M.Sc. MICROBIOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

Curriculum and Syllabus

Regular (2021 – 2022)

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)
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M.Sc. MICROBIOLOGY

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FACULTY OF ARTS, SCIENCE AND HUMANITIES

POST – GRADUATE PROGRAMMES

(REGULAR PROGRAMME)

REGULATIONS
(2021)

DEPARTMENT OF MICROBIOLOGY
FACULTY OF ARTS, SCIENCE AND HUMANITIES

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FACULTY OF ARTS, SCIENCE AND HUMANITIES
POST-GRADUATE PROGRAMMES
(M.Sc., M.Com.)

REGULAR MODE
CHOICE BASED CREDIT SYSTEM (CBCS)
REGULATIONS – 2021

The following Regulations are effective from the academic year 2021-2022 and are applicable to the candidates admitted in Post Graduate (PG) Degree programmes in the Faculty of Arts, Science, and Humanities, Karpagam Academy of Higher Education (KAHE).

1. PROGRAMMES OFFERED,

MODE OF STUDY AND ADMISSION REQUIREMENTS

1.1 P.G. PROGRAMMES OFFERED

The various P.G. Programmes offered by the KAHE are listed in the table below.

S. No.	Programme Offered
1	M.Sc. Biochemistry
2	M.Sc. Microbiology
3	M.Sc. Biotechnology
4	M.Sc. Physics
5	M.Sc. Chemistry
6	M.Sc. Mathematics
7	M.Sc. Computer Science
8	M.Sc. Applied Astrology
9	M.Com.

1.2 MODE OF STUDY

Full-Time

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

1.3 ADMSSION REQUIREMENTS (ELIGIBILITY)

Candidates for admission to the first semester Master's Degree Programme shall be required to have passed an appropriate Degree Examination of this Karpagam Academy of Higher Education or any other University accepted by the KAHE as equivalent thereto. Admission shall be offered only to the candidates who possess the qualification prescribed against each course as given in the table below.

S. No.	Name of the Programme Offered	Eligibility
1	M.Sc. Biochemistry	B.Sc. Degree with Biology / Biochemistry / Chemistry / Biotechnology / B.F.Sc. / Polymer Chemistry / Microbiology/ Zoology / Botany / Plant Science / Plant Biotechnology / Animal Science / Animal Biotechnology / B.Pharm / Industrial Chemistry / Applied Microbiology / Medical Microbiology / Human Genetics / Medical Genetics / Molecular Biology / Genetics Technology / Environmental Science / Environment Biotechnology / Genetics Engineering / Bioinformatics / Plant Biology & Biotechnology / Animal Cell & Biotechnology / Agriculture / Medical Lab Technology / Nutrition & Dietetics
2	M.Sc. Microbiology	B.Sc. Microbiology / Applied Microbiology / Industrial Microbiology / Medical Microbiology / Botany / Zoology / Biology / Biotechnology / Molecular Biology / Genetic Engineering / Biochemistry / Agriculture / Forestry / Medical Lab Technology / Life Sciences

3	M.Sc. Biotechnology	B.Sc. Degree with Biology / Biochemistry / B.Sc Biology with Chemistry Ancillary / B.F.Sc. / Microbiology / Zoology / Botany / Plant Science /Plant Biotechnology / Animal Science /Animal Biotechnology / B.Pharm / Applied Microbiology / Medical Microbiology / Human Genetics / Medical Genetics / Molecular Biology / Genetics / Environmental Science / Environment Biotechnology / Genetics Engineering / Bioinformatics / Plant Biology & Biotechnology / Animal Cell & Biotechnology / Agriculture / B.Tech (Biotech)
4	M.Sc. Physics	B.Sc. Physics, B.Sc. Physics (CA) / B.Sc. Applied science
5	M.Sc. Chemistry	B.Sc. Chemistry, Industrial Chemistry, Polymer Chemistry
6	M.Sc. Mathematics	B.Sc. Mathematics / B.Sc. Mathematics with Computer Applications
7	M.Sc. Computer Science	B.Sc. Computer Science / Computer Technology / Information Technology / Electronics / Software Systems / BCA/ B.Sc. Applied Sciences
8	M.Sc. Applied Astrology	B.Sc. Allied Astrology or Equivalent degree
9	M.Com	B.Com./BCom.(CA)/B.Com(PA)/B.Com(Finance& Insurance)/ B.Com.(e-Commerce)/ B.Com.(IT) /B.B.M. /B.B.M.(CA) /B.B.A./B.B.A (CA) / B.Com (CS), B.A. Co-Operation / Bachelor's Degree in Bank Management/ B.A. Economics / B. Com Financial Analytics/ B. Com International Accounting and Finance

QUALIFICATIONS FOR ADMISSION

2. DURATION OF THE PROGRAMMES

2.1 The minimum and maximum period for completion of the P.G. Programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
M.Sc., M.Com	4	8

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

3. CHOICE BASED CREDIT SYSTEM

3.1 All programmes are offered under Choice Based Credit System with a total credit ranges from 87 to 93 for the PG programmes.

3.2 Credits

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

4. STRUCTURE OF THE PROGRAMME

Every Programme will have a curriculum and syllabus consisting of core courses, elective courses, open elective and project work.

a. Core course

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

b. Elective course

Elective courses are to be chosen with the approval of the Head of Department concerned from the list of elective courses mentioned in the curriculum.

c. Project Work

The candidates shall undertake the project work in the Fourth Semester either in the Department concerned or in Industries, Institute or any other Organizations and the project report has to be submitted at the end of the fourth semester.

In case the candidate undertakes the project work outside the Department, the teacher concerned within the Department shall be the Main guide and the teacher/scientist under whom the work is carried out will be the Co-guide. The

candidate shall bring the attendance certificate from the place of project work carried out.

d. Value Added Courses

Courses of varying durations but not less than 30 hours which are optional and offered outside the curriculum that add value and help the students in for getting placement. Students of all programmes are eligible to enroll for the Value Added Courses. The student shall 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.

e. Internship

The student shall undergo 15 days internship in the end of second semester.

Online Course

Student shall study at least one online course from SWAYAM / NPTEL / MOOC in any one of the first three 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 third 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.

5. MEDIUM OF INSTRUCTION

The medium of instruction for all courses, examinations, seminar presentations and project/thesis/dissertation reports should be in English.

6. MAXIMUM MARKS

The maximum marks assigned to different courses shall be as follows:

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

(ii) Maximum marks for Project work

S. No	Programme	Maximum marks	CIA	ESE
1	M.Sc., M.Com.	200	80	120

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 is satisfactory during the course.

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

faculty who will function as mentor throughout their period of study. Faculty mentors 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 to 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 the 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 teachers of the class concerned, student representatives (Minimum two boys and 2 girls of various capabilities and Maximum of 6 students) and the concerned HoD / senior faculty as a Chairperson. The objective of the class committee Meeting is all about the teaching – learning process. Class Committee shall be convened at least once in a month. The functions of the Class Committee shall include

- Analyzing and Solving problems experienced by students in the class room and in the laboratories.
- Analyzing the performance of the students of the class after each test and finding the ways and means to improve the performance.
- The Class Committee of a particular class of any department is normally constituted by the HoD / Chairperson of the Class Committee. However, if the students of different departments are mixed in a class, the class committee shall be constituted by the respective faculty Dean.
- The Class Committee shall be constituted during the first week of each semester.

- The HoD / Chairperson of the class committee are authorized to convene the meeting of the class committee.
- The respective faculty Dean 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 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 group shall have a "Course Committee" comprising all the teachers handling the common course with one of them nominated as course coordinator. The nomination of the course coordinator shall be made by the Dean depending upon whether all the teachers handling the common course belong to a single department or to various other departments. The 'Course Committee' shall meet in order to arrive at a common scheme of evaluation for the tests 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 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 records of test marks and attendance. The HoD shall sign with date after due verification. The same shall be submitted to Dean once in a month. After the completion of the semester the HoD should keep this record in safe custody for five years. Because records of attendance and assessment shall be submitted for Inspection as and when required by the 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	Attendance	5
2	Test – I (first 2 ½ units)	10
3	Test – II (last 2 ½ units)	10
4	Journal Paper Analysis & Presentation*	15
Continuous Internal Assessment : Total		40

*****Evaluated by two faculty members of the department concerned. Distribution up of marks for one Journal paper analysis: Subject matter 5 marks, Communication/PPT Presentation 4 marks, Visual aid 2 marks and Question and Discussion 4 marks

Practical Courses

S. No.	Category	Maximum Marks
1	Attendance	5
2	Observation work	5
3	Record work	5
4	Model practical examination	15
5	*Viva – voce* [Comprehensive]*	10
Continuous Internal Assessment: Total		**40**

**Viva - voce* conducted during model practical examination.

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

11.3 Pattern of Test Question Paper

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 marks 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

End Semester Examination (ESE): ESE will be held at the end of each semester for each course. The question paper is for a maximum of 60 marks.

Pattern of ESE Question Paper

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 six marks each (5 x 6 = 30 Marks.) Question No. 21 to 25 will be 'either-or' type, covering all five units of the syllabus; i.e., Question No. 21: Unit - I, either 21 (a) or 21 (b), Question No. 22: Unit - II, either 22 (a) or 22 (b), Question No. 23: Unit - III, either 23 (a) or 23 (b), Question No. 24: Unit - IV, either 24 (a) or 24 (b), Question No. 25: Unit - V, either 25 (a) or 25 (b)
Part - C	Question No.26. One Ten marks Question (1 x 10 = 10 Marks)

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

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

Guidelines to prepare the project report

- Cover page
- Bonafide certificate
- Declaration
- Acknowledgement
- Table of contents

Chapters

Introduction
Aim and Objectives
Materials and Methods (Methodology)
Results (Analysis of Data) and Discussion (Interpretation)
Summary
References

12.3.3 The evaluation of the project will be based on the project report submitted and *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 supervisor is not available, the HoD shall act as an Internal Examiner.

12.3.4 If a candidate fails to submit the project report on or before the specified date given by 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 *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 secures 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 A candidate who is absent in ESE in a Course / Practical / Project work after having enrolled for the same shall be considered to have **failed** in that examination.

14. IMPROVEMENT OF MARKS IN THE COURSE ALREADY PASSED

Candidates desirous 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 corresponding grade scored.
II. The Grade Point Average (**GPA**) for the semester and
III. The Cumulative Grade Point Average (**CGPA**) of all courses enrolled from first semester onwards.

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

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

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

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

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

where,

Ci is the credit fixed for the course 'i' in any semester
GPi is the grade point obtained for the course 'i' in any semester
'n' refers to the Semester in which such courses are credited

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

17. REVALUATION

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 Examinations will arrange for the revaluation and results will be intimated to the candidate

through the HODs 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 wish. The student may represent the grievance, if any, to the Grievance Committee, which consists of Dean of the Faculty, (if Dean is HoD, the Dean of another Faculty nominated by the KAHE), the HoD of Department concerned, the faculty of the course and Dean from other discipline nominated by the KAHE and the CoE. If the Committee feels that the grievance is genuine, the script may be sent for external valuation; the marks awarded by the External examiner will be final. The student has to pay the prescribed fee for the same.

19. ELIGIBILITY FOR THE AWARD OF THE DEGREE

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

- Successfully completed all the components in clause 3 and gained the required number of total credits as specified in the curriculum corresponding to his / her Programme within the stipulated period.
- 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 13) having passed the examination in all the courses in his / her first appearance, within the specified minimum number of semesters and securing a **CGPA not less than 8.0** shall be declared to have passed the examination in **First Class with Distinction.**

20.2 Candidate who qualifies for the award of the Degree (vide clause 13) having passed the examination in all the courses within the specified maximum number of semesters (vide clause 2.1), securing a **CGPA not less than 6.5** shall be declared to have passed the examination in **First Class**.

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

21. PROVISION FOR WITHDRAWAL FROM END-SEMESTER EXAMINATION

21.1 A candidate due to valid reason on prior application may be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination.

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

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

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

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

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

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

22. PROVISION FOR AUTHORISED BREAK OF STUDY

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

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

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

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

22.4 The total period for completion of the Programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 2.1 irrespective of the period of break of study (vide clause 22.3) in order that he/she may be eligible for the award of the degree.

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

23. RANKING

A candidate who qualifies for the PG Degree programme passing all the Examinations in the first attempt, within the minimum period prescribed for the programme of study from Semester I through Semester IV to the programme shall be eligible for ranking. Such ranking will be confined to 10% of the total number of candidates qualified in that particular programme of Study subject to a maximum of 10 ranks.

The improved marks will not be taken into consideration for ranking.

24. SUPPLEMENTARY EXAMINATION

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

25. DISCIPLINE

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

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

26. REVISION OF REGULATION AND CURRICULUM

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

PREAMBLE

The ‘small is not only beautiful but also selfless’.

Microorganisms, being the established colonizers of this planet, have come to stay as a sophisticated firm of highly compatible organisms. These organisms have a major contact on all aspects of life. Diseases caused by microbes are well-known and can involve viruses, bacteria and protozoa. Our understanding of these organisms is directly linked to the control and prevention of infectious diseases. Immunology plays a key role in understanding how humans and animals respond to the challenge of these disease-causing organisms. Activities of microorganisms are very important to almost every sector of concern to mankind. The scope and significance of microbiology has enlarged manifold, particularly when importance of environment. In the context of microbial enzymes, chemotherapeutic agents and bacterial metabolism, microbes are gaining momentum in view of their role as Mini biofactories. Importance of this branch lies due to the fact that about 30% of the total Nobel Prizes given in the field of physiology and medicine are awarded to those working on problems related to microbiology.

Microbiology is a discipline of enormous importance in basic and applied science and the course has been restructured to suit an increasing number of students of diverse educational backgrounds. Point of reference of this course is also towards basic and applied research in microbiology, providing opportunity to the talented students with an aspiration of becoming scientists of international standard and offers some of the most exhilarating and demanding careers.

Objectives of the department are

- to promote understanding of advancements and various emerging areas in microbiology.
- to provide a quality educational experience in a field of laboratory science.
- to make the students expertise in terms of its practical applicability.
- to study useful and disease producing microorganisms.
- to study the biological activities of microbes.
- to make students to think critically and to engage in a deeper understanding of their microbial environment.
- to prepare students for further studies, helping in their bright career.
- 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 labs.
- to develop skills required in various industries and in the field of human health.
- to allow our students to be qualified in the field of Microbiology for work anywhere in the world.

