திட்டம் (2020-2021)

பகுதி – I, தமிழ், தாள் 1 முதல் பருவம் 20LSU101 4-H,4-C

(இளநிலை அறிவியல் பட்ட வகுப்புகளுக்குரியது)

(For I-UG Science Degree Classes)

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-தாய்தந்தையரைப் போற்றுதல்- தேர்ந்தெடுக்கப்பட்ட 5 பாடல்கள்)
   சின்னவோர் பொருள், கடவுளை வருந்தி, எப்புவிகளும், வைத்தவர், ஈன்றவர்

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).

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. தன்விவரக் குறிப்புடன் வேலை வேண்டி விண்ணப்பம் எழுதுதல்
2. பல்கலைக்கழகப் பன்னாட்டுக்கருத்தரங்கச் செய்தியை நாளிதழில் வெளியிட வேண்டி 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, பதிப்பகத்தாருக்கு விண்ணப்பம்

Semester – I

20ENU101 **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 train students to acquire proficiency in English by reading different genres of literature and learning grammar.
- To provide aesthetic pleasure through literature.

COURSE OUTCOME:

- Retrieve fundaments of English language to construct error free sentences
- 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

Types of Sentences, Subject and Predicate, Parts of Speech and Articles

UNIT –II: Interpersonal Skills

Greetings & Introduction- Giving &Denying Permission- Telephone Etiquette-
Oral Presentation – Plan, PowerPoint Presentation- Preparation of Speech- Audience psychology- Secrets of Good Delivery

UNIT - III: Communication Exercise

Importance of Business Language- Words often Confused- Words often Misspelt- Common Errors in English- Charts and Pictorial Writing.

UNIT - IV: LSRW Skills

Listening- Listening and its types, Basic Listening Lessons
Speaking- Basics of speaking, Regular English, Business English, Interview English
Reading- Reading and its purposes, Types of Reading, Reading Techniques
Writing- Types of Writing, Components of Writing, Language and Style with accordance to the contexts

UNIT - V: Literature

Prose: Let's Do What India Needs from Us -Dr.A.P.J. Abdul Kalam
Poem: A Prayer for My Daughter - W.B. Yeats
Short Story: Sparrows- K. Ahmad Abbas

SUGGESTED READING

1. Hewings Martin, 2013 Advanced Grammar in Use, Cambridge University Press
2. Haines Simon, 2015 Advanced Skills, A resource Book of Advanced- Level Skill Activities

Semester–I

20MBU101 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 strong, fundamental foundation in microorganisms for advanced studies in biological sciences, particularly microbiology.

COURSE OUTCOMES

1. After completion of this course paper, the students clearly understand the contributions of various scientists for development of microbiology field.
2. This paper also makes the student study the diversity of microbes and their applications.

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. Role of microorganism in fermentation, Germ theory of disease, Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Ellie Metchnikoff, Edward Jenner. Application in industries, medicine, agriculture, biotechnology and biology.

Unit II- 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 and Universal Phylogenetic tree. 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. (2008). Microbiology: An Introduction. 9thedition. Pearson Education.
2. Madigan, M.T., Martinko J.M., Dunlap, P.V., and Clark, D.P. (2014). Brock Biology of Microorganisms. 14th edition. Pearson InternationalEdition.
3. Cappucino, J., and Sherman, N. (2010). Microbiology: A Laboratory Manual. 9th 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

20MBU102 **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.
- To learn techniques and methods used in the cultivation and isolation of bacteria.
- To learn various physical and chemical means of sterilization
- 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 can able to:

- Understand the basic microbial structure and function
- Understand the structural similarities and differences among various physiological groups of bacteria and archaea
- Demonstrate theory and practical skills in staining procedures
- Understand various Culture media and their applications
- Understand various physical and chemical means of sterilization
- Know General bacteriology and microbial techniques for isolation of pure cultures 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. Cyanobacteria: An Introduction.

SUGGESTED READINGS

1. Willey, J.M., Sherwood, L.M., and Woolverton, C.J. (2019). Prescott's Microbiology. 11thedition. 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. Black, J.G. (2008). Microbiology: Principles and Explorations. 7th edition. PrenticeHall
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

20MBU103 **BIOCHEMISTRY -I** **Semester – 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 basics of biochemistry and its applications.
- It serves as good research techniques and the ability to combine and analyze information.

COURSEOUTCOME (CO'S)

- Student will able to understand the structures of enzymes, proteins, carbohydrates, fats
- Student will able to understand the functions of bio molecules
- Student will able to analyze the process of metabolism
- Student will able to understand of nucleic acids and their importance

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, 4thedition. Published by Churchill Living stone.
3. Tymoczko, J.L., Berg, J.M., and Stryer, L. (2012) Biochemistry: A short course, 2ndedition. W.H. Freeman.
4. Berg, J.M., Tymoczko, J.L., and Stryer, L. (2011) Biochemistry, W.H. Freeman and Company. Nelson, D.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.

Semester –I

20MBU111 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 and colony characteristics. Various staining techniques
- Isolation of parasites from edible fruits.
- Biosafty 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.

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 Lacto phenol 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 Sherman,N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson EducationLimited.

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

Semester – I

20MBU112 **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 learn various staining techniques

COURSE OUTCOME

After Completion of this course candidate can able to demonstrate:

- Theory and practical skills in staining procedures
- Various Culture media and their applications
- Various microbial techniques for isolation of pure cultures of bacteria

EXPERIMENTS

1. Preparation of different media: synthetic media BG-11, Complex media - Nutrient agar, McConkey agar, EMB agar.
2. Micrometry.
3. Motility by hanging drop method.
4. Simple staining
5. Negative staining
6. Gram's staining
7. Acid fast staining – demonstration permanent slide only.
8. Capsule staining
9. Endospore staining.
10. Isolation of pure cultures of bacteria by streaking method - Quadrant, Continuous and T-streaking.
11. Preservation of bacterial cultures by various techniques - Agar slants and deeps - Mineral Oil, Glycerol stocks
12. Estimation of Colony Forming Unit (CFU) count by spread plate method/pour plate method.

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. Cappucino, J., and Sherman. N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited

Semester – I

20MBU113 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
- Tomakestudentsfamiliarwithpracticaltechniquesusedforstudyingbiochemicalstructureandanalysisofbiochemical methods.

COURSE OUTCOME

- Students will get practical knowledge about various techniques used in Biochemistry.

EXPERIMENTS

1. Propertiesofwater,conceptofpHandbuffers,preparationofbuffersandnumericalproblemstoexplaintheconceptsof 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 effect of temperature, pH and heavy metals on enzyme activity.
9. Estimation of any four vitamins.

