M.Sc. MICROBIOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

Curriculum and Syllabus

Regular (2023 – 2024)

DEPARTMENT OF MICROBIOLOGY

FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT

KARPAGAM ACADEMY OF HIGHER EDUCATION

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

(Accredited with A+ Grade by NAAC in the second cycle)

Eachanari (Post), Coimbatore – 641 021.

Phone No. 0422-2980011 – 15

Fax No: +91-422-2980022, 23

Web: www.kahedu.edu.in

M.Sc. MICROBIOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

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

FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT

POST – GRADUATE PROGRAMMES

(REGULAR PROGRAMME)

REGULATIONS

(2023)

DEPARTMENT OF MICROBIOLOGY

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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.

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Coimbatore - 641 021, Tamil Nadu, India

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

REGULAR MODE
CHOICE BASED CREDIT SYSTEM (CBCS)

REGULATIONS - 2023

The following regulations are effective from the academic year 2023 -2024 and are applicable to the candidates admitted in Post Graduate (PG) Degree programmes in the Faculty of Arts, Science, Commerce and Management, 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.Com.
9	MA English

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)

A candidate 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.

QUALIFICATIONS FOR ADMISSION

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.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
9	MA English	BA (English)/Any UG degree with Part II – English for four semester.

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., MA	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.

4. STRUCTURE OF THE PROGRAMME

Every Programme will have a curriculum and syllabus consisting of core courses, elective courses, open elective, Internship 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, Research Institute or any other Organizations (National / International) 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 where the 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 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. Internship report will be evaluated and marks will be awarded in the third semester. Students have to earn 2 credits for the Internship.100 marks is awarded for Internship through Continuous Internal Assessment.

f. Open Elective

He / She may select one of the open elective courses from the list given below offered by other departments in the third semester. Students have to earn 02 credits for this course. (The student cannot select a course offered by the parent department).

S.No.	Name of the Department	Course Code	Name of the Course
1	M.A English	23EGPOE301	English for Competitive Examinations
2	M.Com	23CMPOE301	Personal Finance and Planning
3	MBA	23MBAPOE301	Organizational Behavior
4	MCA	23CAPOE301	Robotics Process Automation
5	M.Sc Computer Science	23CSPOE301	Cyber Forensics
6	M.Sc Mathematics	23MMPOE301	Coding theory
7	M.Sc Physics	23PHPOE301	Material Characterization
		23PHPOE302	Numerical Methods and Programming
8	M.Sc Chemistry	23CHPOE301	Chemistry in Everyday Life
9	M.Sc Microbiology	23MBPOE301	Fermentation Technology
10	M.Sc Biochemistry	23BCPOE301	Nutrition and Dietetics
11	M.Sc Biotechnology	23BTPOE301	Sericulture

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., MA	200	80	120

7. 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 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.

8. 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

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

9. 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).

10. 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 should be satisfactory during the course.

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

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

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 week for checking the syllabus coverage, records of test marks and attendance. The HoD shall sign with date after due verification. The same shall be submitted to respective Dean once in a fortnight. After the completion of the semester the HoD should keep this

record in safe custody for five years as records of attendance and assessment shall be submitted for inspection as and when required by the KAHE/any other approved body.

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

Theory Courses

S. No.	Category	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 or equal to 75	0

12. ESE EXAMINATIONS

12.1**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.,

Instruction	Remarks
	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 prepared according to the approved guidelines and duly signed by the supervisor(s) shall be submitted to HoD.

Guidelines to prepare the project report

a. Cover page
b. Bonafide certificate
c. Declaration
d. Acknowledgement
e. Table of contents
f. 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 be 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 Absent (AAA) 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.

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

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

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

CGPA of the entire programme = ----------

Sum of the credits of the courses of the entire programme

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

where,

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

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

17. REVALUATION

Candidate can apply for revaluation or 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.

Karpagam Innovation and Incubation Council (KIIC)

(A Section 8 Company)

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

Norms to Student Start-Ups

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

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

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

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

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

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

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

Guide lines to award Credits/ Marks to a Student startup

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

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

DEPARTMENT OF MICROBIOLOGY

FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT

PG PROGRAM – M. Sc. Microbiology

(2023–2024 Batch onward)