DEPARTMENT OF MICROBIOLOGY

FACULTY OF ARTS, SCIENCES AND HUMANITIES

PG PROGRAM – M. Sc. Microbiology

(2021 – 2022 Batch & onwards)

Course code	Name of the course	Objectives and out comes		Instruction hours / week			Credit (s)	Marks			Category *	Page No.
		PEOs	POs	L	T	P		CIA	ESE	Total		
SEMESTER-I												
21MBP101	Principles and systematics of Microbiology	I	a,f	4	0	0	4	40	60	100	C	6
21MBP102	Microbial Physiology and Metabolism	II	a,g	4	0	0	4	40	60	100	C	8
21MBP103	Microbial Genetics	II	a,f	4	0	0	4	40	60	100	C	10
21MBP104	Bioinstrumentation	VI	b	3	1	0	4	40	60	100	C	12
21MBP105A*	Marine microbiology	I	a,h,i	4	0	0	4	40	60	100	E	14
21MBP105B*	Advanced Bioinformatics	VII	d								E	16
21MBP105C*	Pharmaceutical Microbiology	II	a,m								E	18
21MBP111	Microbial Physiology Practical	VI	b,n	0	0	4	2	40	60	100	C	20
21MBP112	Genetics and Instrumentation Practical	VI	b,n	0	0	4	2	40	60	100	C	22
Journal Paper Analysis & Presentation		IV	a	2	0	0	-	-	-	-		23
Semester total				**21**	**1**	**8**	**24**	**280**	**420**	**700**		
SEMESTER–II												
21MBP201	Virology	I	a	3	1	0	4	40	60	100	C	24
21MBP202	Medical Bacteriology	I	a,o	4	0	0	4	40	60	100	C	26
21MBP203	Biostatistics and Research Methodology	VI	c,d	4	0	0	4	40	60	100	C	28
21MBP204	Environmental and agricultural microbiology	I	a	4	0	0	4	40	60	100	C	29
21MBP205A*	Cell biology	I	a	4	0	0	4	40	60	100	E	31
21MBP205B*	Molecular biology	I	a								E	33
21MBP205C*	Bioprocess engineering	IV	a,f,j								E	35
21MBP211	Microbial Technology Practical	I	b,o	0	0	4	2	40	60	100	C	37
21MBP212	Diagnostic Microbiology Practical	I	b,k	0	0	4	2	40	60	100	C	38
Journal Paper Analysis & Presentation		IV	a	2	0	0	-	-	-	-		40
Semester total				**21**	**1**	**8**	**24**	**280**	**420**	**700**		

Course code	Name of the course	Objectives and out comes		Instruction hours / week			Credit (s)	Marks			Category *	Page No.
		PEOs	POs	L	T	P		CIA	ESE	Total		
SEMESTER-III												
21MBP301	Advanced Immunology	II	a,k	4	0	0	4	40	60	100	C	41
21MBP302	Food Microbiology and Quality Control	IV	a,m	4	0	0	4	40	60	100	C	43
21MBP303	Medical Mycology and Parasitology	I	a,a	4	0	0	4	40	60	100	C	45
21MBP304	Microbial Technology and Intellectual Property Rights	V	b,o	4	0	0	4	40	60	100	C	47
21MBP305A*	Genomics and Proteomics	I	a	4	0	0	4	40	60	100	E	49
21MBP305B*	Laboratory animal care	V	b								E	51
21MBP305C*	Bio nanotechnology	IV	a								E	53
21MBP311	Immunology and Serology Practical	I	b,n	0	0	4	2	40	60	100	C	55
21MBP312	Food and Beverage Practical	I	b,o	0	0	4	2	40	60	100	C	56
Journal Paper Analysis & Presentation		IV	a	2	0	0	-	-	-	-		58
Semester total				**22**	**0**	**8**	**24**	**280**	**420**	**700**		

Category * C – Core Paper, E- Elective Paper

Course code	Name of the course	Hrs / Week	Marks			Exam Hrs	Credit (s)	Page No.
			CIA	ESE	Total			
SEMESTER - IV								
21MBP491	Project and Viva Voce	-	80	120	200	-	15	59
Semester total		**-**	**80**	**120**	**200**	**-**	**15**	
		90	**920**	**1380**	**2300**		**87**	

Elective courses*

Elective – 1 (21MBP105)		Elective – 2 (21MBP205)		Elective – 3 (21MBP305)	
Course code	Name of the Course (Theory)	Course Code	Name of the course (Theory)	Course Code	Name of the course (Theory)
21MBP105A	Marine Microbiology	21MBP205A	Cell biology	21MBP305A	Genomics and Proteomics
21MBP105B	Advanced Bioinformatics	21MBP205B	Molecular Biology	21MBP305B	Laboratory animal care
21MBP105C	Pharmaceutical Microbiology	21MBP205C	Bioprocess engineering	21MBP305C	Bio nanotechnology

Postgraduate Programme – M.Sc

Microbiology Programme Outcomes

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

a. Science Observation: Microbiology majors able to discuss science and scientific methodology as a way of knowing. Microbiology majors will make observations, develop hypotheses and design and execute experiments using appropriate methods. They will be able to explain how the nature of science is applied to everyday problems.

b. Laboratory Skills: Microbiology students will master the following laboratory skills: aseptic pure culture techniques, preparation of and viewing samples for microscopy, use appropriate methods to identify microorganisms, estimate the number of microorganisms in a sample and use common lab equipment. They will be able to practice safe microbiology using appropriate protective and emergency procedures.

c. Data analysis skills: Microbiology majors will be able to systematically collect record and analyze data, identify sources of error, interpret the result and reach logical conclusions. They will be able to appropriately format data into tables, graphs and charts for presentation and publication.

d. Critical Thinking Skills: Microbiology majors will be able to (1) differentiate between fact and opinion, (2) recognize and evaluate author bias and rhetoric, (3) develop inferential skill, (4) recognize logical fallacies and faulty reasoning and (5) make decisions and judgments by drawing logical conclusions using sound quantitative and statistically – based reasoning.

e. Problem Solving Skills: Microbiology majors will be competent problem-solvers. They should be able to assess the elements of a problem and develop and test a solution based on logic and the best possible information. Microbiology students should be able to analyze and interpret results from a variety of microbiological methods and apply these methods to analogous situations. They will use mathematical and graphing skills and reasoning to solve problems in microbiology

f. Students will be acquainted with the basic concept of prokaryotes, their differentiation from eukaryotes and biosafety regulatory framework for prokaryotes and able to learn how Microbiology developed and scope of the various branches of the subject

g. Our candidates will be able to explain why microorganisms are ubiquitous in nature, inhabiting a multitude of habitats and occupying a wide range of ecological habitats.

h. Able to cite examples of the vital role of microorganisms in biotechnology, fermentation, medicine and other industries important to human wellbeing.

i. Able to demonstrate that microorganisms have an indispensable role in the environment, including elemental cycles, biodegradation etc.

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

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

Programme Specific Outcomes (PSOs)

l. Upon master graduation, Microbiology majors will mastered a set of advanced skills, which would be useful to function effectively as professionals and to their continued development and learning within the field of Microbiology.

m. The course is reasoning and application based, making the students eligible for higher studies, jobs in various sectors and Entrepreneurship abilities.

n. With the individual Research projects, Research orientation will be improved which is reflected in the form of papers and conference presentations.

o. Applied papers are advanced, making the students updated in the field. More number of practicals are there in the course making the students well worse with the subject.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Programme Educational Objectives of PG Microbiology: The major objectives of the postgraduate course is

PEO-I: To provide detailed knowledge of Microbiology (bacteriology, virology, parasitology and mycology) and their application fields (Medical, Agricultural and Marine Microbiology). To understand the beneficial and harmful role of microorganisms in the environment and in the industries.

PEO-II: To understand the fundamentals of physiological reactions including metabolic pathways and biochemical reactions in microorganisms. To understand the fundamental concepts of immunology, biochemistry, biotechnology and genetics etc.

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: Gain experience with standard molecular tools and approaches utilized: manipulate genes, gene products and organisms. Become familiar with handling of Laboratory animals for the research purpose. Interpret differences in data distributions via visual displays.

PEO-VI: Become familiar with public policy, biosafety, bioinformatics and intellectual property rights issues related to microbiology applications.

Pos	A	b	c	d	e	f	g	h	i	j	k	l	m	n	o
PEO I	X					X	X	X			X		X		X
PEO II	X	X							X	X		X		X	
PEO III			X	X	X	X					X		X	X	X
PEO IV	X					X	X	X	X	X	X	X			
PEO V		X	X	X						X			X	X	
PEO VI				X	X	X						X			X

Semester –I

21MBP101 PRINCIPLES AND SYSTEMATICS OF MICROBIOLOGY 4H –4C

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

COURE OBJECTIVES

- The course in designed to provide a basic understanding on the fundamental aspects of microbiology from historical development.
- To improve the proficiency and knowledge of the candidate on the study of microbial techniques for well exploitation of microorganisms.
- To comprehend the various methods for identification of unknown microorganisms
- This course enables the students to understand various physical and chemical means of sterilization and also learn various techniques for isolation of pure cultures.
- This course figures out them to know about culture collection and maintenance of microbial cultures.
- The beneficial and harmful manifestations of microorganisms especially of bacteria and their role in microbial mineralization and disease processes.

COURSE OUTCOME (CO'S)

1. Understand the basic microbial structure and functions of various physiological groups of prokaryotes and eukaryotes.
2. Learn the theory and practical skills in microscopy handling and staining techniques know various culture media and their applications.
3. Study microbial nutrition's- Autotrophy and heterotrophy modes of nutrition.
4. Identify the unknown organisms by using microbial tools.
5. Demonstrate electricity generation from the organic matter.
6. Understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolism.

UNIT I - Introduction and History of Microbiology

History of development of Microbiology, Development of fields of Microbiology in 20th century; the spontaneous generation controversy; Germ theory of disease. Structure of prokaryotic and eukaryotic cell, General features of microorganisms- Bacteria, Algae, Fungi and Protozoa.

UNIT II - Classification of microorganisms

Systematics of bacteria - Microbial evolution and Diversity –Phenetic and Phylogenetic Haeckel's three–kingdom concept, Whittaker's Five- kingdom concept, Three-domain concept of Carl Woese. Bergey's manual and its importance. –Bacteria, Classification-Phenetic classification, Numerical Taxonomy, Phylogenetic Classification, Classification-Archaea-fungi-virus and algae.

UNIT III - Microscopy and staining methods

Microscopy –Simple, Compound, Dark-field, Phase contrast, Fluorescent microscopes, Electron microscopes (SEM and TEM), Confocal microscopy, Stereo zoom microscope, differential interference contrast (DIC) – Principles and their applications. Stains and Staining techniques: Simple and Differential staining methods.

UNIT IV - Scope of Microbiology

Scope of Microbiology- Cycle of matter in nature. Microbial interactions- mutualism, symbiosis, commensalisms, predation, parasitism, amensalism, competition, bioluminescence, biodegradation, biofilms. Cleaning oil spills, microbes in composting, biopesticides, bioremediation, bioleaching, SCP, microbial enzymes and fermented foods. Human diseases and their causative agents. Microbial Biostimulants.

UNIT V - Molecular taxonomy

Modern Microbiology: Molecular taxonomy, 16S/18S rRNAs sequencing and its importance in identification of microorganisms. Phylogenetic tree, recent trends in exploitation of microbial diversity, Community level physiological profile, fatty acid methyl esterase analysis, G+C ratio, nucleic acid reassociation and hybridization and DNA micro arrays.

SUGGESTED READINGS

1. Dubey, R.C., and Maheswari, D.K., (2010). *A Text book of Microbiology*. (3rd Ed), S. Chand and Company, New Delhi.
2. Modi, H. A. (1996). *Elementary Microbiology*. Vol.2, AKTA Prakashan Nadiad, Gujarat
3. Powar, C.B., and Daginawala, H.F., (2008). *General Microbiology*. Vol: 2. Himalaya Publishing House.
4. Singh, R.P. (2007). *General Microbiology*. Kalyani Publishers, New Delhi.
5. Christopher, J.W., Linda, S., and Joanne, W., (2016).*Prescott's Microbiology*. (10th Ed), McGraw-Hill Education, UnitedStates.
6. Noel, R.K., Wolfgang, L., William, B.W., Brian, P.H., Bruce, J.P., James, T.S., Naomi, W., and Daniel, B., (2011). *Bergey's Manual of Systematic Bacteriology: Volume 4*, Springer Science & Business Media,Germany.
7. Frobisher, H., Hinsdil, R.D., Crabtree, K.T., and Goodhert, D.R., (2005). *Fundamentals of Microbiology*, Saunder and Company,London.
8. Tortora, G.J., Funke, B.R., and Case, C.L., (2010). *Microbiology: An Introduction*. (10thed.). Pearson Education,Singapore.
9. Stanier, R.Y., Ingraham, J.L., Wheelis, M.L., & Painter, P.R.,(2008). *General Microbiology. (5thed.). Macmillan Press Ltd, London.*
10. Salle, A.J. (2007). *Fundamental Principles of Bacteriology*. (7th ed.).,Envins Press, New York.
11. Alcomo, I.E., (2006). *Fundamentals of Microbiology*. (8thed.). Jones and Bartlett Publishers, Sudbury,Massachusetts.
12. Pelczar Jr. M.J., Chan, E.C.S., and Kreig, N.R., (2004). *Microbiology*. (5thed.). Tata McGraw-Hill Publishing Company, New Delhi.
13. Powar. C.B and Daginnawala. H.F. 2010. General Microbiology (Vol-II). Himalaya Publishing house.
14. Powar.C.B. 2010. General Microbiology (Vol-I). Himalaya Publishing house.
15. Atlas, R.M. Principles of Microbiology, 2nd edition 2015, Mc Graw Hill India.

Semester – I

21MBP102 **MICROBIAL PHYSIOLOGY AND METABOLISM** **4H–4C**

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

COURSE OBJECTIVES

- To gain the knowledge with the various inner and outer structures of prokaryotes and eukaryotes in detail.
- To provide information on sources of energy and its utilization by microorganisms. Microorganisms play important role in environment as producers, consumers and decomposers.
- To impart knowledge on metabolic function and biochemical reaction going on inside the microbial cell.
- To teach metabolic pathways, their regulation and engineering, and methods used in their elucidation.
- To teach students about cell cycle, growth and methods to determine microbial growth.
- Understand the microbial transport systems in energy conservation

COURSE OUTCOME (CO'S)

1. The students will be able to understand and predict the various metabolic reactions in microbial cell.
2. This will make them to predict the intermediate products which can be employed in industrial production processes.
3. The students will be able to know how bacterial and archaeal structure lead to function, how metabolic processes are regulated.
4. The course makes them to understand how microbes respond to environmental stressors, and how microbes can be manipulated to enhance their growth or the production of desired products.
5. Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement
6. The students will be able to understand how the organisms communicate to the population by using various mechanisms.