SUGGESTED READING

1. Campbell., M.K.(2012) Biochemistry,7thedition. Published by Cengage Learning.
2. Campbell, P.N., and Smith, A.D. (2011) Biochemistry Illustrated, 4thedition. Published by 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,5thEdition. W.H.Freeman and Company.
6. Willey, M.J. Herwood, L.M. & Woolverton,C.J. (2013) Prescott ,Harley and Klein's Microbiology 9thEdition. McGrawHill
7. Voet,D,.and Voet,J.G. (2004) Biochemistry 3rd edition, John Wiley and Sons.

கற்பகம் உயர்கல்வி கலைக்கழகம்

தமிழ்த்துறை

பகுதி - I தமிழ்ப் பாடத்திட்டம் (2020 - 2021)

(இளநிலை அறிவியல் பட்ட வகுப்புகளுக்குரியது)

(For I-UG Science Degree Classes)

பாடத்திட்டப் பொதுநோக்கம்

- கற்றல் வழி சிந்தனைத் திறனையும், கருத்து வெளிப்பாட்டுத் திறனையும், ஆய்வுநோக்கையும் மேம்படுத்துதல்.
- இலக்கியங்கள் உணர்த்தும் வாழ்வின் நுட்பமான பகுதிகளை உணர்த்துதல்.
- மனித மனத்தினைப் பக்குவப்படுத்துதலில் இலக்கியம் தரும் பங்கினை உணர்த்துதல்.
- வளர்ந்து வரும் சமூகத்தில் அறஉணர்வு, பண்பாடு போன்றவை குறித்து அறிவூட்டல்.
- அரசுத் தேர்வுகளுக்கு மாணவர்களை ஆயத்தமாக்குதல்.

பாடத்திட்டப் பயன் விளைவு

- இந்திய குடியுரிமைப் பணி முதலான போட்டித் தேர்வுகளில், விருப்பப் பாடமாக இடம்பெறுகின்ற, 'தமிழ் இலக்கிய வரலாறு' குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்.
- கல்வெட்டியல், ஓலைச்சுவடியியல் மற்றும் தொல்லியல் சார்ந்த ஆவணத் தேடலுக்குரிய ஆய்வுமனப்பான்மையுடன், இலக்கியங்களை அணுகுதல்.
- தமிழின் வளர்ச்சித் துறையாகிய, 'அறிவியல் தமிழ்' ; 'இணைய தமிழ்' குறித்த பன்நோக்கு அணுகுமுறையிலான ஆய்வுச் சிந்தனை வளர்ச்சி.
- வேலைவாய்ப்புக்குரிய சுயதிறன் மேம்பாட்டுடன், படைப்பாக்கத்திறன் மேம்பாடும் பெற்றிருத்தல் .
- சமுதாய மற்றும் வாழ்வியல் மதிப்புகளைப் பேணுவதற்கு உறுதுணையாக இலக்கியங்களை நாடுகின்ற மனப்பான்மை.

தாள்கள் வரிசையும் தேர்வுச் செயல்திட்டமும்

பகுதி-I தமிழ்

இளநிலைப் பட்ட அறிவியல் வகுப்புகள்

பருவம்	தாள்	கற்பிக்கும் நேரம்/வாரம்	தேர்வு மணிகள்	மதிப்பெண்	மொத்தம்	மதிப்பீடு
				அக மதிப்பீடு / எழுத்துத்தேர்வு		
இரண்டு	II	4	3	40 / 60	100	4

கற்பகம் உயர்கல்வி கலைக்கழகம்

தமிழ்த்துறை

பகுதி - I தமிழ்ப் பாடத்திட்டம் (2020-2021)

பகுதி – I, தமிழ், தாள்-2 இரண்டாம் பருவம் 20LSU201

4-H,4-C

(இளநிலை அறிவியல் பட்ட வகுப்புகளுக்குரியது)

(For I-UG Science Degree Classes)

அலகு – I : தமிழ் இலக்கிய வரலாறு- II **(5 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 கவிதை - சிறுகதை – உரைநடை – இலக்கியங்களின் தோற்றம் – வளர்ச்சி – உத்திகள் – நாட்டுப்புற இலக்கியங்கள்- கொங்குநாட்டார் வாய்மொழி வழக்காறுகள்.

அலகு – II : பக்தி இலக்கியமும் சிற்றிலக்கியமும்: **(12 மணிநேரம்)**

அ). பக்தி இலக்கியம் (6 மணிநேரம்)

1. **1. சைவம் -** பெரியபுராணம் – இளையான்குடிமாறநாயனார் புராணம் - **(19 பாடல்கள்) .**

(அம்பொன் நீடிய, கொண்டு வந்து, ஆளு நாயகர், செல்வம் மேவிய, மாரிக் காலத்து, ஈர மேனியை, நமக்கு முன்பிங்கு, செல்லல் நீங்க, மற்றம் மாற்றம், உள்ளம் அன்பு, காலினால் தடவி, வந்தபின் மனைவியாரும், முறித்தவை அடுப்பின், வழிவரும் இளைப்பினோடும், மனைவியார் கொழுநர், கணவனார் தம்மை, அழுந்திய இடருள், மாலயற் கரிய, அன்பனே அன்பர் பூசை)

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.

ஆ). சிற்றிலக்கியம் (6 மணிநேரம்)

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.

அலகு – III: கவிதையும் சிறுகதையும் (16 மணிநேரம்)

அ). கவிதை இலக்கியம் (8 மணிநேரம்)

1. மகாகவி பாரதியார் – கண்ணன் – என் சீடன்
2. புரட்சிக்கவிஞன் பாரதிதாசன் – இளையார் ஆத்திசூடி - அழுபவன் கோழை
3. கவிமணி தேசிக விநாயகம் பிள்ளை – கோயில் வழிபாடு
4. கவிக்கோ. அப்துல்ரகுமான் – பாருக்குள்ளே நல்ல நாடு
5. சிற்பி பாலசுப்பிரமணியன் – மலையாளக் காற்று
6. கவிஞர் தாமரை – தொலைந்து போனேன்
7. கவிஞர் கரிகாலன் – விடுதலை

ஆ). சிறுகதை இலக்கியம் (8 மணிநேரம்)

1. சாபவிமோசனம் – புதுமைப்பித்தன்
2. நகரம் – சுஜாதா
3. அந்நியர்கள் – ஆர். சூடாமணி
4. இந்நாட்டு மன்னர் – நாஞ்சில்நாடன்

அலகு – IV : உரைநடை இலக்கியம் (8 மணிநேரம்)

1. ஆளுமைத்திறன் அறிவோம் - தன்னம்பிக்கை மாத இதழிலிருந்து
2. திருக்குறளும் சமுதாயவியலும் -- முனைவர் புரிசை நடராசன்
3. தமிழ் – உயர்தனிச் செம்மொழி -- முனைவர் இரா. குணசீலன்
4. நொய்யல் – முனைவர் ப. தமிழரசி

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

இலக்கணப் பயிற்சி: 1. அணி இலக்கணம்

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

2. துறை சார் கலைச்சொல் பயன்பாட்டாக்கம்
3. படைப்பிலக்கியப் பயிற்சிகள்
    1. மரபுக்கவிதை, புதுக்கவிதை, சிறுகதை, கட்டுரை படைப்பாக்க உத்திகள் - பயிற்சிகள்
    2. எழுத்தாளருடனான நேர்காணல் மற்றும் கள ஆய்வுக்கான வினா நிரல் தயாரித்தல் நுட்பங்களும் பயிற்சிகளும்.
4. மொழிபெயர்ப்புப்பயிற்சிகள்
    1. தமிழ்-ஆங்கில மொழிபெயர்ப்புப் பயிற்சிகள் -2.
    2. ஆங்கிலம்-தமிழ் மொழிபெயர்ப்புப் பயிற்சிகள்-2.

பாட நூல்: கற்பகச்சோலை – தமிழ் ஏடு.

கற்பகம் உயர்கல்வி கலைக்கழகத் தமிழ்த்துறை வெளியீடு.

Part I TAMIL 2020. Even Sem Science Karpagam Academy of Higher Education, Coimbatore – 21.

B.Sc.Microbiology **2020-2023**

Semester – II

20ENU201 **ENGLISH-II** **(4H – 4C)**

Instruction Hours / week: L: 3 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 understand different kinds of communication involved in the business environment.
- 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.
- 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 – Grammar

Voice, Idioms and Phrases, Clauses and Reported Speech

UNIT –II –Business and Technical Reports

Business Correspondence – Memo, Notices, Agenda, Minutes- Resume Writing- Report Writing- Letter Writing- Personal and Social Letters- E-mail Writing

UNIT –III – Communication Practice

Verbal and Non-Verbal Communication- Group Discussion and Seminars- Note-Taking and Note-Making

UNIT –IV – LSRW Skills

Listening - Listening Talks and Presentations

Speaking - Public Speaking- Preparatory steps, Time Management, Handling Questions and Meeting unexpected situations

Reading - Language of Newspapers, Magazines and Internet

Writing - Writing Paragraphs and Essays- Content Writing

UNIT –V – Literature

Prose- Morals in the Indian Context by Francis Nicholas Chelliah

Poetry- Telephone Conversation by Wole Soyinka

Short Stories- The Last Leaf by O' Henry

Books for References

Oxford Handbook of Writing: St. Martins Handbook of Writing 2013 CU Press

Sound Business, Julian Treasure 2012OUP

20MBU201 **(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.
- It serves as good research knowledge on various metabolic pathways that prevails inside the human body.

COURSEOUTCOMES

- A candidate can able to understand metabolic pathways of carbohydrates, proteins, Lipids and Nucleic acids.
- This course will provide clear understanding about the Biological oxidation.

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.

Unit II- Carbohydrate metabolism

Glycolysis, TCA cycle, Glycogenesis, Glycogenolysis, HMP shunt, Gluconeogenesis, Glucuronic acid pathway.

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.

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

20MBU202 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

- It gives brief description on the microbial metabolism and its energetics
- It deals with the various aerobic and an aerobic processes through which the organisms obtain and utilize the energy for their growth.
- Explains photosynthesis and photosynthetic bacteria.

COURSE OUTCOME

After completion of this course candidate can able to:

- Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement
- Understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolism
- The students will be able to understand and predict the various metabolic reactions in microbial cell.
- Understand the microbial photosynthesis and photosynthetic pigments.

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: primary and secondary active transport, Group translocation and Iron uptake.Uniport, Symport, Antiport, Electrogenic transporter, Electroneutral transporter.

Unit II- Microbial growthandconcept of Fermentation

Bacterial cell division, Growth curve - Different phases of growth curve - generation time, growth rate and growth kinetics. Measurement of microbial growth- Direct and indirect method. 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. (2005). Microbial Physiology. Scientific Publishers India

B.Sc.Microbiology	BIOCHEMISTRY–II PRACTICAL	2020-2023
		Semester – II
20MBU211		(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.
- To make students to gain knowledge with these techniques used for purification and structural predication of bioorganic compounds.

COURSE OUTCOME

1. Students will get practical knowledge about various techniques used in Biochemistry.

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

20MBU212 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: 6 Hours

COURSE OBJECTIVES

- To enhance the students knowledge on various aspects of microbial physiology like growth and chemical characterization of microbes.

COURSE OUTCOME

After Completion of this course candidate can able to:

- Understand the growth curve and various factors for optimal growth of *E.coli.*
- Understand and predict the various metabolic reactions in microbial cell.

EXPERIMENTS

1. Study and plot the growth curve of *E. coli* by turbidometric 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. (2005). Microbial Physiology. Scientific Publishers India

Semester – II

20AEC201 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.

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. Disaster management (floods, earthquake, cyclones and landslides).Environmental Movements (Chipko, Silent valley, Bishnois of Rajasthan). Environmental ethics: Roleof 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 text book for Environmental Studies, University Grants Commission and Bharat Vidypeeth Institute of Environmental Education Research, New Delhi.
2. Anubha Kaushik., and Kaushik, C.P. 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.

Semester – III

20MBU301 **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.

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 various mechanisms to enter and escape from host.

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.

Unit V- Antiviral compounds

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 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. 6thedition, Blackwell PublishingLtd.
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

19MBU302 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 of genetics.
- To discuss about the microbial genes, genomes, and expression is essential for understanding the biology and evolution of microorganism and their interaction with the environment.
- To Understanding the central dogma of biology (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:

- This course provided candidates with basic awareness and outline of Molecular Biology with unique reference to microbial genome.
- Students will be able to describe the nature of molecular world and its application in modern Microbiological sectors.
- Students will be able to understand the process of Mutation and mutagenesis.
- This paper provided the knowledge about the central dogma of biology.
- This course provided the concepts of genetic recombination techniques.
- 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 .DNA repair mechanisms.

Unit II- Plasmids

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

Unit III- Genetic code

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

Unit IV- Mutations

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

Unit V- Transposons

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

SUGGESTED READINGS

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

Semester – III

20MBU303 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 use of microorganisms in the manufacture of industrial products.

COURSE OUTCOME

- Student will be able to understand the role of microorganisms in industries
- Student will analyze the importance of secondary metabolites
- Student will be able to understand the steps involved in production and purification of various products
- Student will have knowledge about the large scale production of industrial product, providing the trends to cater the needs of industry

Unit I

Brief history and developments in industrial microbiology. Professional ethics, 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. 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, Role of microbes in bioleaching and textile industry.