UNIT I - Prokaryotic cell structure

Prokaryotic cell structure and organization - cell wall, plasma membrane, cytoplasmic matrix, inclusion bodies, ribosome, nucleiod, capsule, slime layers, S layers, pili, fimbriae, flagella and motility. Eukaryotic cell structure and its organelles. Lichens and microalgae: Structural organization and their properties. Mycoplasma. Basic structure of viruses.

UNIT II – Bacterial spores

Structure of bacterial endospore, Molecular architecture of spores, induction and stages of sporulation cycle. Influence of different factors on sporulation. Sporulation in fungi, biochemical and macromolecular changes. Biofilm and biosurfactant production in bacteria

UNIT III – Metabolic pathway

Glycolysis, EMP and TCA cycle. Metabolism of lactic acid bacteria, propionic acid bacteria. Aerobic respiration and anaerobic respiration. Electron transport chain in prokaryotes and eukaryotes, inhibitors of electron transport chain. Substrate level and oxidative phosphorylation – ATP generation. Biosynthesis of fatty acids, nucleotides, amino acids, Cell wall biosynthesis of Gram positive and Gram negative bacteria. Toxins – characterization, mechanism of action.

UNIT IV – Stress physiology

Effect of oxygen toxicity ,pH, osmotic pressure, heat shock etc on bacteria Adaptations in thermophiles, halophiles ,alkaliphiles ,acidophiles , Extremophiles – adaptations & significance in microbiology .

UNIT V - Photosynthetic bacteria & Bioluminescence

Photosynthetic bacteria, photosynthetic pigments, and generation of reducing power by cyclic and non-cyclic photophosphorylation, RUBISCO structure and molecular regulations of light and dark reaction. Photoperiodism and mechanism and action of Hydrogen oxidizing bacteria and Methanogenesis – assimilation of carbondioxide. Bioluminescence and Quorum sensing – mechanism, importance and applications.

SUGGESTED READINGS

1. Joanne, M.W., Linda, S., and Christopher, J.W., (2008). *Prescott, Harley, and Klein's Microbiology*. (7th Ed). McGraw-Hill Higher Education, UnitedStates.
2. Berg, J.M., Tymoczko, J.L., Stryer, L., and Clarke, N.D., (2001). *Biochemistry*. (5thed.). WH Freeman &Co.
3. Doelle, H.W. (2005). *Bacterial Metabolism*. Elsevier India Pvt. Ltd., NewDelhi.
4. Moat, A,G., and Foster J.W., (2003). *Microbial Physiology*. John Wiley and Sons, NewYork.
5. Caldwell, D.R. (2008). *Microbial Physiology and Metabolism*. (2nded.). Wm C Brown Publishers, England.
6. Rose, A.H. (2008). *Chemical Microbiology – An Introduction to Microbial Physiology*. (International Ed.). Plenum Publishing Corporation.
7. Atlas, R.M., (1997). *Principles of Microbiology*. (2nded.). Wm. C. Brown Publishers, Lowa, US
8. Madigan, M.T., Martinko, J.M., and Parker, J., (2003). *Brock Biology of Microorganisms*. (10thed.). Prentice Hall, New Jersey.
9. White, D. (2003). *Physiology & Biochemistry of Prokaryotes*. (2nded.). Oxford University Press, NY.
10. Voet, D., and Voet J.G., (2003). *Biochemistry*. John Wiley and Sons, NewYork. .
11. Satyanarayana, U. and Chakrapani, U. 2013. Biochemistry, Fourth Edition Book and Allied Pvt. Ltd., Kolkata.
12. Nelson, D.L. and Cox, M.M. 2012. Lehingers's Principles of Biochemistry, Sixth Edition, Mac Millan worth Publishers, New Delhi.
13. Donald Voet and Judith G. Voet, 2011. Biochemistry. Third Edition, John Wiley and Sons, Inc. New York.

Semester –I

21MBP103 **MICROBIAL GENETICS** **4H –4C**

Instruction Hours / Week: L: 4 T: 0P: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 genetics 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.
- To provide molecular mechanisms underlying mutations, detection of mutations and DNA damage and repair mechanisms
- The course includes among others model systems, genetics behind complex diseases, identification of disease genes and different types of mutations.
- It helps the students to explore genetic engineering techniques.

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 of recombination DNA.
4. An in-depth study of mutagenesis and genetic analysis with gene mapping.
5. Have a conceptual knowledge about DNA as a genetic material, enzymology, and replication strategies.
6. Full understanding of all aspects of all-important techniques used for the study of biomolecules.

Unit I -Historical Preview of Genetics

Mendelian principles and classical genetics, Genetic concepts, use of microorganisms in genetic studies. Chemical basis of heredity – early concepts of genes – discovery of the chemical basis of heredity - experimental evidences – contributions of Griffith, Avery, Hershey and Chase, Fraenkel – Conrat. Structure of nucleic acids – Structure of DNA and its elucidation, types and different models of DNA, extra-chromosomal DNA (Plasmids,Transposons). Structure of RNA. Organization of genetic material - Genome organization in viruses, bacteria and eukaryotes.

UNIT – II -Transcription

Organization of transcriptional units and regulation of gene expression Mechanism of transcription of prokaryotes-Structure and function of RNA polymerase, (DNA foot printing), termination and antitermination – N proteins and nut sites in DNA binding proteins, enhancer sequences and control of transcription, RNA processing (Capping, polyadenylation, splicing, introns and exons) Ribonucleoprotein, structure of mRNA, rRNA, tRNA.

UNIT – III -Translation

Direction of protein synthesis, RNA template, direction with experimental proof, tRNA as adaptor, ribosomes and their organization in prokaryotes, polycistronic mRNA in bacteria, initiation of translation in bacteria, small sub-units, its accessory factors, SD sequence in bacteria, initiator tRNA, elongation of translation, translocation and termination mechanisms. Post-translational modification. Salient features of genetic code.

Unit - IV - Genetic recombination

Genetic recombination processes: Role of rec proteins in homologous recombination. Conjugation: Discovery, F+, F- and Hfr cells, types of Hfr; F^+ and F^- and Hfr and F^- genetic crosses. Mechanism of conjugation. Sexduction, conjugational transfer of colicinogenic and resistance transfer factors. Genetic mapping. Plasmid Replication and Incompitability, Control of copy number. Transposons – Insertion sequences and composite transposons, phages as transposons, replicative, non-replicative and conservative transposition.

UNIT – V Mutation and repair mechanism

Mutagen, mutagenesis and mutation. Luria Delbruck experiment and its significance. Molecular basis of mutation. Spontaneous and induced mutations. Different types of mutation, mutant detection, mutant selection and carcinogenicity testing. DNA damage – types of damage (deamination, oxidative damage, alkylation, Pyrimidine dimers) – DNA repair mechanism (base excision, nucleotide excision, recombination repair, SOS repair). Mutations i.e. deletions, inversions and Frame shift due to transposition. Mechanism of transposition, controlling elements of maize – autonomous and non-autonomous elements. Types of transposons and their properties.

SUGGESTED READINGS

1. Snyder L. and Chapness W. Molecular Genetics of Bacteria 2007, ASM Press.
2. Dale,J.W., Park, S.F. Molecular Genetics of Bacteria, 5th Edition,2013, John Wiley & Sons.
3. Birge EA. Bacterial and Bacteriophage Genetics. 5 th edition, 2006 Springer-Verlag New York
4. Gardner JE, Simmons MJ & Snustad DP. Principles of Genetics. 8 Edition, 2006, JohnWiley & Sons.
5. Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick. Lewin's GENES XII, 12 Edition, 2018, Jones & Bartlett Learning.
6. Cronan, J., Freifelder,D., Maloy, S. R. Microbial Genetics, 2 Edition, 2008, Narosa.

Semester -I

21MBP104 **BIOINSTRUMENTATION** **4H – 4C**

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

COURSE OBJECTIVES

- Introduce the basic concept of qualitative and quantitative analysis of a given sample
- To Study various spectroscopic techniques and its instrumentation.
- To know the concept of separation science and its applications.
- To understand the basic laboratory skills that are essential for beginning-level employment in clinical, pharmaceutical, microbiology, biochemistry and biotechnology laboratories.
- To impart the concept of radiochemical analysis along with industrial analyzers
- To understand working of different laboratory equipment's used in microbiological laboratories.

COURSE OUTCOME (CO'S)

1. This enables students to be able to explain bioinstrumentation techniques, design and application.
2. To know the concepts and operation of various lab instruments and related terms.
3. Acquire knowledge and lab skills to perform experiments in laboratory.
4. Connect the concepts of physics, chemistry and engineering principles in the instrumentation.
5. The students will be able to know all the basic principles, technology and applications of various instruments in life science.
6. Comprehend the techniques and the underlying principles in bioinstrumentation

UNIT I - **Spectroscopy**

Properties of electromagnetic radiations. Instrumentation and applications of calorimetry, Visible spectrophotometer, UV-Visible spectrophotometer, spectrofluorimeter, atomic spectroscopy, double beam spectroscopy, FTIR, NMR spectroscopy and flow cytometer.

UNIT II - Centrifugation

Principle and types of centrifuges. Principles and applications of analytical and preparative centrifuges. Relative molecular mass determination and sedimentation coefficient. Sub-cellular Fractionation of cellular components.Density gradient and ultra-centrifugation. Centrifuge rotor types and application. Calculation of centrifugal force and angular velocity.

UNIT III - Chromatography

Principle, instrumentation and applications of ion exchange, affinity, gel filtration**,** Paper chromatography**,** thin layer chromatography, column chromatography, Gas chromatography, Low pressure liquid chromatography (LPLC) and high-performance liquid chromatography (HPLC) and fast protein liquid chromatography (FPLC), gas liquid chromatography-mass spectroscopy (GC-MS), LCMS, LCMS/MS, MS-MS, LCMS – QQQ, MALDI – TOF.

UNIT IV – PCR and Electrophoresis

Polymerase chain reaction (PCR), Reverse transcription Polymerase chain reaction (RT-PCR), Quantitative Polymerase chain reaction (Q-PCR). Principle, instrumentation and applications of agarose gel electrophoresis, native PAGE, sodium dodecyl sulphate - polyacrylamide gel electrophoresis (SDS-PAGE), Isoelectricfocusing, Immuno electrophoresis, pulse field gel electrophoresis, capillary electrophoresis, gel documentation – applications. Zone and moving boundary electrophoresis.

UNIT V - Radioisotopic techniques

Introduction, nature of radio activity, types and rate of radioactive decay, units of radio activity, detection and measurement of radio activity. Principle, instrumentation and applications of Geiger- Muller counter, solid and liquid scintillation counter and autoradiography. Biosafety methods in radioactive laboratory. Uses of Radio isotopic techniques and isolation.

SUGGESTED READINGS

1. John Enderle., (2006). *Bioinstrumentation*. (2006). Morgan and Claypool Publishers,NJ.
2. Richard Normann. (1988). *Principles of bioinstrumentation*. WileyPublishers,US.
3. Keith Wilson and John Walker. (2010). *Principle and Techniques of Biochemistry and molecular biology*. (7thed.). Cambridge university press,NY.
4. Boyer, R. (2000). *Modern Experimental Biochemistry*. (3rded.). Addison Wesley Longman, New Delhi.
5. Chatwal, G.R., and Anand, S.K., (2003). *Instrumental Methods of Chemical Analysis*. (5thed.). Himalaya Publishing House,Mumbai
6. Friedfelder,D.(2001).*PhysicalBiochemistry:Applications to biochemistry and molecularbiology.* Oxford Publishers, New York.
7. Sharma, B.K. (2007). *Instrumental Methods of Chemical Analysis*, Krishna Prakashan Media (P) Ltd, India.
8. Wilson, K., and Walker, J., (2010). *Principles and Techniques of Biochemistry and MolecularBiology*, (7th Low Price ed.). Cambridge University Press, India.

WEBLINK

1.https://www.coleparmer.com/tech-article/basics-of-centrifugation.
2. https://www.intechopen.com/books/principles-and-applications-in-nuclear-engineering-radiation-effects-thermal-hydraulics-radionuclide-migration-in-the-environment/radioisotope-applications-effects-and-occupational-protection.

Semester -I

21MBP105A **MARINE MICROBIOLOGY** **4H – 4C**

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

COURE OBJECTIVES

- To provide students with basic knowledge on the biology and ecology of marine microorganisms, and their ecological role.
- To know the basic biology of marine microorganisms and their activities
- To impart modern techniques for the characterization and study of marine microorganisms and microbial communities.
- To understanding the ecological role of marine microorganisms and marine microbial communities.
- To know the main techniques of modern use necessary for the characterization and study of marine microbes.
- To understand basic biological processes that occur in and between organisms in nature.

COURE OUTCOME

1. Capable of describing and explaining both biological interaction processes and their importance to ecosystems.
2. To acquire knowledge of the most common research methods used to develop our knowledge of biological processes.
3. learn to work independently in collecting and analysing scientific data, both in the field and in the laboratory.
4. Understand the architecture of marine ecosystem and its essential role
5. Specify the biological significance of biomolecules in metabolism
6. To understand computer applications and Bioinformatics.

UNIT I - Marine microorganisms

Introduction of coastal, shallow and deep sea. Marine microorganisms- important and their significance. Marine micro and macro-organisms-Collection, enumeration, identification based on morphological, physiological and biochemical characteristics and preservation. International and national collection centres.

UNIT-II- Extremophiles and Marine bio-diversity

Thermopiles, basophiles, halophiles, psychrophiles, alkalinophiles, oligotroph, toxitolerant, xerotolerant, endolith – Extremophiles and their environment. Coral reefs, Sea grass, Mangroves, Hydrothermal vents and water currents.

UNIT III- Marine food pathogens and microbial toxin

Marine food pathogenic microorganisms, distribution, indicator organism's prevention and control. Microbiology of processed -finfish and shellfish products. Microbial diseases- diagnosis and control. Introduction, microbial toxin, algal blooms, types. Harmful effect- Human health, Economic impact and Environmental impact, Potential remedies.

UNIT IV – Xenobiotics and Marine nutrient cycles

Microbiology of degradation of xenobiotic environment: Ecological considerations, decay behavior, degradative plasmids, hydrocarbons, oil pollution, surfactants, pesticides, plastics and heavy metals. Factors affecting bioremediation – role of microbes in the marine nutrient cycles.

UNIT V – Marine Microbes bioproducts

Microalgae and seaweeds – Food products- Human food and animal feed, Biomedical Products- Antimicrobial, antioxidant, antiviral and anticancer activity. Aquaculture feed inoculants -. Industrial Application- bioethanol production. Biopigment products - Phytoplanktons, Bioluminescence**.**

SUGGESTED READINGS

1. Colin Munn. (2011). *Marine Microbiology: Ecology & Applications*. (2nded.). Black Well Publishers.
2. David Sigee. (2005). *Freshwater Microbiology: Biodiversity and Dynamic Interactions of Microorganisms in the Aquatic Environment*. (1sted.). Black wellPublishers.
3. Joanne, M.W., Linda, S., and Christopher, J.W., (2008). *Prescott, Harley, and Klein's Microbiology*. (7th Ed). McGraw-Hill Higher Education, UnitedStates.
4. Se-Kwon Kim. (2013). *Bioactive compounds and biotechnological applications*. CLSPublishers
5. Dube, H.C. (1994). *A text book of fungi, bacteria and viruses*. Vikas Publishing House, New Delhi.
6. Dale, J.W. (1994). *Molecular genetics of Bacteria*. John Wiley andStones.
7. Pelczar, M., JR., Chan, E.C.S., and Noel, R. K., (2006). *Microbiology*. Tata McGraw, Hill. Co. (5thed.). NewDelhi.
8. Presscott, L.N., Harley, J.P. and Klein, D.A., (1999). *Microbiology*. W.C. BrownPublishers.
9. Stanier, R.Y., Ingharam, J.L., Wheelis, M.L., and Painter, P.R., (1986). *General Waste water engineering Treatment, Disposal and Reuse*. Metcaff and Eddy. Inc., Tata Mc Grew Hill, New Delhi.
10. Rheinheimer, G., 1980 Aquatic Microbiology-an Ecological Approach. Blackwell Scientific Publications
11. Kirchman, L Microbial Ecology of the Oceans 2000 John Wiley and Sons. Hans G. Truper et. al 1991.

Semester - I

21MBP105B **ADVANCED BIOINFORMATICS** **4H – 4C**

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

COURSE OBJECTIVES

- To detail the importance of computer in field of life sciences.
- To obtain good understanding about the interpretation of biological data base. To uptake knowledge in latest tools and technology.
- To describe the history, scope and importance of Bioinformatics and role of internet in Bioinformatics
- Provide an overview of the application areas of bioinformatics, with a focus on the topics that will be taught in the course
- To get introduced to the basic concepts of Bioinformatics and its significance in Biological data analysis
- Classify different types of Biological Databases.

COURSE OUTCOME (CO'S)

1. The students will have an understanding about the information on the search engines and various software tools involved in bioinformatics.
2. Additional knowledge on different operating systems would enable the candidate to work with versatility.
3. Provides computational skill on search engines and various software tools involved in bioinformatics
4. It will impart computational based techniques which includes genomics and proteomics in Bioinformatics.
5. Retrieve information from available databases and use them for microbial identifications and drug designing
6. Gain ability to modify gene and protein structures in simulated systems

UNIT – I

Basic introduction of Bioinformatics; An overview of major bioinformatics resources; NCBI, EBI, ExPASy, RCSB, Open access bibliographic resources and literature databases, Sequence databases, Derived Databases.

UNIT – II

Bioinformatics tools - Global Vs local alignment – Similarity searching –Pair wise alignment and multiple alignments – Biological Databases – Literature, Sequence and Structure – identification and retrieving data from databases.

UNIT – III

Protein information resources –primary sequence database, Composite protein sequence database, secondary database, and Composite protein structure database. Protein structure prediction - Prediction of secondary and tertiary structure, Proteomic tools - ExPASy server.

UNIT – IV

Protein structure comparison and classification – RNA structure analysis – Plasmid mapping and Primer designing– Structure visualization softwares – Phylogenetics – Tree types and construction methods. Phylogenetic analysis algorithms such as maximum Parsimony, UPGMA, Transformed Distance, Neighbors-Relation, Neighbor-Joining, Bootstrapping methods, use of tools such as PHYLIP, MEGA.

UNIT – V

DNA sequencing –Specialized genomic resources. DNA microarray – principles and databases – Genomics and Proteomics – genes prediction, splices sites and regulatory regions, Modeling biological systems, Drug design - Structure-based drug design: Identification and Analysis of Binding sites and virtual screening, Vaccine design.

SUGGESTED READINGS

1. Rashidi, H., and Buehler, L.K., (2005). *Bioinformatics Basics: Applications in Biological Science and Medicine*. CRC Press/Taylor & FrancisGroup.
2. Krawetz, S.A., David, D., Womble, S.A., Krawetz, D.D., Womble, D., (2003). *Introduction to Bioinformatics: A theoretical and Practical approach*. Humana Press, USA.
3. Bergeron, B. (2002). *Bioinformatics Computing*. Prentice Hall Publishres.
4. MountD. W. (2001). *Bioinformatics. Sequence and Genome Analysis*, Cold Spring Harbor LaboratoryPress.
5. Higginns, D., and Taylor, W., (2000). *Bioinformatics. Sequence, Structure and databanks – A Practical Approach*, Oxford UniversityPress.
6. Baxevanis, A.D., and Francis Ouellette, B.F., (2001) *Bioinformatics – A Practical Guide to the Analysis of Genes and Proteins*, Wiley –Interscience.
7. Gibson, G., and Muse, S.V., (2002). *APrimer of Genome Science, Sinauer Associates*, Inc. Publishers.
8. Misener, S., and Krawetz, S.A., (2000). *Methods in Molecular Biology – Bioinformatics. Methods and Protocols*, Humana Press.
9. Attwood, T.K., and Parry-Smith, D. J., (2001). *Introduction to Bioinformatics*, Pearson Education Asia.
10. Claverie, J.M., and Notredame, C., (2003). *Bioinformatics for Dummies***,** Wiley Publishing,Inc
11. Bioinformatics for Systems Biology (2009) by Stephen Krawetz, Published by Humana Press

Semester-I

21MBP105C PHARMACEUTIAL MICROBIOLGY 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 Understand the basics of pharmaceutical microbiology and important microorganism playing role pharmaceutically
- To understand different products of microbial origin playing key role in pharmaceutical applications.
- To understand role of secondary metabolites in pharmaceutical industry.
- Understand the functions of biomolecules.
- Understand of nucleic acids and their importance to combine and analyses information
- To understand good practices and regulation involved in utilizing microbial product for pharmaceutical application

COURSE OUTCOME

1. Have basic knowledge of pharmaceutical microbiology
2. Have well versed with the different microbial products used in pharmaceutical applications
3. Better understanding of good laboratory practices and regulations for utilizing microbial product in pharmaceutical applications
4. Get introduced to various drug discovery tools and appreciate use of in silico methods in drug designing.
5. Summarize the DNA & RNA structure and base pairing schemes
6. Understand the process of production of various biopharmaceuticals.

UNIT I

Microorganisms affecting pharmaceutical industry

The atmosphere, water, skin & respiratory flora of personnel, raw-materials, packing, equipment's, building, utensils etc. Types of microorganisms occurring in pharmaceutical products. Microbiological spoilage prevention of pharmaceutical products. Preservation of pharmaceutical products; antimicrobial agents used as preservatives, evaluation of the microbial stability of formulation. Sterilization in pharmaceutical industry Good manufacturing practices in pharmaceutical industry. Physical, chemical & mechanical method of sterilization. Sterility indicators.

UNIT II

Drug Metabolism

Absorption and distribution of drugs, importance of drug – protein interaction. Drug metabolism: chemical pathway of drug metabolism, phase I and phase II reactions, role of cytochrome P450, non- microsomal reactions of drug metabolism, drug metabolizing enzymes. Drug elimination of liver and kidney. Biotransformation of drugs. Enzymes responsible for bio transformations, microsomal & non-microsomal mechanism.

UNIT III

Drug Discovery and Development

Microbial, Recombinant, Biochemical and Molecular level screening systems and their construction/ design strategies. Conventional Process; Bio-prospecting. Search of database/data mining for Drug designing; Preclinical and Clinical trials; Estimation of toxicity: LD_{50} and ED_{50}; Rational Drug Design – Principle (Structure activity relationship -SAR) and Tools (applications of High through

Put Screening, Combinatorial synthesis).Drug target, computer aided drug design, Preclinical and clinical testing.

UNIT IV

The drug resistance

The drug resistance – The phenomenon, clinical basis of drug resistance, biochemistry of drug resistance, genetics of drug resistance in bacteria. Microbiological assays: Assays for growth promoting substances, nutritional mutants and their importance, vitamin assay, amino acid assay. Assay for growth inhibiting substances – Assay for non-medicinal antimicrobials (Phenol coefficient/RWC). Drug sensitivity testing methods and their importance. Assay for antibiotics – Determination of MIC, the liquid tube assay, solid agar tube assay, agar plate assay (disc diffusion, agar well and cylinders cup method). Biochemical mechanism of resistant.Resistant bacteria by over use and misuse of antibiotics and uses of antibiotic combinations.

UNIT V

Regulatory aspects in pharmaceuticals

Good laboratory/manufacturing practices for pharmaceuticals production, validation and regulation; Government regulatory practices and policies for pharmaceutical industry: Food and Drug Administration (FDA), The Central Drugs Standard Control Organization (CDSCO), the Drug Controller General of India (DCGI); patenting of pharmaceutical products. Good documentation practices in pharmaceutical industry.

SUGGESTED READINGS

1. Geoff Hanlon & Norman A (2013). *Hodges Essential Microbiology for Pharmacy and Pharmaceutical Science*, Wiley-Blackwell
2. Madhu Raju Saghee , Tim Sandle , Edward C. Tidswell (2011). *Microbiology and Sterility Assurance in Pharmaceuticals and Medical Devices*, Business Horizons.
3. Geoff Hanlon, Norman A. Hodges (2013). *Essential Microbiology for Pharmacy and Pharmaceutical Science*, Wiley-Blackwell.
4. Stephen P. Denyer , Norman A. Hodges, Sean P. Gorman , Brendan F. Gilmore (2011). Hugo and *Russell's Pharmaceutical Microbiology*, Wiley-Blackwell.
5. Prahlad Singh Mehra (2011). *A Textbook of Pharmaceutical Microbiology*, I K International Publishing House.

Web link:

1. https://pharmacy.sgtuniversity.ac.in/syllabus-pharmaceutical-microbiology-theory-b-pharmacy/

2. https://www.umu.se/en/education/syllabus/3fa015/

Semester – I

21MBP111 **MICROBIAL PHYSIOLOGY PRACTICAL** **4H –2C**

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

COURSE OBJECTIVES

- This course is put forward with the objectives of equipping the candidates with practical knowledge on basic techniques involved in the isolation, characterization and identification of different types of microorganism.
- Know various Culture media and their applications and also understand various physical and chemical means of sterilization.
- Know General bacteriology and microbial techniques for isolation of pure cultures.
- Master aseptic techniques and be able to perform routine culture handling tasks safely and effectively.
- Comprehend the various methods for identification of unknown microorganisms.
- Understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolism

COURSE OUTCOME

1. A student able to skillfully isolate and identify the microorganisms using different microbiological techniques needed in laboratory.
2. To enhance the ability of the student skills in medical laboratories and research sectors.
3. Demonstrate practical skills in the use of tools, technologies and methods common to microbiology.
4. To apply the scientific method and hypothesis testing in the design and execution of experiments
5. To develop theoretical and practical skills in the design and execution of experiments.
6. Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.

EXPERIMENTS

1. Micrometry
2. Staining techniques: Simple, Differential, Capsule, Endospore and AFB (Demo)
3. Motility determination - Hanging drop and SIM inoculation.
4. Cultivation of anaerobic microorganisms – Wrights tube – McIntosh anaerobic jar - roll tube methods.
5. Lactophenol cotton blue mounting of fungi – *Aspergillus* sp, *Mucor* sp, *Rhizopus* sp, *Fusarium* sp, *Penicillium* sp
6. Measurement of microbial growth – Viable count – Direct count – Turbidity methods
7. Biochemical characterization
   a) Indole Test
   b) Methyl Red Test
   c) Voges Proskauer Test
   d) Citrate utilization Test
   e) TSI Test
   f) Catalase Test
   g) Oxidase Test
   h) Urease Test
   i) Nitrate Test
   j) Carbohydrate fermentation Test
   k) Amino acid utilization Test
   l) Hydrolysis of polymers- Starch, Lipid, Casein, Gelatin.

SUGGESTED READINGS

1. Cappucino, J.G. and Sherman, N., (2001). *Microbiology A Laboratory Manual*, (6th ed.). Benjamin Cummings, NewYork.
2. Dubey, R.C., and Maheshwari, D.K., (2002). *Practical Microbiology*, (1st ed.). S. Chand and Company Ltd, NewDelhi.
3. Gunasekaran, P. (1996). *Lab Manual in Microbiology*, (1st ed.). New Age International (P) Ltd, Publishers, NewDelhi.
4. Brook,G.F., J., Butel, S., Stephen, A., and Morse, A., (2003). *Medical Microbiology*, (22nd ed.). McGraw Hill.
5. Chakraborty, P. (2003). *A Text book of Microbiology*. (2nd ed.). New Central Book Agency (P) Ltd., Calcutta.
6. Dismukes, W.E., Pappas, P.G., and Sobel, D., (2003). *Clinical Mycology*. Oxford University Press, UK.
7. Jawetz, E., Melnic, J.L., and Adelberg, E.A., (2019). *Medical Microbiology*. (28th ed.). Lange Medical Publishers. NY

Semester – I

21MBP112 GENETICS AND INSTRUMENTATION PRACTICAL 4H –2C

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

COURSE OBJECTIVES

- To acquire skill on the different molecular mechanism of gene transfer, mutations and separation of nucleic acids.
- This course is put forward with the objectives of equipping the candidates with practical knowledge on basic techniques.
- To impart skills of isolation, characterization and identification of different types of microorganism.
- Know various Culture media and their applications and also understand various physical and chemical means of sterilization.
- To make students understand the principles of Genetics
- Students will learn the basic principles of inheritance at the molecular, cellular and organismal levels.

COURSE OUTCOME

1. A student undertaking this course will be learning the principles behind the molecular techniques which would enable him to work in competent molecular biology-based laboratories.
2. Imparts knowledge on the different aspects of genetics and pedigree analysis.
3. Students will apply their knowledge of to selected examples of changes or losses in cell function.
4. Identify the organs and tissue systems of plants, and explain their respective function.
5. Impart knowledge on applications of microorganisms in various fields
6. Provides skill development on microbial products

EXPERIMENTS

1. Spontaneous Mutation – gradient plate technique
2. Induced Mutagenesis-chemical and physical -UV
3. Replica plating technique.
4. Competent cell preparation.
5. Transformation in Bacteria
6. Bacterial Conjugation
7. Induction of Lac operon
8. Measurement of growth-one step growth curve using a T seven phage
9. Titration of phages(T4)
10. Nuclear staining for nucleic acid identification.
11. Analysis of amino acid by Paper chromatography
12. Analysis of amino acid by Thin layer chromatography
13. Purification of proteins by column chromatography

SUGGESTED READINGS

1. Arora, B., and Arora, D.R., (2007). *Practical Microbiology*, (1st ed.). CBS Publishers and Distributors, Bangalore.
2. Alfred Brown and Heidi Smith. *Benson's Microbiological Applications, Laboratory Manual in General Microbiology*, 13th Edition, 2015, McGraw-Hill
3. Palanivelu, P. (2004). *Analytical Biochemistry and Separation Techniques*, (3rd ed.). Twenty First Century Publication, Madurai.