Unit III

Types of fermentation processes – Solid-state and liquid-state (stationary and submerged) fermentations; batch, fed-batch and continuous fermentations. Components of a typical bio-reactor, Types of bioreactors – Laboratory, pilot-scale and production fermenters, constantly stirred tank and air-lift fermenters.

Unit IV

Downstream processing-techniques and methods: 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) (micro-organisms involved, media, fermentation conditions, downstream processing and uses).

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

20MBU304A INSTRUMENTATION AND BIOTECHNIQUES (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 develop skills related to

- Understand the principles of various instruments used in the life sciences
- Ability to operate the instruments
- Data analysis and interpretations

COURSE OUTCOME

- Offers the students with an opportunity to gain knowledge on the bioinstrumentation and concepts of principles and applications.

Unit I

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

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 and HPLC.

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, Quantification of DNA and RNA.

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, 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. Analytical centrifugation.

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

20MBU304B **MICROALGAL TECHNOLOGY** **(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 enhance the students knowledge on the culture aspects and development
- of microalgae culture technology and their applications
- To acquire an overall knowledge on the morphology, functions biological applications on
- microalgae.

COURSE OUTCOME

- Students understand the importance of microalgae
- Students know the characteristics of microalgae
- 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

Phytoplankton- Classification and their importance-primary production. Phytoplankton- collection, identification, isolation, stages of phytoplankton culture and development of pure culture techniques.

UNIT II

Culture maintenance – Mass culture production of phytoplankton-culture media and preparation methods. Biochemical composition of micro algae- Microalgae growth promoting factors.

UNIT III

Pharmaceutical applications of Marine Microalgae-Biotic analysis of Microalgae-Algal compounds uses of pharmaceuticals- Antitumor activity of Microalgae-Medicinal uses of microalgae.

UNIT IV

Agriculture Applications- 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 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) Indira Priyadarshani and Biswajit Rath Department of Biotechnology, North Orissa University, Sriram Chandra Vihar, Takatpur, Baripada-757003.

2) Abd El-Baky, H.H. Moawd, A. El-Behairy, A.N. and ElBaroty, G.S. 2002 Chemoprevention of benzo[a]pyreneinduced carcinogen and lipid peroxidation in mice by lipophilic algae extracts (phycotene). J. Med. Sci. 2: 185– 93.

3) Abe, K. Nishmura, N. and Hirano, M. 1999 Simultaneous production of β-carotene, vitamin E and vitamin C by the aerial microalga Trentepohia aurea. J. Appl. Phycol. 11: 33–6.

4) Avagyan, A.B. 2008 Microalgae: Big Feed Potential in a Small Package. Feed International. 16-18.

5) H.A. Spoehr and H.A. Milner, "The Chemical Composition of Chlorella: Effect of Environmental Conditions," Plant Physiol. 24: 120 (1949).

Semester – III

19MBU311 VIROLOGY–PRACTICAL (4H –2C)

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

End Semester Exam: 6 Hours

COURSE OBJECTIVES

- To study general aspects of 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 knowledge on structure of plants, animal, bacteria and viruses.
2. This paper also enables the student on isolation, propagation of various viruses.

EXPERIMENTS

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.

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

20MBU312 MICROBIAL GENETICS- PRACTICAL (4H –2C)

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

End Semester Exam: 6 Hours

COURSE OBJECTIVES:

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

COURSE OUTCOME (CO'S)

- End of this practical's students can able to describe the techniques involved in Microbial Genetics.
- They could successfully categorize the mutation and its characteristics.
- Students able to evaluate the nature and molecular size of DNA via peculiar techniques.
- They could be able to understand the application of plasmid in biotechnology.
- They could be able to evaluate the microorganisms growth and the factor involved for their growth.

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 Agaraose gel electrophoresis.
8. Perform quantitative PCR for bacterial DNA sample.
9. Perform of Bacterial Conjugation.
10. Perform of bacterial transformation and transduction.
11. Perform of Restriction digest and plasmid mapping.

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, BenjaminCummings.
5. Gardner, E.J., Simmons, M.J., Snustad, 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

19MBU313 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 industrial products.

COURSE OUTCOME

- Student will analyze the importance of secondary metabolites
- Student will be able to understand the steps involved in production and purification of various products
- Student will have knowledge about the large scale production of industrial product, providing the trends to cater the needs of industry

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.

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

20MBU314A 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

To develop skills related to

- Understand the principles of various instruments used in the life sciences.
- Ability to operate the instruments.
- Data analysis and interpretations.

COURSE OUTCOME

Offers the students with an opportunity to gain knowledge on the bioinstrumentation and concepts of principles and applications

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.

Nigam A and Ayyagari A. (2007). Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw Hill

Semester – III

20MBU314B MICROALGAL 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 culture aspects and development of microalgae culture technology and their applications
- To make the students knowledgeable on the various techniques involved.

COURSE OUTCOME

- Students know the applications of microalgae biotechnology
- 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 READINGS

1) Indira Priyadarshani and Biswajit Rath Department of Biotechnology, North Orissa University, Sriram Chandra Vihar, Takatpur, Baripada-757003.

2) Abd El-Baky, H.H. Moawd, A. El-Behairy, A.N. and ElBaroty, G.S. 2002 Chemoprevention of benzo[a]pyreneinduced carcinogen and lipid peroxidation in mice by lipophilic algae extracts (phycotene). J. Med. Sci. 2: 185– 93.

3) Abe, K. Nishmura, N. and Hirano, M. 1999 Simultaneous production of β-carotene, vitamin E and vitamin C by the aerial microalga Trentepohia aurea. J. Appl. Phycol. 11: 33–6.

4) Avagyan, A.B. 2008 Microalgae: Big Feed Potential in a Small Package. Feed International. 16-18.

Semester – IV

20MBU401 **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.

COURSE OUTCOME

Introducing the science of immunology and to study various types of immune systems their classification structure and mechanism of immune activation

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. 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, 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

20MBU402 **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.
- The course creates the conceptual basis for understanding pathogenic microorganisms and particularly address the fundamental mechanisms of their pathogenicity.

COURSE OUTCOME:

- 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.
- It will develop the student's knowledge on medically important microorganism's morphology with the main focuses being the characterization based on physiological factors.
- It will give improved knowledge on current antimicrobial chemotherapy, antibiotics towards target sites, drug resistance mechanisms and spectrum evaluation methods in the clinical settings.
- Student can be able to safeguard the society and can work for advanced clinical diagnostics practices.
- 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: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract. Host pathogen interaction: Definitions – Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, Pathophysiologic effects of LPS. Collection, transport and culturing of clinical samples – Sputum, Stool and Urine.