Semester – I

JOURNAL PAPER ANALYSIS AND PRESENTATION **2H**

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

Semester – II

21MBP201 **VIROLOGY** **4H –4C**

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

COURSE OBJECTIVES

- Virology, often considered a part of microbiology or of pathology, is the study of biological viruses and virus like agents.
- Viral structure, classification and evolution, their ways to infect and exploit cells of virus reproduction, the disease they cause.
- The techniques to isolate and culture them and their potential uses in research and therapy.
- To know how viruses are classified
- To understand the architecture of viruses
- To understand the interactions between viruses and the host immune system.

COURSE OUTCOME (CO'S)

1. Describe the structure and replication strategies of the viruses, the processes of entry into cells, control of gene transcription and where relevant translation and gene product stability, control of and mechanism of genome replication, virion assembly and egress from the cell.
2. Define the process of virus latency and describe in molecular terms control of the process and activation of viral genomes during reactivation.
3. Describe the growth behavior differences between normal cells and cells transformed by oncogenic DNA and RNA viruses.
4. Integrate experimental strategies learned in the context of viral systems into the design of experiments involving other systems.
5. Discern the replication strategies of representative viruses from the seven Baltimore classes
6. To understand the interactions between viruses and the host immune system.

UNIT I - Viral classification and properties

Historical perspective of virology - Scope of virology -Viral classification and properties of viruses – Replication of viruses, cultivation of viruses (animal inoculation, Embryonated egg and tissue culture) - properties of viroids and Prions.

UNIT II – Animal DNA viruses

Animal viruses- DNA viruses - morphology, replication, pathogenesis and laboratory diagnosis of Pox virus, Adeno virus, Hepatitis viruses – type A, B and D. Herpes simplex viruses, Oncogenic viruses- Papova virus, - oncogenes and Oncogenesis.

UNIT III - Animal RNA viruses

Animal viruses - RNA viruses - morphology, replication, pathogenesis and laboratory diagnosis of Poliovirus.Rabies virus, Influenza virus, Mumps virus, Measles virus and Rubella virus, Retro virus - HIV virus.Dengue and Japanese Encephalitis, Swine Flu, Coronavirus-SARS and COVID-19.

UNIT IV - Plant viruses

Plant viruses – RNA viruses – TMV, Cowpea mosaic virus, Bromomosaic viruses, Satellite viruses – Double stranded DNA viruses - CaMV – Single stranded DNA viruses – Gemini virus. Structure and Replication of Bacteriophage (T4) – Filamentous phage (ΦX174).

UNIT V- Infections and Immunization

Nosocomial infections, Viral Vaccines-Interferons - Antiviral drugs - strategies to develop AIDS vaccines - Rabies vaccines preparation (animal and cell culture) and their immunization. Types of vaccine and their immunization schedule in children as well as adult.

SUGGESTED READINGS

1. Ananthanarayanan, R., and Panicker, C.K.J., (2005). *Text book of Microbiology*. (7thed.). Orient Longman, NewDelhi.
2. Carter, J., and Saunders, V., (2007). *Virology: Principles and Applications*. (1sted). Wiley.
3. Acheson, N.H. (2006). *Fundamentals of Molecular Virology*. Wiley publication.
4. Cann, A.J. (2005). *Principles of Molecular Virology*, Academic Press.
5. Dimmock, N.J., Easton, A.J., and Leppard, K.N., (2007). *Introduction to Modern Virology*, (6thed.). Blackwell Scientific Publications, Oxford,UK.
6. Flint, S.J., Racaniello, V.R., Enquist, L.W., Rancaniello, V. R., and Skalka, A. M., (2003). *Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses*. American Society Microbiology.
7. Jawetz, E., Melnic, J.L, and Adelberg, E.A., (2001). *Review of Medical Microbiology*. (22nded.). Lange Medical Publishers,NY.
8. Levy, J. A., Fraenkel-Conrat, H., and Owens, O. S., (1994).*Virology*. (3rded.). Benjamin Cummings.
9. Knipe D.M., Howley P.M., and Griffin D.E., (2006). *Fields Virology*. (5thed). Vols - I, II. Lippincott, Williams &Wilkins.
10. Prescott, M., Harley, J.P., and Klein, D.A., (2007). *Microbiology*. (7thed.). McGraw-Hill Inc. New York.
11. White, D. O., and Fenner, F.J., (1994). *Medical Virology*, (4thed.). Academic Press, New York.

WEBLINK

1. https://www.medicalnewstoday.com/articles/181418.php
2. https://www.medicinenet.com/swine_flu/article.htm#swine_flu_h1n1_and_h3n2_influenza_

Semester -II

21MBP202 MEDICAL BACTERIOLOGY 4H – 4C

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- Medical Bacteriology introduces basic principles and then applies clinical relevance of many etiological agents responsible for global infectious diseases.
- The infectious disease cycle of the pathogens enables to solve the epidemics.
- The territory covered by infections and the immune response
- We focus on pathogenic mechanisms in order to foster a student's ability to solve problems in their future clinical career and able to establish the medical laboratory.
- This course provides learning opportunities in the basic principles of medical microbiology and infectious disease
- It covers mechanisms of infectious disease transmission, principles of aseptic practice, and the role of the human body's normal microflora

COURSE OUTCOME

1. Demonstrate an understanding at an advanced level of microbial virulence mechanisms and host response to infection.
2. Application of molecular techniques to medical microbiology; biochemical and genetic mechanisms of antimicrobial agent activity, microbial susceptibility and resistance to antimicrobial agents.
3. Demonstrate an understanding of skin and respiratory tract infections (microbial causes, pathogenesis, transmission of infection, diagnosis, prevention and treatment) by being able to identify an unknown organism in clinical samples, and describe the pathogenesis of important pathogens.
4. It also provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.
5. To understand the importance of pathogenic bacteria in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.
6. Recall the relationship of this infection to symptoms, relapse and the accompanying pathology.

UNIT I- Isolation and identification of pathogens

Laboratory precaution and guidelines – Collection of clinical specimens – Blood, Urine, Sputum, Pus, CSF, Stool, Throat swab, Semen, Dental plaque – transport Media and its types – handling and examination of pathological specimens – methods of isolation, identification and interpretation of pathogenic organisms – Antibiotic susceptibility testing.

UNIT II - Infections

Infections – types of infections – methods of infections – Sources of infections – infectious disease cycle. Biomedical waste management. Definitions of Epidemics, Endemics Pandemics and investigation of epidemics and control. Definition of pathogens, Saprophytes and Commensal. Quality control in microbiology lab, clean room maintenance and surveillance, face mask porosity testing-Bacterial Filtration Efficiency (BFE).

UNIT III - Gram positive organisms

Morphology, cultural characteristics, antigenic property, pathogenicity, laboratory diagnosis and treatment. *Staphylococcus* sp., *Streptococcus* sp., *Bacillus* sp., *Corynebacterium* sp., *Clostridium sp. Mycobacterium* sp.

UNIT IV - Gram negative organisms

Morphology, cultural characteristics, antigenic property, pathogenicity, laboratory diagnosis and treatment. *E.coli*, *Klebsiella* sp., *Proteus* sp., *Pseudomonas* sp., *Vibrio* sp., *Salmonella* sp., *Shigella* sp.,*Treponema* sp., *Leptospira* sp; *Neisseria* sp. and *Haemophilus* sp.

UNIT – V – Infection and Therapy

Nosocomial infection – Urinary tract infection, Respiratory tract infection, Sexually transmitted disease – Monoprophylaxis – Antimicrobial chemotherapy and Antibiotics. Vaccines – Types – Vaccination Schedule.

SUGGESTED READINGS

1. Ananthanarayanan, R., and Panicker, C.K.J., (2017). *Text Book of Microbiology* (10thed.). The Orient Blackswan
2. Salle, A.J. (2008). *Fundamentals principles of bacteriology*. T.M.H. Ed.). McGraw Hill.
3. Carl Fraenkel. (2012). *Text book of bacteriology*. Printing company publishers, NewYork.
4. Brook,G.F., J., Butel, S., Stephen, A., and Morse, A., (2003). *Medical Microbiology*, (22nded.). McGraw Hill.
5. Brook,G.F., J., Butel, S., Stephen, A., and Morse, A., (2003). *Medical Microbiology*, (22nded.). McGrawHill.
6. Jawetz, E., Melnic, J.L., and Adelberg, E.A., (2019). *Medical Microbiology*. (28thed.). Lange Medical Publishers. NY.

21MBP203 BIOSTATISTICS AND RESEARCH METHODOLOGY Semester – II

4H –4C

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

COURSE OBJECTIVES

- About collection, interpretation and presentation of statistical data
- The analytics of data, probability, and hypothesis testing of samples
- The essential role of statistics in present, future use and applications of Biology.
- Analytical techniques to generate results
- Comparison of different groups.
- To know the significant among the groups.

COURSE OUTCOMES

1. Apply basic statistical concepts commonly used in health and medical sciences
2. Use basic analytical techniques to generate results
3. Interpret results of commonly used statistical analyses in written summaries.
4. Demonstrate statistical reasoning skills correctly and contextually and this course will support the employment in various bioscience sector.
5 The analytics of data, probability, and hypothesis testing of samples
6 The essential role of statistics in present, future use and applications of Biology

UNIT I - Introduction of Biostatistics and Correlation

Introduction to Biostatistics, Basic Measures - Central Tendency and Dispersion, Variables in Bioscience, Correlation – Meaning and definition - Scatter diagram –Karl Pearson's Correlation Coefficient. Rank Correlation. Regression: Regression in two variables – Properties of Regression, uses of Regression

UNIT II - Test of Significance

Sampling parameters: Difference between sample and Population, Censoring, difference between parametric and non-parametric statistics. Sampling Distributions, Standard Error, Testing of Hypothesis, Level of Significance and Degree of Freedom, Confidence Interval; Small sample test based on t-test, Large Sample Test based on Normal Distribution - Z- test and F test.

UNIT III Analysis of Variance

Distribution-free test - Chi-square test; Basic Introduction to Multivariate statistics, etc. Test of significance: Tests based on Means only-Both Large sample and Small sample tests - Chi square test - goodness of fit. Analysis of Variance – one way and two-way classification, CRD, RBD Designs.

UNIT IV-Research

Research: Scope and significance – Types of Research – Research Process – Characteristics of good research – Problems in Research – Identifying research problems.

UNIT V - Sampling Design

Research Designs – Features of good research designs. Sampling Design: Meaning – Concepts – Steps in sampling – Criteria for good sample design. Scaling measurements - Types of scale, Types of sampling – random sampling and non- random sampling. Sampling Errors.

SUGGESTED READINGS

1. Jerrold H. Zar. (2003). *Biostatistical Analysis.* (4th ed.). Pearson Education (P) Ltd, New Delhi.
2. Kothari. C.R. (2004). *Research Methodology – Methods and Techniques.* (2nd ed.). New Age International Pvt. Ltd, New Delhi.

Semester – II

21MBP204 ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY 4H –4C

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

COURSE OBJECTIVES

- To educate the students about concepts of designs of water distribution systems, sewer networks, working principles and design of various physical, chemical and biological treatment systems of water and wastewater.
- To study about the biofertilizers, plant disease and increasing soil fertility.
- To impart a skilled knowledge on Microbes and environment and ecological importance.
- The main goal is to know and understand the role of microbes in biogeochemical processes in different ecosystems. The students will learn the basic microbiological principles, the methods in microbial ecology and their theoretical and practical use.
- The knowledge can give the base for understanding processes and changes in the environment.
- The students can get some skills to recognize the ecological problems and critical evaluation of the human impacts on pollution, climate changes and as well as environmental protection.

COURSE OUTCOME (CO'S)

1. This course will provide the student insights into these invaluable areas of Environmental microbiology, which play a crucial role in determining its future use and applications in environmental management.
2. Students able to know detailed idea about biofertilizer production and plant disease.
3. Students able to become Entrepreneur after understanding this process and product development.
4. This course will determine microbial role in nutrient cycling
5. This course can able to determine water quality.
6. It will explain the degradation of natural organic compounds and selected pollutants in the environment.

UNIT I

Aquatic environment

Microbiology of water-water borne diseases and their control measures. Major water pollutants. Microbiological analysis of water (total count, indicative organism), B.O.D. & C.O.D. - determination and implication. Methods of sewage treatment - physical screening, chemical, biological (sludge digestion; activated sludge, aerating filters, oxidation pond), Disposable of wastes-primary, secondary and tertiary treatment.

UNIT II

Microbiology of air and Bioremediation

Microbial contaminants of air –Indoor air quality analysis- Micro flora in Hospitals, Houses and Library. Microbial indicators of air pollution. Air samplers and sampling techniques. Air sanitation. Bioremediation of air pollutants. Bioleaching – Biology of mineral leaching, recovery of metal from ores– oxidation of minerals – testing for biodegradability.

UNIT III

Microbes in agriculture

Importance of microbes in agriculture, Current agriculture problems and solution. Bacterial diseases of agricultural crops - pathogens, symptoms and control measures with reference to paddy, cotton, maize, tomato, citrus, mango and potato. Plant protection –phenolics – phytoalexins and related compounds.

UNIT – IV Biological nitrogen fixation

Symbiotic and non-symbiotic microorganisms, root nodule formation, nitrogen fixers, Uride metabolism in Plants, Enzymology (Hydrogenase, Nitrogenase), Genetics of symbiotic fixers- *nif* gene regulation. Rhizosphere- R: S ratio, Interaction of microbes with plants. Bioconversion of agricultural wastes. Plant microbial interactions-Endophytic cycles. VAM.

UNIT V

Biofertilizers and Biocontrol

An Industrial Perspective of Plant Beneficial Microorganisms– A combination of biofertilizer and manure applications with reference to soil, seed and leaf sprays. Plant growth promoting microorganisms-Myzorrhizae, Rhizobia, Azosprillum, Azotobacter, Azolla, Frunkia, Blue green algae, Phosphate- solubilizers fluorescent *Pseudomonas*. Laboratory and field application; Cost-benefit analysis of biofertilizer and bio manure production. Biocontrol and its application: Biofungicides, bionematicides and Biopesticides. Microflora in storage environment and their control.