Unit II

List of diseases of various organ systems and their causative agents.The following diseases in detail with symptoms, mode of transmission, prophylaxis and control.Respiratory pathogens: *Streptococcus pyogenes, Haemophilus influenzae, Mycobacterium tuberculosis.* Gastrointestinal Diseases: *Escherichia coli, Salmonella typhi, Vibrio cholerae, Helicobacter pylori.* Others: *Staphylococcus aureus, Bacillus anthracis, Clostridium tetani, Treponema pallidum,* Significance of ESKAPE Pathogens, Polymicrobial infection and colonization.

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).

Unit IV

Brief description of each of the following types of mycoses and one representative disease to be studied with respect to 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, Elephanttiasis, 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.

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

Semester – IV

20MBU403 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.

COURSE OUTCOME

Imparts the concepts of rDNA technology and their applications and Acquire knowledge on the applications of genetic engineering.

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), 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

20MBU404A MOLECULAR BIOLOGY (3H –3C)

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- The course presents methods and experimental tools used in modern molecular biology with emphasis on prokaryotes and eukaryotes.
- The theoretical grounds of methods and their applications in research will be discussed.
- The course also deals with the genome structure, stability, organization, and its expression.
- The course includes among others model systems, genetics behind complex diseases, identification of disease genes and different types of mutations.

COURSE OUTCOME (CO'S)

1. This course allows the candidate to recollect the basics of molecular genetics and apply a cognitive thinking on the application oriented sectors of genetics.
2. Students would be able to practically apply this knowledge in different sectors with possibilities ranging from the treatment of human diseases to the development of novel medicines.
3. A thorough understanding of the process of translation and operons along with recombination of DNA.
4. An in-depth study of mutagenesis and genetic analysis with gene mapping.
5. Full understanding of all aspects of all important techniques used for the study of biomolecules.

Unit I

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, 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.

Unit III

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

Unit IV

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, Denaturation and renaturation, cot curves, Damage and Repair - Causes (spontaneous, chemical agent, radiation) and types of DNA damage, Mechanism of DNA repair: Direct repair, base excision repair, nucleotide excision repair, mismatch repair, recombination repair.

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

19MBU404B BIOMATHEMATICS AND BIOSTATISTICS (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

This course enables the students to learn

- The concepts of sentential and predicate calculus.
- The methods of differential and integral calculus.
- About collection, interpretation and presentation of statistical data
- The analytics of data, probability, and hypothesis testing of samples
- The essential role of statistics in present, future use and applications of Biology.

COURSE OUTCOMES

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

- Master in the concepts of mathematical logic, set theory and relation
- Solve biological problems with the help of concept and principles of differential and integral calculus
- Acquire four basic sampling techniques.

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 fibres 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

20MBU411 IMMUNOLOGY–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 strengthen the knowledge of students in immunodiagnostics.
- To learn the latest trends in immunology.
- Rapid diagnosis and Immune reaction.

COURSE OUTCOME

Introducing the science of immunology and to study various types of immune systems their classification structure and mechanism of immune activation.

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.

Semester – IV

20MBU412 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 create a clear understanding of the scientific basis of traditional and modern microbiological concepts
- To introduce the knowledge of the medically important microorganisms, microbial morphology with the main focuses being the characterization, isolation and identification ofdifferent microorganisms.
- To develop the knowledge on specialist practical skills and critical awareness needed to pursue a career in medical microbiology.

COURSE OUTCOMES:

- Students can able to gain maximum exposure to both the practical and theoretical aspects of a wide range of clinically relevant pathogens.
- It will help the students to develop practical skills that are valued by potential employers.
- This course will encourage the students to develop the level of laboratory skills to meet up employer requirements.

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, McConkey 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

20MBU413 RECOMBINANT DNA TECHNOLOGY–PRACTICAL (4H–2C)

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

End Semester Exam: 6 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

COURSE OUTCOME

This paper imparts the concepts of rDNA technology and their applications and Acquire knowledge on the applications of genetic engineering.

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

20MBU414A **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

- The course presents methods and experimental tools used in modern molecular biology with emphasis on prokaryotes and eukaryotes. .
- The course include among others model systems, genetics behind complex diseases, identification of disease genes and different types of mutations.
- The course explores technologies using molecular biology, embryo manipulation, cell and tissue culture to manipulate the genomes of animals for ways to improve the live stock for food production and biomedical purpose.

COURSE OUTCOME

1. Acquire technical skills on isolation of DNA & Plasmid & their quantification
2. Know how to perform gene transfer, protein quantification
3. Gain the basic skill on blotting techniques & PCR
4. Molecular detection of infectious proteins by blotting techniques.

EXPERIMENTS

1. Competent cell preparation
2. Bacterial transformation
3. Isolation of genomic DNA from *E. coli.*
4. Estimation of salmon sperm / calf thymus DNA using colorimeter (diphenylaminereagent) or UV spectrophotometer (A260 measurement).
5. Estimation of RNA using colorimeter (orcinol reagent) or UV spectrophotometer (A260 measurement).
6. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
7. Estimation of protein by Lowry's method
8. Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (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.

Semester – IV

20MBU414B 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 enables the students to learn

- About collection, interpretation and presentation of statistical data
- The analytics of data, probability, and hypothesis testing of samples
- The essential role of statistics in present, future use and applications of Biology.

COURSE OUTCOMES

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

- Master in the concepts of Measures of Central tendency and Measures of Dispersion. Solve biological problems with the help of sampling techniques.

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 (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-V

20MBU501 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 recognise the ecological problems and critical evaluation of the human impacts on pollution, climate changes and as well as environmental protection.

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.

UNIT I: Introduction- Environment

Environment Definition, scope and importance, components, Ecosystem Definition, Concept, Scope, importance, Structure and functions of ecosystem. Energy flow, Ecological succession Food chains and food webs. Classification of ecosystem. Environmental monitoring through microorganisms, monitoring of water and soil.

Unit II: Natural Resources - Renewable and Non-renewable Resources

Natural resources and associated problems. Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources : Use and over-utilization, exploitation. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles. Ill-effects of fireworks.

Unit III: Biodiversity and Its Conservation

Introduction, definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels.India as a mega-diversity nation.Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

Unit IV: Environmental Pollution

Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management: Floods, earthquake, cyclone and landslides.