SUGGESTED READINGS

1. Saxena., and Sanjai., (2015). *Applied Microbiology*. Springer, Germany.
2. Denise., G.A., Sarah, S., and Deborah, A., (2015). *Nester's Microbiology*. McGraw-Hill Education
3. Rangaswami, G., and Bhagyaraj, D.J., (2001). *Agricultural Microbiology*. (2nded.). Prentice Hall, New Delhi.
4. Rao, N.S. (1995). *Soil Microorganisms and plant Growth*. Oxford and IBH Publishing Co., New Delhi.
5. Pelzar, M.J., and Reid, M., (2003). *Microbiology*. (5thed.). Tata McGraw-Hill, NewYork.
6. Moshrafuddin Ahmed and Basumatary, S.K., (2006).Applied Microbiology.MJP Publishers, Chennai.
7. Sen, K., and Ashbolt, N.J., (2010). *Environmental Microbiology: Current Technology and Water Applications.*
8. Maier, R.M., Pepper, I,L., and Gerba, C.P., (2009). *Environmental Microbiology*. (2nded.). Elsevier Publisher.
9. Atlas, R.M., and Bartha, M., (2000). *Microbial Ecology - Fundamental and Applications*. (3rded.). Redwood City CA. Benjamin/Cumming Science Publishing Co., New Delhi.
10. Maier, R.M., Pepper, I.L., and Gerba, C.P., (2000). *Environmental Microbiology*. (1sted.). Academic Press, New York.
11. Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. 2000. Twelth Edition, Biology Microorganisms, Prentice Hall, New Jerry. 5.
12. Mark Wheelis, 2010. Principles of Modern Microbiology, Jones & Bartlett India Pvt. Ltd., New Delhi.
13. Bagyaraj D.J., and Rangaswami.G. 2009. Agricultural Microbiology (2nd edition). PHI Learning Pvt. Ltd.
14. R.P. Pareek and Navneet Pareek. 2019. Agricultural Microbiology. Scientific Publishers.
15. K. R. Aneja. 2017. Fundamental agricultural microbiology (19th edition). New Age International Private Limited.

Semester - II

21MBP205A **CELL BIOLOGY** **4H -4C**

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

COURSE OBJECTIVES

- To study cell structure, functions of organelle and gain exposure on transportations through cell membrane and to focus on different receptors and model of signaling.
- Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
- Students will understand how these cellular components are used to generate and utilize energy in cells.
- To gain the knowledge base in genetics, molecular biology and cell physiology.
- To engage the students in review of scientific literature in the areas of cell mediated biomedical studies.
- Conceptualize and describe protein structure, folding and sorting

COURSE OUTCOME (CO'S)

1. Students upon completion of this paper will have clear knowledge on various cellular functions such as transportation and signaling.
2. It will enable the students to enter into cellular function level research for their future.
3. Students will understand the cellular components underlying mitotic and meiotic cell division.
4. Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function.
5. Students will get the knowledge of common and advanced laboratory practices in cell and molecular biology
6. Conceptual knowledge of properties, structure, function of enzymes, enzyme kinetics and their regulation, enzyme engineering, Application of enzymes in large scale industrial processes

UNIT I - Cell

Cell properties definitions, Cell theory, Catalysis & biosynthesis of cell, Ultra structure of eukaryotic cell - plant and animal. Bacterial cell wall structure - composition – functions. Methods of Microscopy studies in cells, Primary cell culture, Culture media manufacturing.

UNIT II - Plasma membrane

Plasma membrane - Membrane structure and function, lipid bi layer model, Transportation – types and methods, Membrane protein diffusion, Osmosis, Ion channels - active and passive transport, Mechanism of sorting and regulation of intracellular transport, Electrical properties of membranes, Cytoskeleton - Role of microtubules and microfilaments. Cell communication and Cell signaling, Extra- and intracellular signal transduction.

UNIT III - Cell organelles

Endoplasmic reticulum – Structure, Types of Endoplasmic Reticulum and functions, Golgi complex- structure- functions, Mitochondria structure, mitochondrial DNA Properties, Functions - cellular respiration, Chloroplast, Ribosomes, Lysosomes, Peroxisomes, Nucleus - Organization of genes and chromosomes**,** Vacuoles.

UNIT IV - Mitosis

Properties and significance, cell division and five phases of mitosis, doubling of chromosomal constituents, Differentiation of chromosomes regulation, and control of cell cycle.

UNIT V – Meiosis

Properties and significance, Phases of meiosis, Meiosis regulation, Cytokinesis, Synaptonemal Complex, Genetic Control of Meiosis, Control of cell cycle, Recombination and Genetic Variability, Cellular aging and cell adhesion molecules.

SUGGESTED READINGS

1. Najman, S. (2012). *Current Frontiers and Perspectives in Cell Biology*.
2. Twesigye, C. K. *Cell Biology and Genetics*.
3. Cooper, G.M., and Hausman, R. E., (2007). *The Cell: A Molecular Approach*. (4th ed.). Sinauer Associates, Incorporated Publications
4. Ge Yang. (2011). *Engineering Molecular Cell Biology*. Garland Science Publishers.
5. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., and Walter, P., (2002). *Molecular Biology of the Cell*. (4th ed.). Garland Science Publications.
6. Albert, B., Bray, D., Lewis, J., Raff, M., Roberts, K., and Watson, V., (1989). *Molecular Biology of the Cell*, Garland Publishing Inc, London.
7. Sadava, D.E. (1993). *Cell biology: Organelle structure and functions*. (1st ed.). Jones and Bartlett Publishers, USA.
8. Karp, G. (1984). *Cell biology*, (2nd ed.). McGraw-Hill Publications, USA.
9. Gupta, M.L., and Jangir, M.L., (2001). *Cell Biology: Fundamentals and Applications*, (1st ed.). Agrobios, Jodhpur,India.
10. Verma, P.S., and Agarwal, V.K., (2005). *Cell Biology*, (24th ed.)., S. Chand and Company Limited,India.
11. Bruce Alberts, Alexander Johnson , Julian Lewis, Martin Raff, Molecular Biology of the Cell, Fifth Edition (ISBN 0-8153-4105-9).
https://en.wikibooks.org/wiki/Cell_Biology

Semester – II

21MBP205B **MOLECULAR BIOLOGY** **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 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 courses include 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.
3. The development of novel medicines for treatment.
4. A thorough understanding of the process of translation and operons along with recombination of DNA.
5. An in-depth study of mutagenesis and genetic analysis with gene mapping.
6. Full understanding of all aspects of all important techniques used for the study of biomolecules.

Unit I -Structure of genetic material

DNA Structure: Mieschertto 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-Replication

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

Unit III- Transcription

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-Translation

Translational machinery, charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides in both prokaryotes and eukaryotes, Fidelity of translation, Inhibitors of protein synthesis in prokaryotes and eukaryote and post translational modifications. Regulation of gene expression in prokaryotes *lac* operon and *trp* operon.

Unit V-Molecular Techniques

Molecular biology techniques, Denaturation and renaturation, cot curves, PCR, RT-PCR, Q-PCR, RNAi, CRISPR, DNA finger Printing, DNA micro array, PAGE, Western blot, Southern blot, northern blot.

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 – II
4H – 4C

21MBP205C **BIOPROCESS ENGINEERING**

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

COURSE OBJECTIVES

- This course encompasses the use of microorganisms in the manufacture of food or industrial products.
- The use of microorganisms for the production of food, either human or animal, the microorganisms used in bio processes may be natural isolates; laboratory selected mutants or genetically engineered organisms.
- To know the basics and concepts of various biotechnological related terms
- Elucidate the significance of transgenic plants as bioreactors for the production of enzymes.
- Address bioethical and biosafety issues related to plant transgenics
- Elucidate the molecular techniques involved in gene manipulation and rDNA technology

COURSE OUTCOME

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

UNIT I - Fermenter

Design of a basic fermenter, bioreactor configuration, design features, computer control of fermentation process, measurement and control of process.Types of Bioreactors and its functions.

UNIT II - Cultures in the fermenter

Growth of cultures in the fermenter. Importance of media in fermentation, media formulation and modification. Kinetics of growth in batch culture, continuous culture with respect to substrate utilization, specific growth rate, steady state in a chemostat, fed-batch fermentation, yield of biomass, product, calculation for productivity.

UNIT III - Physical factors and scale-up

Transport phenomena in fermentation: Gas- liquid exchange and mass transfer, oxygen transfer, critical oxygen concentration, heat transfer, aeration/agitation, its importance. Sterilization of Bioreactors, nutrients, air supply, products and effluents, process variables and control, scale-up of bioreactors.

UNIT IV – Microbial Products and Downstream process

Enzymes- Introduction, Enzyme Kinetics, Immobilized Enzyme system, large scale production, Vitamins (Vitamin C), Amino acids, Enzymes, Antibiotics, Organic acids, Vaccines, Cheese, and Exopolysaccharides. Bio transformation product (steroid). Down streaming process of microbial products (Peptides, Biopolymers, surfactants, Enzymes) - separation, centrifugation, filtration, extraction, purification, crystallization, crystal washing, drying of crystals, freeze-drying, spray drying.

UNIT V - Strain improvement & Preservation

Isolation, selection and improvement of important strains and pathways –Mutation, Protoplast fusion, parasexual cycle and genetic engineering for strain improvements, product formation and inhibition pathways and their regulations; applications in medicine, agriculture and industry. Role of plant and animal cells in bioprocess. Industrially important microorganisms, preservation, national and international culture collection centers.

SUGGESTED READINGS

1. Shuler, M.L., Kargi F., and DeLisa, M. *Bioprocess Engineering: Basic concepts*, 3rd Edition, 2017, Prentice Hall, Engelwood Cliffs.
2. Peter Stanbury, Allan Whitaker., S, Stephen Hall. *Principles of Fermentation Technology*, 3rd Edition, 2016, Elsevier Science and technology.
3. Casida, L.E.J.R. *Industrial Microbiology*, 2 nd Edition, 2019, New Age International Private Limited
4. Richard H. Baltz., Arnold L. Demain., Julian E. Davies. *Manual of Industrial Microbiology and Biotechnology*, 3rd edition, 2010, American Society for Microbiology.
5. Michael J. Waites., Neil L. Morgan. *Industrial Microbiology: An Introduction*, 2001, Wiley-Blackwell
6. El-Mansi, E. M. T., Bryce, C. F. A., Arnold L. Demain., Allman, A.R. *Fermentation Microbiology and Biotechnology*, 3rd Edition, 2011, CRC Press

21MBP211 MCROBIAL TECHNOLOGY PRACTICAL 4H – 2C

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

COURSE OBJECTIVES

- To obtain outstanding practical skill in various techniques in Microbial Biotechnology and Agricultural Microbiology.
- The course provides the basics of microbiology to build a foundation for more advanced studies in microbiology and biotechnology
- In this course students will learn key methods of microbial production (e.g. fermentation, recombinant protein production and purification).
- Practice in research project planning, in different methods for biotechnology, and for conducting scientific research project.
- To develop an understanding of the major principles of and current issues in the several topical areas that collectively constitute Microbiology Techniques.
- It will distinguish the students to acquire practical skills on advanced laboratory analysis.

COURSE OUTCOME (CO'S)

1. This practical course renders a candidate the knowledge of advanced techniques involved in Microbial Biotechnology and Agricultural Microbiology.
2. Candidates would be able to understand and perform molecular techniques which forms an integral part of core Microbiology.
3. This practical course renders a candidate the knowledge of advanced techniques involved in microbial biotechnology.
4. He/she will be able to judge how microbes and enzymes could be applied in industry.
5. Candidates would be skilled enough to perform a molecular technique which forms an integral part of industrial microbiology.
6. Students can develop entrepreneur skills for applications in biotechnology-based industries

EXPERIMENTS

1. Isolation of plasmid DNA from Bacteria
2. Isolation of chromosomal DNA from Bacteria
3. Restriction digestion and electrophoresis.
4. Estimation of Protein by Lowry's Method.
5. Determination of molecular weight by SDS Polyacrylamide gel electrophoresis
6. Protein Purification using microfiltration.
7. Screening and identification (Genus Level) of a production strain (enzyme /antibiotic) from soil samples
8. Formulation of cost effective alternative bacterial culture media from agricultural waste
9. Maintenance of the isolated production organism on agar slants/glycerol stock
10. Isolation of symbiotic nitrogen fixers from root nodule -*Rhizobium*
11. Isolation and identification of VAM fungi
12. Determination of BOD (Biochemical Oxygen Demand) of water
13. Determination of COD (Chemical Oxygen Demand) of water

REFERENCES

1. Green and Sambrook. *Molecular Cloning: A Laboratory Manual*, 4th Edition, 2012, Cold Spring Harbor Laboratory Press,U.S.
2. Prakash S. Bisen. *Laboratory protocols in applied life sciences*. 2014, CRC Press, Taylor & Francis Group
3. Alfred Brown and Heidi Smith. *Benson's Microbiological Applications, Laboratory Manual in General Microbiology*, 13th Edition, 2015, McGraw-Hill

Semester - II

21MBP212 **DIAGNOSTIC 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 acquire practical knowledge in numerous diagnostic tests and procedures used in the microbiology laboratory.
- To understand the importance of diagnostic procedures and gain skills related to the laboratory experiments.
- To learn the techniques pertaining to amplification of biological molecules
- To provide hands-on experience to determine microorganisms in clinical samples
- To understand the importance of diagnostic procedures and gain skills related to the laboratory experiments.
- It helps the students to study the advanced laboratory diagnosis procedures.

COURSE OUTCOME (CO'S)

1. This course provides the current medical aspects on the clinical diagnosis of infection providing the combined treatment of bacteriology and virology.
2. It will also provide opportunities for a student to develop diagnostic skills in microbiology, including the practical application and interpretation of laboratory tests for the diagnosis of infectious diseases.
3. It will also provide opportunities for a student to develop diagnostic skills in microbiology, including the practical application and interpretation of laboratory tests for the diagnosis of infectious diseases.
4. The significance of bacterial genetic variation (in drug resistance, pathogenesis or virulence and variation, diagnosis, and vaccination), and manipulation of cloned DNA.
5. To know the Virulence of bacteria, bacterial virulence factors and their regulation.
6. To understand drug resistance, drug-bacteria relationship, clinical implications, and prevention

EXPERIMENTS

1. Laboratory diagnosis of clinical specimen – Pus, Sputum, Urine, Blood, Stool.
2. Antibiotic sensitivity test disc preparation
3. Antibiotic sensitivity test – Kirby - Bauer, Stroke's method
4. MIC determination by Broth dilution technique, filter paper disc assay
5. Biomedical waste Segregation and Disposal (Color Coding)
6. Cultivation of viruses-Egg inoculation and cell line
7. Isolation of coli phage from sewage using membrane filter technique.
8. Examination of plant viral diseases: Wilt of potato, Citrus canker, Rice dwarf virus.
9. MALDI TOF - Demonstration

SUGGESTED READINGS

1. Arora, B., and Arora, D.R., (2007). *Practical Microbiology*, (1st ed.). CBS Publishers and Distributors, Bangalore.
2. Cappucino, G.J., and Sherman, N., (2001. *Microbiology A Laboratory Manual*. (6th ed.). Benjamin Cummings, New York.
3. Baron, E.O., and Finegold, S., (1990). *Bailey and Scott's Diagnostic Microbiology*. (8th ed.). C V Mosby Company, StLouis.
4. Gaud, R.S., and Gupta, G.D., (1999). *Practical Microbiology*. (1st ed.). Nirali Prakashan ,Pune.
5. Mukherjee, K.L. (2005). *Medical Laboratory Technology*, Vol. 3, Tata McGraw-Hill Publishing

Company Ltd, NewDelhi.
6. Reddy, S.M., and Reddy, S.R., (2004). *Microbiology A Laboratory Manual*. (3rded.). Sri Padmavathi Publication, Hyderabad.
7. Sundararaj, T. (2005). *Microbiology laboratory manual*.AswathySundararaj Publishers. Chennai.
8. Vandepilte, J., Verhaegan, J., Engbaek, K., Rohner, P., Prot, P., and Heuck, C.C., (2004). *Basic Laboratory Procedures in Clinical Bacteriology*. (2nded.). A.I.T.B.S Publishers and Distributors, Delhi.

Semester - II

JOURNAL PAPER ANALYSIS AND PRESENTATION **2H**

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

21MBP301 **ADVANCED IMMUNOLOGY** **4H – 4C**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- Imparting advanced technological knowledge through a detailed study of topics such as immunodiagnosis, assessment of cell mediated immunity and current trends in immunology of diseases.
- The students will be able to identify the cellular and molecular basis of immune responsiveness.
- The students will be able to describe the roles of the immune system in both maintaining health and contributing to disease.
- The students will be able to describe immunological response and how it is triggered and regulated.
- The students will be able to demonstrate a capacity for problem-solving about immune responsiveness.
- Students will be able to transfer knowledge of immunology into clinical decision-making through case studies presented in class.

COURSE OUTCOME (CO'S)

1. To strengthen the technical skill on the immune system, their structure and classification, genetic control of antibody production, Types, structure of antigens and immunodiagnostics.
2. To obtain knowledge of through Molecular immunology, hypersensitive immune reaction and Latest trends in immunology.
3. Upon completion students will gain knowledge of immune system, cells involved along with complement system and autoimmunity.
4. Develop understanding about immune system, antigen antibody interactions.
5. Gain theoretical knowledge of various diseased conditions generated due to interplay of immune system components.
6. Introducing the employment aspect of immunology and to study various types of immune systems their classification structure and mechanism of immune activation.

UNIT – I Immune system

Immunity – types. Cells of the immune system - lymphoid cells, mononuclear cells, granulocytic cells and mast cells. T & B – cell maturation, activation and differentiation. Organs of the immune system - primary and secondary lymphoid organs – cutaneous / mucosal - associated lymphoid tissues

UNIT – II Immunogenecity Functions

Antigens - factor influence immunogenicity - Epitopes - Haptens - study of antigenicity. Basis of antigen specificity. MHC – types and importance- distribution and function. Antigen processing and presentation to T- lymphocytes. Immunoglobulin- structure, types, distribution, biological and chemical properties - Monoclonal and polyclonal antibodies. Complement system – mode of activation- Classical, Alternate and Lectin pathways, biological functions.

UNIT – III Immune response

Antigen recognition – T-cell receptors (TCRs), B-cell receptor (BCR) MHC restriction, lymphocyte activation, clonal proliferation and differentiation. Physiology of acquired immune response – various phases of humoural immunity (HI), cell-mediated immunity (CMI), – cell mediated cytotoxicity, Delayed-type Hypersensitivity (DTH) response- hypersensitivity types

UNIT – IV Vaccines

Active and passive immunization; Live, killed, attenuated, sub unit vaccines; vaccine technology –Role and properties of adjuvants, recombinant DNA and protein-based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines; Antibody genes and antibody engineering –chimeric and hybrid monoclonal antibodies; Catalytic antibodies and generation of immunoglobulin gene libraries, VLPs and therapeutic vaccine

UNIT – V Immunonological Techniques

Antigen-antibody interactions: Precipitation, agglutination and complement mediated immune reactions; Advanced immunological techniques –RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence, flow cytometry and immunoelectron microscopy; forensic serology, Immunohaematology – ABO, RH incompatibility.

SUGGESTED READINGS

1. Ramesh, S.R. *Immunology*, 1st edition, 2017, McGraw Hill Education India Private Limited.
2. Massoud Mahmoudi. *Immunology made ridiculously simple*. 1st edition 2009, Med master
3. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt. *Roitt's Essential Immunology*, 13th Edition, 2017, Wiley-Blackwell
4. Doan, Thao; Melvold, Roger; Viselli, Susan. *Lippincott's Illustrated Reviews, Immunology*, 2nd Edition, 2012, Lippincott Williams & Wilkins (LWW)
5. Jenni Punt, Sharon Stranford, Patricia Jones, Judy Owen. *Kuby Immunology*, 8th Edition, 2019, W. H. Freeman
6. Ian Tizard. Immunology: An Introduction, 4th Edition, 2005, Cengage Learning.

Web Link

1. http://www.roitt.com/animations.asp

21MBP302 **FOOD MICROBIOLOGY AND QUALITY CONTROL** **4H – 4C**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- To encompasses the employability, use of microorganisms in the manufacture of food or industrial products.
- The aim of the course is to give the students broad theoretical and practical skills in food and industrial microbiology.
- This paper adds information about the role of microorganisms in many food, beverage and pharma industries both in production and spoilage processes.
- The students will be able to discuss the role of microorganisms in industry, as well as to carry out experiments to produce microbial metabolites.
- It will make the students to explore their practical skills in entrepreneurial activities.
- It will deliver the large-scale production of microbial products techniques in advanced level.

COURSE OUTCOME (CO'S)

1. Provides knowledge in the large-scale production of industrial product, providing the trends to cater the needs of industry.
2. This will help the students to enhance their employment knowledge on microbiology based commercial products.
3. The aim of the course is to give the students broad theoretical and practical skills in industrial microbiology.
4. To encode the importance of the role of microorganisms in food industries both in beneficial and harmful ways.
5. To obtain a good understanding of industrial microbiology and become qualified as microbiologist in food and other industries and candidate able to become entrepreneur after understanding this entire course.
6. Explain why microbiological quality control programmes are necessary in food production

UNIT – I Food Microbes

Food and microorganisms –Morphological Characteristics-Industrial Importance-Fungi, Bacteria; Intrinsic and extrinsic, relative Humidity, temperature gaseous atmosphere parameters of food affecting microbial growth – sources of contamination of food. Food plant sanitation – Indicator microorganisms and Microbiological criteria – Coliform bacteria. Lactic antagonism and hurdle concept.

UNIT – II Preservation

Food preservation – principles – factors affecting preservation – food preservation using temperature – low temperature food preservation, lyophilization – characteristics of psychrotrophs – high temperature food preservation – characteristics of thermophiles – preservation of foods by drying chemicals and radiation – limitations – commercial applications.

UNIT – III Food Toxins and Control

Food borne diseases - Mycotoxins, Aflatoxins Alternaria toxins, toxigenic Phytoplanktons and viruses. Food poisoning - food borne infection and intoxication- Food control agencies - microbial quality control and food laws, Chemicals antibiotics, Radiation, Low and high temperature, High-Pressure Processing Pulsed Electric Field .Aseptic Packaging, Manothermo sonication

UNIT – IV Methods for detection

Applications of Food Microbiology: Beneficial uses of Microorganisms in Food, Fermented foods, Intestinal Beneficial Bacteria-Concept of Prebiotics and Probiotics, Genetically modified foods. Biosensors in food. Microorganisms in Foods and methods for detection: Fresh meat, Processed meat and poultry- Culture, Microscopic, and Sampling Method for detecting microbes, Physical, Chemical methods, Whole animal assays, Immunological methods.

UNIT – V Food Control Agencies

Relevance of microbial standards for food safety- Hazard Analysis Critical Control Point (HACCP).Food Safety and Standards Authority of India (FSSAI), Food Agricultural Organization (FAO), World Health Organization (WHO), The International Children's Emergency Fund (UNICEF) Codex Alimentarius Commission, The International Commission on Microbiological Specifications for Foods (ICMSF), The Food and Drug Administration (FDA), United States Department of Agriculture (USDA).

SUGGESTED READINGS

1. Banwart, G.J. (2004). *Basic Food Microbiology*. (2nd ed.). CBS Publishers and Distributors New Delhi.
2. Casida, L.E. Jr., (2003). *Industrial Microbiology.* New Age International Publishers, New Delhi.
3. Food Spoilage Microorganisms: Ecology and Control, 2017 by Yanbo Wang, Wangang Zhang, Linglin.
4. Adams, M.R. and Moss, M.O. 2008. Food Microbiology, RSC Publishing, Cambridge, UK.
5. Blackburn C. de W. 2006, Food spoilage microorganisms, Wood head Publishing, Cambridge, UK
6. Ray. B. 2000. Fundamental Food Microbiology. 2nd Edition. CRC Press. New York. USA. Press, New York.
7. Merle D.Pierson,Don L.Zink and L.Michelle Smoot. Food Microbiology: Fundamentals and Frontiers.3rd Edition.ASM Press, Washington.D.C.

MEDICAL MYCOLOGY AND PARASITOLOGY

Semester - III

21MBP303 **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

- Medical Bacteriology introduces basic principles and then applies clinical relevance of many etiological agents responsible for infectious diseases.
- The infectious disease cycle of the pathogens enables to solve the epidemics.
- The territory covered by infections and the immune response
- We focus on pathogenic mechanisms in order to foster a student's ability to solve problems in their future clinical career and able to establish the medical laboratory.
- This course provides learning opportunities in the basic principles of medical microbiology and infectious disease
- It covers mechanisms of infectious disease transmission, principles of aseptic practice, and the role of the human body's normal microflora

COURSE OUTCOME (CO'S)

1. Demonstrate an understanding at an advanced level of microbial virulence mechanisms and host response to infection.
2. Application of molecular techniques to medical microbiology; biochemical and genetic mechanisms of antimicrobial agent activity, microbial susceptibility and resistance to antimicrobial agents.
3. 3. Demonstrate an understanding of skin and respiratory tract infections (microbial causes, pathogenesis, transmission of infection, diagnosis, prevention and treatment) by being able to identify a unknown organisms in clinical samples, and describe the pathogenesis of important pathogens.
4. 4.It also provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.
5. 5. To understand the importance of pathogenic bacteria in human disease with respect to infections of. the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue
6. 6.Recall the relationship of this infection to symptoms, relapse and the accompanying pathology.

UNIT – I Characterization of Fungi

General Properties of Fungi - Isolation and identification of medically important fungi – diagnosis of fungal disease - routine mycological techniques - antifungal agents

UNIT – II Etiology

Mycosis – Types of mycosis. Superficial mycosis. Cutaneous mycosis – Dermatophytoses. Deep mycosis –Opportunistic mycosis, Mycotic Poisoning.

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UNIT – III Parasites characterization

Introduction to Parasitology – Classification of Parasites - protozoa-amoebae – flagellates - Laboratory techniques in parasitology - Ova, cyst analysis direct and concentration methods. Blood smear examination - antiprotozoan therapy.

UNIT – IV Parasites Etiology

Protozoan infections - *Entamoeba histolytica, Plasmodium falciparum, Leishmania donovani - Giardia intestinalis Trichomonas vaginalis, Toxoplasma gondii, Pneumocystis carinii, Balantidium coli*.

UNIT – V Parasites Etiology

Helminthic infections – *Taenia solium. Trematodes - Schistosoma haematobium,* Nematodes - *Trichuris trichiura - Ascaris lumbricoides, Ancylostoma duodenale, Wuchereria bancrofti.*

SUGGESTED READINGS

1. Ananthanarayanan, R., and Panicker, C.K.J., (2005). Text Book of Microbiology (7thed.). Orient Longman, New Delhi.
2. Carl Fraenkel. (2012). Text book of bacteriology. Printing company publishers, NewYork.
3. Brook,G.F., J., Butel, S., Stephen, A., and Morse, A., (2003). Medical Microbiology, (22nded.). McGraw Hill.
4. Chakraborty, P. (2003). A Text book of Microbiology. (2nded.). New Central Book Agency (P) Ltd., Calcutta.
5. Dismukes, W.E., Pappas, P.G., and Sobel, D., (2003). Clinical Mycology. Oxford University Press, UK.
6. Jawetz, E., Melnic, J.L., and Adelberg, E.A., (2001). Review of Medical Microbiology. (22nded.). Lange Medical Publishers, NY.
7. Panjarathinam, R. (2007). Text book of Medical Parasitology, (2nd ed.). Orient Longman Publishers.
8. Parija, S.C. (2008). A Text book of Medical Parasitology. (3rd ed.). All India Publishers and Distributors, New Delhi

Semester - III

21MBP304 **MICROBIAL TECHNOLOGY AND INTELLECTUAL PROPERTY RIGHTS** **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

- Microbial technology is concerned with the industrial processing of materials by microorganisms to provide desirable products or serve other useful purposes.
- This paper emphasizes the application of biological systems to the manufacturing and service industries or the use of biological processes within the framework of technical operations and industrial production.
- It creates awareness on the Intellectual property rights and patenting of biotechnological processes.
- This course will provide technical skill majorly deals with DNA.
- Recent developments in IPR laws in India
- To know the types of IPR.

COURSE OUTCOME (CO'S)

1. To learn the basic tools in recombinant technology
2. To understand the various concepts of cloning vectors
3. To learn the cloning strategies
4. To familiarize with the principles of bioethical concepts
5. To understand the IPR issues in patents in biotechnology innovations
6. To apply their knowledge in new product development

UNIT – I Microbial technology

Introduction to microbial technology, restriction enzymes – nomenclature – types – and its properties, isolation of DNA, plasmids and RNA. Handling and quantification of nucleic acids, radiolabelling and non-radiolabelling of nucleic acids, gel electrophoresis - Blotting techniques – Southern, Northern and Western blotting techniques.

UNIT – II Cloning

Cloning vectors: Plasmid as cloning vectors - pBR322, Bacteriophage - lamda, M13; Cosmid, phagemids. Yeast vector. Expression vectors. Prokaryotic hosts: *E.coli*, Eukaryotic hosts: Yeast cell. Gene cloning - basic steps, cloning construction of cDNA, selection and screening method of recombinants. biolabeling of genes and proteins.

UNIT – III Transgenic plant

Transgenic plants: Methodology, development of herbicide resistance plants, delayed fruit ripening, Biocontrol agents - Insecticidal toxin of BT, cry gene and baculovirus. Trangenic animals. Methodology, development of transgenic mice – its application. DNA diagnostic in medical forensics. Biosafety and Bioethics.