Unit V: Biogas and biodegradation technology

Biogas Technology- Plant design, construction, operation. Biogas from organic wastes. GMO and their important-Use in environmemental 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

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

20MBU502A 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 OBJECTIVES

- To study the properties of soil and their microbial diversity
- To understand the involvement of various microbes in agriculture

COURSE OUTCOMES

- Student will be able to understand the role of microbes in plant growth and disease suppression
- Student will analyze advantages of chemical pesticides with microbial pesticides
- Student will understand the different mechanisms of microbes in maintaining the soil fertility
- Students will apply their knowledge of composting to become entrepreneur
- Student will understand the involvement of microbes in mineralization of organic matter

Unit I

Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversity and distribution of microorganisms in soil, Mineralization of cellulose, hemicelluloses, lignocelluloses, lignin and humus, phosphate, nitrate, silica, potassium

Unit II

Decomposition of plant and animal residues by microbes in soil, Role of microbes in production and control of carbon dioxide, methane, nitrous oxide and nitric oxide, Micobial 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, Role of microbes in composting process.

Unit IV

Plant growth promoting bateria, biofertilizers – symbiotic (*Bradyrhizobium, Rhizobium, Frankia,* VAM, potash solubilizer), Non Symbiotic (*Azospirillum, Azotobacter*, Mycorrhizae, MHBs, Phosphate solubilizers, algae), Novel combination of microbes as biofertilizers, PGPRs,

Unit V

Mushroom Classification, Mushroom morphology, Biology of Mushrooms, Equipment and sterilization techniques, Mushroom production, Processing and preservation of mushrooms. Biotech feed, Silage, Biomanure, biogas, biofuels – advantages and processing parameters, Advantages, social and environmental aspects, 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

20MBU502B **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 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.
- 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 rise of commercialization in veterinary industry
2. Students will be able to developed, 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.
5. Demonstrate an understanding at an advanced level of microbial virulence mechanisms and host response to infection.

UNIT I: Introduction to veterinary virology

History and scope of Veterinary Virology, Founders of the science of virology, Origin and nature of viruses, Viruses and their properties, Glossary of terms, Morphology and structure of viruses, Electron microscopy, X-rat crystallography and other techniques used in study of morphology.

UNIT II: Biochemical composition and stability of viral compound

Biochemical composition-Nucleic acids(DNA/RNA)Proteins, glycoproteins and lipids, stability of viral infectivity, Influence of temperature, pH, Ionic environment, Lipid solvent and detergent etc.

UNIT III: cell interaction and cell damage

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: Pathogenecity and Epidemiology

Pathogenesis of viral diseases: Representative models of respiratory, intestinal, lymphoreticular and haematopoietic, central nervous system, multisystem, chronic and slowly progressive viral diseases. Epidemiology of viral diseases, Computations and databases for epidemiological analysis, Epidemiological investigations- types, models, Transmission of virus, Mechanism of virus survival in nature.

UNIT V: Viral vaccines

Viral Vaccines, 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 Publ.

3. Tortora GJ, Funke BR & Case CL. 2004. Microbiology: An Introduction. Benjamin/Cummins Publ.

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.

Semester–V

20MBU503A **BIOINFORMATICS** **(4H – 4C)**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To create the importance of computer in field of life sciences.
- Students can be able to understand about the interpretation of biological database management system.
- To uptake knowledge in latest bioinformatics tools and technology.
- To provide the students about the search engines and various software tools involved in bioinformatics
- To give a better understanding on accessing molecular data for genetic engineering.

COURSE OUTCOME

- Students will gain understanding of the principles and concepts of both biology along with Computer science
- Students can be able to perform recent analysis on genomics and proteomics.
- It will provide the knowledge on bioinformatics methods which is used to relate sequence to structure and function in evolutionary studies.
- It will develop problem-solving skills, new algorithms and analysis methods to address a range of biological questions.
- It will create the students to get advanced knowledge on nucleic and protein sequence analysis for molecular studies.

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.

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

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 Prêeti (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

20MBU503B 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

Drug Design and Discovery course introduce the basic principles of modern drug design, discovery and development. The course deals with the different source of drug with specific focus on microbial source, drug development and manufacturing process. Prerequisite: Masters students in Life Sciences

COURSE OUTCOME

The course will imparts knowledge on detection, selection, and validation of new antibacterial targets, vaccines and the use of gene technology in pharmaceutical industry

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, Oestrogens, Progesterone and progestogens etc), plant origin (Alkaloids Atropine and scopolamine Morphine and cocaine Additional plant alkaloids)

UNIT-II

Sources of Drugs- Microbial drugs, Plants as a source of drugs, E. coli as a source of recombinant therapeutic proteins. Expression of recombinant proteins in yeasts, animal cell culture systems. Additional production systems: Fungal production 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, Freezedrying, 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. Genebased vaccines.

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

20MBU504A **CELL BIOLOGY** **(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 explain the cell structure and functions of organelle.
- To determine the transportations through cell membrane.
- To categorize the different receptors and model of signaling.
- To analyze the concept of cell signaling.
- To describe the basic concept of cell structure, membrane, cellular functions of different types of cell, modes of cellular signaling and signal amplification.

COURSE OUTCOMES:

- Students can able to interpret about the cell and its functions.
- Students will understand the structure and importance of each cell organelle.
- Students will able to differentiate the cell receptor and its function in human system.
- This paper will motivate the students to do research work based on cell biology.
- Students could able to design a cell line for many diseases.

Unit I

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. Cytoskeleton: Structure and organization of actin filaments, association of actin filaments with plasma membrane junctions, gap plasmodesmata (only structural junctions & aspects). intermediate filaments and microtubules.

Unit II

Structure of Mitochondria, mitochondria synthesis and targeting mitochondria proteins. Peroxisomes, chloroplasts chrloroplaste protein synthesis. Photosynthesis, electron transport chain. Ultrastructure & function of ciliary and flagellar movement. Nuclear envelope, nuclear pore complex and nuclear lamina. Chromatin – Molecular organization. Nucleolus.

Unit III

Ribosomes, Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing and quality control in ER, smooth ER and lipid synthesis, export of proteins and lipids. Golgi Apparatus – Organization, protein glycosylation, protein sorting and export from Golgi Apparatus Lysosomes. Glyclosylation. Mechanisms of membrane resistance to lysosome enzyme. intra cellular digestion and lysosome storage diseases.

Unit IV

Signalling molecules and their receptors. Function of cell surface receptors. Pathways of intra-cellular receptors – Cyclic AMP pathway, cyclic GMP and MAP kinase pathway. Carrier proteins : Ubiquitins, cargo trafficking. Endocrine signals.

Unit V

Eukaryotic cell cycle and its regulation, Mitosis and Meiosis, Development of cancer, causes and types, apoptosis Programmed cell death, pathways of apotosis, Stem cells, Embryonic stem cell, induced pleuripotent stem cells. Primary cell culture(NACCS), Cancer cell line , includes breast cancer. MCF7 cell lines. Histology and histopathology.