UNIT – IV Patenting

Discrepancies in biotechnology / chemical patenting. IPR – historical perspective – recent developments in IPR laws in India, IPR and the rights of farmers in developing countries. Types of IPR- Governing bodies-National and International.

UNIT – V Fundamental research

Patenting – fundamental requirements – patenting multicellular organisms – patenting and fundamental research. Patenting of biological materials, Product patents, conditions for patenting, Patenting of liveforms, regulating recombinant technology, Food and food ingredients. Trade secrets. Writing a patent document.

SUGGESTED READINGS

1. Sathyanarayana, U. (2005). *Biotechnology*. (1st ed.). Books and Allied (P) Ltd, Kolkata, India.
2. Dubey, R.C. (2002). *Text book of Biotechnology*. S. Chand and Company Ltd, New Delhi.
3. Ramawat, K.G. (2003). *Text book of Plant Biotechnology*. S. Chand and Company Ltd, New Delhi.
4. Watson, J.D., Gilman, M., and Wikowski, J., (2001). *Recombinant DNA*. (2nd ed.)., Scientific American Books. W.H. Freeman and Co. NY.
5. Verma, A., and Podila, G.K., (2005). *Biotechnological Applications of Microbes*. I.K. International Publishing House, New Delhi
6. Brown, T.A. (2001). *Gene Cloning and DNA analysis: An Introduction*. (4th ed.). Blackwell Publishing, USA.
7. Glick, B.K., and Pasternak, J.J., (2003). *Molecular Biotechnology. Principles and Applications of Recombinant DNA*. (3rd ed.). ASM Press, Washington.
8. Old, R.M., and Primrose, S.B., (2003). *Principles of Gene Manipulation*. (6th ed.). Blackwell Scientific Publication, London.
9. Primrose, S.B. (2001). *Molecular Biotechnology*. (2nd ed.). Blackwell Scientific Publishers, Oxford Press, London.
10. Winnacker, E.L. (2003). *From Genes to Clones: Introduction to Gene Technology*. (1st ed.). VCH. Weinhein, Germany.
11. Slater, A., and Scott, N., (2003). *Plant Biotechnology - The Genetic Manipulations of plants*. (2nd ed.)., Oxford University Press, New York.

21MBP305A **4H –4C**

GENOMICS AND PROTEOMICS

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

COURSE OUTCOME (CO'S)

1. Infer the basic concepts of genomics, transcriptomics and proteomics.
2. List and discuss the use of genomics and proteomics in human health.
3. Suggest and outline solution to theoretical and experimental problems in Genomics and Proteomics fields.
4. Understand various steps involved in protein engineering.
5. Understand methods for chemical synthesis and sequencing of DNA
6. Identification of disease genes and different types of mutations.

UNIT I

Pattern of genome evolution

The origin of genomes- Origin of macromolecules, RNA world and DNA world Acquisition of new genes (By gene duplication) and Gene families – (Types, Pseudogenes, Origin of gene families (lateral gene transfer, allopolyploidy).

UNIT II

Introduction to Genomics and Proteomics

Introduction – Organization and structure of genomes, Genome size, Sequence complexity, Introns and Exons, Genome structure in viruses and prokaryotes, Isolation of Chromosomes, chromosome micro dissection, Retrofitting. Introduction to Proteomics – The Proteome, mining proteomes, Bridging Genomics and Proteomics. Proteomics and the new biology.

UNIT III

Gene Identification, Expression and Mapping

Genome annotation, traditional routes of gene identification, detecting open-reading Frames, software programs for finding genes, Identifying the function of a new gene, gene ontology, overview of comparative genomics, Protein structural genomics, Global expression profiling – Introduction, traditional approaches to expression profiling, Genetic mapping – i) Cross breeding and pedigree analysis, ii) DNA markers - RFLPs, SSLPs, SNPs Physical mapping - Restriction mapping, Fluorescent in situ hybridization, Radiation hybrid mapping

UNIT IV

Genomics

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

UNIT V

Proteomics

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

SUGGESTED READINGS

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

Semester - III

LABORATORY ANIMAL CARE

21MBP305B **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

- Aimed to provide training on various methods of handling.
- Concerning the care and use of laboratory animals.
- Laboratory animal care provides the proper handling and care for various species of animals used in research, testing, and in education.
- It extensively deals with the amended act on the Animal Welfare and the concept, availability, and use of research or testing methods that limit the use of animals or minimize animal distress.
- It extensively deals with the amended act on the Animal Welfare and the concept, availability, and use of research or testing methods that limit the use of animals or minimize animal distress.
- To study the preclinical studies.

COURSE OUTCOME (CO'S)

1. Laboratory animal care provides the proper handling and care for various species of animals used in research, testing, and in education.
2. It extensively deals with the amended act on the Animal Welfare and the concept, availability, and use of research or testing methods that limit the use of animals or minimize animal distress.
3. This course content will enhance the employment in drug testing field.
4. Validation for equipment, methods, cleaning and process
5. Students can develop their entrepreneurial skills in analysis of pens design and environment.
6. Ethical knowledge for use of animals in research.

UNIT – I Responsibilities of institution and chief investigators

General introduction - responsibilities of institution and chief investigators, Aspects of rabbit behavior relevant to housing, Rabbit Group housing in pens, advantages and disadvantages, Pens, design of pens environment, Rabbit care management – Regrouping, catching and identification in pens and cages, Rabbit care management – food, water, health and breeding in pens and cages, Cage design and environment, Environment enrichment for rabbits in pens and cages, Ethical guidelines for use of animals in research.

UNIT – II Mice

Introduction-behavior, anatomic and physiological features of mice in lab, Husbandry-Housing, nutrition and breeding requirements and management of lab mice, occupational health and zoonotic diseases, treatment of disease in mice, regulatory agencies and complain associates with management of lab mice, Restraining and sample collection methods from lab mice, Physical, examination of mice for disease conditions, anesthesia and analgesia -mice, Euthanasia in veterinary care.

UNIT – III Rat

Introduction to anatomical and physiological features of laboratory rat, major color groups and varieties of rats, regulatory management housing of laboratory rats-equipment, feed formulation, ailments & disease management of laboratory rats, disease management and ailments of laboratory rats , restraining and sample collection in lab rats, anesthesia and analgesia of lab rats, breeding of laboratory rats.

UNIT – IV Guinea pig

Introduction – history and classification of guinea pigs, varieties and characteristics of guinea pigs

used in labs, characteristics and behaviors of the guinea pig used in labs, housing, nutrition and feeding of guinea pigs, care and handling of guinea pigs in lab, zoonoses of guinea pigs, reproduction and breeding managements in guinea pigs –gnotobiotic animals.

UNIT – V Role in microbiology

Various routes of inoculation in mice & rats, various routes of inoculation in mice & rats, handling and routes of inoculation in rabbits, guinea pigs, laboratory use of animals –role in microbiology, antibody production in animals, disposal of animal house wastes, safety measures in animal house. National animal house Facilities in India.

SUGGESTED READINGS

1. *The IACUC Handbook*, 2nd ed., eds. Silverman, Murthy, Suckow. CRC Press, (2006).
2. *Anesthesia and Analgesia in Laboratory Animals*. American College of Laboratory Animal Medicine, second ed.)., eds. Richard Fish, Peggy Danneman, Marilyn Brown, and Alicia Karas. Academic Press, (2008.
3. *The Mouse in Biomedical Research*, second ed.)., eds. James G. Fox, Muriel T. Davisson, Fred W. Quimby, Stephen W. Barthold, Christian E. Newcomer and Abigail L. Smith. Elsevier, (2007.
4. *The Laboratory Rat*, (2nd ed.). American College of Laboratory Animal Medicine. eds. Suckow, weisbroth and Franklin. Elsevier, (2006).
5. *Handbook on Genetically Standardized Mice.* (6th ed.). Ed. Joanne Currer, The Jackson Laboratory, Bar Harbor, Maine, (2009).
6. *Laboratory Animal Medicine*, (2nd ed.). American College of Laboratory Animal Medicine, eds. Fox, Anderson, Lowe, Quimby. Academic Press, (2002).
7. Percy, D.H., and Barthold, S.W., (2007). *Pathology of Laboratory* Rodents and Rabbits, (3rd ed.). Blackwell Publishing Company.
8. Nalinasundari, M.S., and Santhi, R., (2006). *Entomology*. MJP Publishers, Chennai.
9. Pelczar, Jr. M.J., Chan, E.C.S., and Kreig, N.R., (1993). *Microbiology* McGraw-Hill Inc. New York.
10. Prescott, M., Harley, J.P., and Klein, D.A., (1993). *Microbiology*, (2nd ed.). McGraw-Hill Inc, NY.
11. Roy, D.N., and Brown, A.W.A., (2003). *Entomology – Medical and Veterinary*. (1st ed.). Part – I, Biotech Books, New Delhi.
12. Warren, D. M. (2002). *Small Animal Care and Management*. (2nd ed.). Delmar – Thomson Learning, Columbia, NY.
13. Yadav, M. (2004). *Applied Entomology*. (1st ed.). Discovery Publishing House, New Delhi.

Semester - III

BIO NANOTECHNOLOGY

21MBP305C **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

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

COURSE OUTCOME (CO'S)

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

UNIT – I Nano particles

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

UNIT – II Bionanomachines

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

UNIT – III Natural bio nanotechnology designing

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

UNIT – IV Principles of Nanotechnology

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

UNIT – V Ethics of Nanotechnology

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

SUGGESTED READINGS

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

21MBP311 **IMMUNOLOGY AND SEROLOGY PRACTICAL** **4H – 2C**

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

COURSE OBJECTIVES

- The general objectives of the lab will be to introduce immunology and basic serological techniques.
- The candidate will gain hands-on knowledge and acquire adequate skill required.
- Identify and enumerate immune cells and also perform agglutination reactions.
- Realize the role of immune cells in developing immunity against microbial diseases
- To develop the skill in health clinic.
- Technical skill of immunology.

COURSE OUTCOME (CO'S)

1. This practical is to provide the student with a basic knowledge and technical skill of immunology and make them to understand the significance to human disease.
2. Upon completion students will gain knowledge of immune system, cells involved along with complement system and autoimmunity
3. Develop understanding about immune system, antigen antibody interactions.
4. Gain theoretical knowledge of various diseased conditions generated due to interplay of immune system components.
5. After course completion, students can apply the knowledge in further studies and higher education.
6. 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 various immune cells by morphology – Leishman staining, Giemsa staining.
2. Separation of serum / plasma
3. ABO Blood grouping - Rh typing and cross matching.
4. Estimation of hemoglobin content of human blood.
5. Agglutination tests.
   - WIDAL - slide and tube test
   - RA test.
   - RPR test.
   - ASO test.
   - CRP test.
   - β -HCG test
6. ELISA- thyroid hormone analysis
7. Ouchterlony's Double Immunodiffusion test (ODD)
8. Counter immunoelectrophoresis (CIE)
9. Development of primary culture from chick embryo fibroblast

REFERENCES

1. Wilmore Webley, *Immunology Lab Manual*, 12th Edition, 2017, LAD Custom Publishing.
2. Patricia Tille. *Bailey & Scott's Diagnostic Microbiology*, 14th Edition, 2018, Elsevier eBook on Vital Source,
3. Alfred Brown and Heidi Smith. *Benson's Microbiological Applications, Laboratory Manual in General Microbiology*, 13th Edition, 2015, McGraw-Hill
4. Ian Freshney, R. *Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications*, 6th Edition, 2010, John Wiley & Sons, Inc.

21MBP312 **FOOD AND BEVERAGE PRACTICAL** **4H – 2C**

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

COURSE OBJECTIVES

- This provides information on fermented food product production in food industries. To know the possible contamination of food products which may include bacteria and fungi.
- To develop the skill in Isolation of pathogen.
- To enhance knowledge in research.
- To give employment opportunities.
- Technical skill of industries techniques.
- To understand disease mechanisms.

COURSE OUTCOME (CO'S)

1. This practical adds a technical skill and good understanding of industrial microbiology
2. Students can develop the skills of an efficient microbiologist in food and beverage industries.
3. Provides necessary entrepreneurial information on the food, dairy Microbiology in safety and quality perspective.
4. It will help to study the importance in the prevention of contamination that might be caused by the microorganisms.
5. To Learn various methods for their isolation, detection and identification of microorganisms in food and employ in industries
6. Identify ways to control microorganisms in foods and thus know the principles involving various methods of food preservation.

EXPERIMENTS

1. Production of enzymes – solid and submerged fermentation.
2. Production of sauerkraut, yoghurt, wine and cheese
3. Isolation and Enumeration of Bacterial and Fungal Food spoilers
4. Detection and enumeration of Microorganisms present in lab surfaces- settle plate method.
5. Analysis of Milk quality by Methylene Blue and Resazurin Dye Reduction Test
6. Detection of coliforms from water - MPN test
7. Mushroom Cultivation.
8. Immobilization technique (Sodium alginate method).
9. Isolation and identification of Candida albicans
10. Wet mount preparation of parasites- Saline, iodine
11. Identification of parasites-formal ether concentration, floatation methods

SUGGESTED READINGS

REFERENCES

1. Adams, M.R., and Moss, M.O., (2000). *Food Microbiology*. Royal Society of Chemistry. Cambridge, U.K.
2. Ahmed, E.Y., and Carlstrom, C., (2003). *Food Microbiology: A Laboratory Manual*, John Wiley and Sons, Inc. New Jeresy.
3. Arora, B., and Arora, D.R., (2007). *Practical Microbiology.* (1st ed.). CBS Publishers and Distributors, Bangalore.

4. Cappucino, G.J., and Sherman, N., (2001). *Microbiology A Laboratory Manual*. (6th ed.). Benjamin Cummings, New York.
5. Demain, A.L., and Davies, J.E., (1999). *Manual of Industrial Microbiology and Biotechnology* (2nd ed.). ASM Press, Washington.
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7. Harry, W., Seeley, Jr., and Denmark, P.N., (1984). *Microbes in Actions: A lab Manual of Microbiology*. D. B. Taraporwalla and Sons.
8. Jay, J.M., Loessner, M.J., Golden, D.A., (2005). *Modern Food Microbiology*. Springer Science, USA.
9. Davies, J.E., and Demain, A.L., (2009). *Manual of Industrial Microbiology and Biotechnology* ASM Publisher, USA.
10. Baltz, R.H., Davies, J.E., and Demain, A.L., (2010). *Manual of Industrial Microbiology and Biotechnology.* (3rd ed.). ASM Publisher, USA.

Semester - III

JOURNAL PAPER ANALYSIS AND PRESENTATION 2H

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

21MBP491	**PROJECT VIVA VOCE**	**15C**

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