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 4th edition 2015 by Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander D.Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter

Semester–V

20MBU504B **BIOPHARMACY** **(3H – 3C)**

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

End Semester Exam: 3 Hours

SCOPE

It provides the basic concept about the components and technique involved in the field of biopharmacy.

OBJECTIVES

An introduction to know about the biological substance which has the medicinal value. It aids to improve the biopharmaceutical components and technical knowledge. To study the origin, types and action of drugs; their effects on human health and legislations on them. Acquire knowledge on the action and effects of drugs on human health.

UNIT – I

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

UNIT – II

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

UNIT – III

Isolation and purification techniques – Thin layer and Column chromatography. Chemical fingerprinting – HPLC and HPTLC.

UNIT – IV

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

UNIT – V

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

REFERENCES

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

Semester-V

20MBU511 ENVIRONMENTAL 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 educate students about Environmental monitoring and environmental aspects of microbes.
- To impart a knowledge on Microbes and environment and ecological importance.
- 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.
- Describe role of microorganism in recycling soil nutrients, biodegradation of complex plant polymers, nutrient cycles, plant and animal microbal interaction.

COURSE OUTCOME

- Provides a comprehensive overview of biogeochemical processes relevant to environmental scientists and engineers mediated by microorganisms.
- Critically discuss the need for environmental microbiology and explain their limitations.
- Clarify application of microorganisms in varied fields of environmental microbiology like bioremediation, biofertilizers and waste water treatment.

EXPERIMENTS

1. Analysis of soil-pH, moisture content, water holding capacity, percolation, capillary action.
2. Isolation of microbes (bacteria &fungi) from soil (28°C&45°C).
3. Isolation of microbes from saline water and soil.
4. Isolation of microbes (bacteria &fungi) from rhizosphere and rhizoplane.
5. Assessment of microbiological quality of water.
6. Determination of BOD of waste water sample.
7. Study the presence of microbial activity by detecting (qualitatively) enzymes (Dehydrogenase, amylase and urease) in soil.
8. Isolation of *Rhizobium* from root nodules.

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/BenjaminCummings.
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

20MBU512A (4H-2C)

MICROBES IN SUSTAINABLE AGRICULTURE AND DEVELOPMENT- PRACTICAL

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

End Semester Exam: 6 Hours

COURSE OBJECTIVES

- To encode the importance of the role of microorganisms in food industries both in beneficial and harmful ways.
- To obtain a good understanding of food microbiology and become qualified as microbiologist in food industries.
- To know the role of microbes which make crop output more and increase the fertility of crops.

COURSE OUTCOMES

- Student will be able to understand the role of microbes in plant growth and disease suppression
- Student will analyze advantages of chemical pesticides with microbial pesticides
- Student will understand the different mechanisms of microbes in maintaining the soil fertility
- Students will apply their knowledge of composting to become entrepreneur
- Student will understand the involvement of microbes in mineralization of organic matter

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
9. Estimation of dehydrogenase activity by soil microbes

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

20MBU512B (4H-2C)

VETERINARY MICROBIOLOGY- PRACTICAL

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

End Semester Exam: 6 Hours

COURSE OBJECTIVES:

- To 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.
- 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 rise of commercialization in veterinary industry
2. Students will be able to developed, 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.
5. Demonstrate an understanding at an advanced level of microbial virulence mechanisms and host response to infection.

EXPERIMENTS

1. Preparation of glasswares & equipments for virus work
2. Preparation of media, solutions , buffers and their sterilization
3. Demonstration of primary cell culture, preparation and subculturing of the cell line
4. Chick Embryo inoculation and harvesting of virus: Allantoic & amp; Chorioallantoic route
5. Chick Embryo inoculation and harvesting of virus: Amniotic & yolk sac routes
6. Animal Inoculation for cultivation of viruses
7. Infection of cell cultures with virus and study of cytopathic effects Demonstrations
8. Study of viral inculsions: Detection of Negri bodies in brain impress. smears stained by Seller's Stain
9. 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 321 Systematic Veterinary Virology.
2. http://kanadadilokulu.xyz/Systematic-Veterinary-Virology-A-Practical-Manual-ebook.pdf

Semester–V

20MBU513A BIOINFORMATICS- 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

- Students able to idea about collection, interpretation and presentation of bioinformatics data.
- Students will apply practical and hands-on experience with common bioinformatics tools and databases.
- Through practical exercises, the students can be able to do evaluation in the use of bioinformatics tools.

COURSE OUTCOME

- This course will provide the learner insights into helpful areas of Bioinformatics which plays an essential role in application oriented biology.
- Students will be trained in the basic theory analysis and application of programs used for database searching, protein and DNA sequence analysis, prediction of protein function, and building phylogenetic trees.
- The course creates the learning of bioinformatics tools in light of the student's knowledge of molecular biology.

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 Swissmodel. 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

20MBU513B DRUG DESIGN AND DEVELOPMENT- PRACTICAL (4H-2C)

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

End Semester Exam: 6 Hours

COURSE OBJECTIVES

Drug Design and Discovery course introduce the basic principles of modern drug design, discovery and development. The course deals with the different source of drug with specific focus on microbial source, drug development and manufacturing process. Prerequisite: Masters students in Life Sciences

COURSE OUTCOME

The course will imparts knowledge on detection, selection, and validation of new antibacterial targets, vaccines and the use of gene technology in pharmaceutical industry

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.

Semester – V

20MBU514A CELL 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 OBJECTIVES

- To explain the cell structure and functions of organelle.
- To determine the transportations through cell membrane.
- To categorize the different receptors and model of signaling.
- To analyze the concept of cell signaling.
- To determine the plan and animal cells structure.

COURSE OUTCOME

- To describe the basic concept of cell structure, membrane, cellular functions of different types of cell, modes of cellular signaling and signal amplification.

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 sixth edition 2016 by Lodish,Berk, Kaiser, Krieger, Scott, Bretscher,Ploegh, Matsudaira.

Semester – V

20MBU514B **BIOPHARMACY- 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 teach students various methods of analyzing biomolecules.

COURSE OUTCOME

To make students familiar with practical techniques used for studying biomolecules. these techniques like extraction of biomolecules and analysis of using methods like Soxhlet and chromatography.

1. Extraction Techniques
   a. Percolation
   b. Soxhlet method
2. Thin Layer Chromatography
   a. Analytical TLC
   b. Preparative TLC
3. Column chromatography
4. Analysis of a compound in HPLC – Gallic acid, Quercetin
5. Analysis of a compound in HPTLC

REFERENCES

1. Trease, G E and M. C. Evans, Textbook of Pharmacognosy 1979. 12th ed. Balliere Tindal, London, 343-383.
2. Harborne, J. B. 1984. Phytochemical Methods. London: Chapman and Hall Ltd, London.
3. Lloyd R. Snyder, Joseph J. Kirkland, Joseph I. Glajch, 1997, Practical HPLC method development, John Wiley and Sons 2nd Edition, USA.

Semester-VI

20MBU601 FOOD AND DAIRY 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 course aims to provide instruction in the general principles of food microbiology.
- The course covers the biology and epidemiology of food borne microorganisms of public health significance, including bacteria, yeasts, fungi, protozoa and viruses,
- Understand food spoilage microorganisms; the microbiology of food preservation and food commodities; fermented and microbial foods; principles and methods for the microbiological examination of foods; micro biological quality control, and quality schemes.

COURSE OUTCOME

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

Unit I

General introduction of foods related microorganisms. Natural flora and source of contamination of foods in general. Intrinsic and extrinsic factors that affect growth and survival of microbes in foods. Microbial spoilage of various foods – Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods, sea food.

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 radition.

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

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.

Robinson R.K. (2018) Dairy Microbiology: Milk and Milk Products, 6rd Edn. Wiley Publishers.

Semester – V

20MBU602A 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.
- 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, lipids, glycolipids, biofertilizers and biopesticides.
- To understand the methods for Production of industrially important compounds from microbes

COURSE OUTCOME

- This paper imparts knowledge on applications of microorganisms in various fields
- Overview of microbial diversity, screening and strain improvement and strain development for production of different bio-molecules.
- Introduction about different secondary metabolites antibiotics, organic acids, enzymes, drugs, vitamins, therapeutic peptides and pharmaceutical products, biopesticides and biofertilizers of microbes' origin.
- Concept of recombinant technology with special emphasis in microbial system.

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. Phagetyping, genetherapy. biotransformation of antibiotics

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. Bio-ethanol 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

2. Ratledge, C and Kristiansen, B. (2001). Basic Biotechnology, 2nd edition, Cambridge University Press.
3. Swartz, J. R. (2001). Advances in Escherichia coli production of therapeutic proteins. Current 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. Poonam Singh & Ashok Pandey, Biotechnology for agro-Industrial residues utilisation. (2019), Springer.
9. Satyanarayana T. and Johri B.N. (2015). Microbial diversity, Current Perspectives and Potential Applications,IK international.

Semester – V

20MBU602B PLANT TISSUE AND ANIMAL TISSUE CULTURE (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 laboratory organization in plants, basic techniques in tissue culture, genetic transformations in plants, plant genetic engineering and industrial products.

COURSE OUTCOME

- Provides detailed idea about laboratory organization for conservation of plants in laboratory condition through tissue culture techniques.
- To provide idea about genetic transformations in plants, plant genetic engineering and plant based industrial products production.
- Provide fundamental knowledge for the development of genetically modified crop including expression of genes related to water deficit tolerance, pest resistance, insect resistance and cold resistance.

UNIT-I

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

UNIT-II

Tissue culture media – composition and preparation, Callus and suspension culture, somaclonal variation, micropropagation, organogenesis, somatic embryogenesis, Embryo culture and embryo rescue. Haploidy; protoplast fusion and somatic hybridization; cybrids; anther, pollen and ovary culture for production of haploid plants and homozygous lines. Plant hardening transfer to soil, green house technology.

UNIT-IV

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

UNIT-IV

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

UNIT-V

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

SUGGESTED READINGS

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

20MBU603A **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 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

COURSE OUTCOME

Provides knowledge to identify the common infectious agents with the help of laboratory procedures and use antimicrobial sensitivity tests to select suitable antimicrobial agents.

Unit I

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

Unit II

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

Unit III

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- Agglutination,ELISA, immunefluorescence, Nucleicacidbasedmethods– PCR, Nucleicacid probes, Typhoid, HBV, HCV, HIV, Denque and VDRL, Vaccination and schedule

Unit V

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 – V

20MBU603B 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.

COURSE OUTCOME

- Provides knowledge on safety aspects in biological laboratory and to create awareness on the Intellectual property rights and patenting of biotechnological processes.

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 & Brene 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 patentables – 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

20MBU611 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 understanding of food and dairy products and become qualified as microbiologist in food and dairy industries

COURSE OUTCOME

- Provides necessary information on the food, dairy Microbiology in safety and quality perspective.
- Its importance in the prevention of contamination that might be caused by the microorganisms.

EXPERIMENTS

1. MBRT of milk samples
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. Isolation of spoilage microorganisms from bread.
7. Preparation of yogurt.
8. Isolation of microorganisms from curd.
9. 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 – V

20MBU612A 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.
- Know General bacteriology and microbial techniques for isolation of pure cultures of microbes from different food, agricultural and environmental sources.
- Know General bacteriology and microbial techniques for isolation of pure cultures of microbes from different food, agricultural and environmental sources.

COURSE OUTCOME

- Impart knowledge on applications of microorganisms in various fields.
- Capable of performing several techniques used during development of immobilization techniques.
- To impart hand on experience in basic techniques used in microbial biotechnology studies.

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 – V

20MBU612B PLANT TISSUE AND ANIMAL TISSUE CULTURE -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 laboratory organization in plants, basic techniques in tissue culture, genetic transformations in plants, plant genetic engineering and industrial products.

COURSE OUTCOME

- Provides detailed idea about laboratory organization for conservation of plants in laboratory condition through tissue culture techniques.
- To provide idea about genetic transformations in plants, plant genetic engineering and plant based industrial products production.
- Provide fundamental knowledge for the development of genetically modified crop including expression of genes related to water deficit tolerance, pest resistance, insect resistance and cold resistance.

EXPERIMENTS

1. Laboratory organization for plant tissue culture
2. Media Preparation
3. *In-vitro* Germination of Seeds
4. Micropropagation
5. Callus induction, differentiation and regeneration
6. Suspension culture
7. Embryo Culture
8. Synthetic seed production.
9. Protoplast Isolation
10. Agrobacterium-mediated gene transformation
11. Preparation and Filter-sterilization of Animal Tissue Culture Medium
12. Chicken embryo fibroblast Culture
13. Quantification of cells by haemocytometer
14. Quantification of viable and non-viable cells by trypan blue dye exclusion method
15. Identification of leukocyte subsets and total count
16. Blood leukocyte culture

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

20MBU613A 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 an 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.

COURSE OUTCOME

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

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.

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 – V

20MBU613B 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.

COURSE OUTCOME

- To understand safety aspects in biological laboratory and to create awareness on the Intellectual property rights and patenting of biotechnological processes.

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.

20MBU691	PROJECT	Semester – VI (8H-6C)

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