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												
23MBP101	Principles and Systematics of Microbiology	I	a	4	0	0	4	40	60	100	C	7
23MBP102	Microbial Physiology and Metabolism	II	b	4	0	0	4	40	60	100	C	10
23MBP103	Microbial Genetics and Molecular Biology	II	f	4	0	0	4	40	60	100	C	13
23MBP104	Bioinstrumentation	VI	a	3	1	0	4	40	60	100	C	16
23MBP105A*	Marine Microbiology	I	c	4	0	0	4	40	60	100	E	19
23MBP105B*	Advanced Bioinformatics	VI	e								E	22
23MBP105C*	Pharmaceutical Microbiology	IV	f								E	25
23MBP111	Microbial Physiology Practical	II	b	0	0	4	2	40	60	100	C	28
23MBP112	Genetics and Instrumentation Practical	I	b	0	0	4	2	40	60	100	C	30
Journal Paper Analysis & Presentation		IV	d	2	0	0	-	-	-	-		32
Semester total				**21**	**1**	**8**	**24**	**280**	**420**	**700**		
SEMESTER–II												
23MBP201	Virology	I	k	3	1	0	4	40	60	100	C	33
23MBP202	Medical Bacteriology	I	k	4	0	0	4	40	60	100	C	36
23MBP203	Biostatistics and Research Methodology	I	c	4	0	0	4	40	60	100	C	39
23MBP204	Environmental and Agricultural Microbiology	IV	i,j	4	0	0	4	40	60	100	C	41
23MBP205A*	Cyber security	I	f	4	0	0	4	40	60	100	E	44
23MBP205B*	Microbial Enzymology	I	h,j								E	46
23MBP205C*	Industrial Microbiology and Bioprocess Technology	IV	h								E	48
23MBP211	Microbial Technology Practical	I	b	0	0	4	2	40	60	100	C	50
23MBP212	Diagnostic Microbiology Practical	IV	b	0	0	4	2	40	60	100	C	52
Journal Paper Analysis & Presentation		IV	d	2	0	0	-	-	-	-	-	54
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												
23MBP301	Advanced Immunology	II	f,k	4	0	0	4	40	60	100	C	55
23MBP302	Food Microbiology and Quality Control	IV	h,j	4	0	0	4	40	60	100	C	58
23MBP303	Medical Mycology and Parasitology	IV	k	4	0	0	4	40	60	100	C	61
23MBP304	Microbial Technology and Intellectual Property Rights	VI	f	4	0	0	4	40	60	100	C	63
23MBP305A*	Metagenomics and Forensic Microbiology	I	d	3	0	0	3	40	60	100	E	66
23MBP305B*	Entrepreneurial Microbiology	V	a								E	68
23MBP305C*	Bio Nanotechnology	IV	a								E	70
23MBP311	Immunology and Serology Practical	I	b,k	0	0	3	2	40	60	100	C	72
23MBP312	Food and Beverage Practical	I	b	0	0	4	2	40	60	100	C	74
Journal Paper Analysis & Presentation		IV	d	1	0	0	-	-	-	-	-	76
23XXPOE301	Open Elective	IV	h	3	0	0	2	40	60	100	OE	77
23MBP391	Internship Programme	III	b	-	-	-	**2**	100	-	100	-	101
Semester total				**23**	**0**	**7**	**27**	**420**	**480**	**900**		

Category * C – Core Paper, E- Elective Paper, OE – Open Elective

Course code	Name of the course	Hrs / Week	Marks			Exam Hrs	Credit (s)	Page No.
			CIA	ESE	Total			
SEMESTER – IV								
23MBP491	Project and Viva Voce	-	80	120	200	-	15	102
Semester total		**-**	**80**	**120**	**200**	**-**	**15**	-
Programme Total		**90**	**1060**	**1440**	**2500**		**90**	

Elective courses*

Elective – 1 (23MBP105)		Elective – 2 (23MBP205)		Elective – 3 (23MBP305)	
Course code	**Name of the Course (Theory)**	**Course Code**	**Name of the course (Theory)**	**Course Code**	**Name of the course (Theory)**
23MBP105A	Marine Microbiology	23MBP205A	Cyber Security	23MBP305A	Metagenomics and Forensic Microbiology
23MBP105B	Advanced Bioinformatics	23MBP205B	Microbial Enzymology	23MBP305B	Entrepreneurial Microbiology
23MBP105C	Pharmaceutical Microbiology	23MBP205C	Industrial Microbiology and Bioprocess Technology	23MBP305C	Bio nanotechnology

Open elective course

Course code	Name of the Course
23MBPOE301	Fermentation Technology

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.

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.

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 are able to assess the elements of a problem and develop and test a solution based on logic and the best possible information. Students are 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 field.

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. Manipulate the microbes using various molecular biology techniques for the benefit of living organisms.

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

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 andharmful role of microorganisms in environment.

l. Focus on innovation and entrepreneurial thinking to be successful in a rapidly changing world.

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 versed 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

23MBP101 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

COURSE 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 ofsterilization 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)

After completion of this course candidate able to:

Cos	Course Outcomes	Blooms Level
CO1	Understand the basic microbial structure and functions of various physiological groups of prokaryotes and eukaryotes.	Understand
CO2	Learn the theory and practical skills in microscopy handling and staining techniques know various culture media and their applications.	Apply
CO3	Study microbial nutrition's - Autotrophy and heterotrophy modes of nutrition.	Understand
CO4	Identify the unknown organisms by using microbial tools.	Apply
CO5	Demonstrate electricity generation from the organic matter.	Apply
CO6	Understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolism.	Understand

Mapping with programme outcomes:

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

S-Strong; M-Medium; L-Low

UNIT I - Introduction and History of Microbiology (10 Hours)

History of development of Microbiology, Contribution of Anton Van Leeuwenhoek, Louis Pasteur, Edward Jenner, Robert Koch, Alexander Fleming, Paul Erhlich, Structure of prokaryotic and eukaryotic cell, General properties of microorganisms- Bacteria, Algae, Fungi and Protozoa. Bacterial Taxonomy- Principles- Modern approaches- Numerical, Molecular, Serotaxonomy and chemotaxonomy.

UNIT II - Classification of microorganisms (09 Hours)

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 (10 Hours)

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 (11 Hours)

Scope of Microbiology. 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. Microbial Biostimulants.

UNIT V - Molecular taxonomy (8 Hours)

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. Christopher, J.W., Linda, S., and Joanne, W., (2016).*Prescott's Microbiology*. (10th Ed), Mc Graw Hill Education, UnitedStates.
4. 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.
5. Tortora, G.J., Funke, B.R., and Case, C.L., (2010). *Microbiology: An Introduction*. (10thed.). Pearson Education,Singapore.
6. Stanier, R.Y., Ingraham, J.L., Wheelis, M.L., & Painter, P.R.,(2008). *General Microbiology. (5thed.). Macmillan Press Ltd, London.*
7. Salle, A.J. (2007). *Fundamental Principles of Bacteriology*. (7th ed.).,Envins Press, New York.
8. Pelczar Jr. M.J., Chan, E.C.S., and Kreig, N.R., (2004). *Microbiology*. (5thed.). Tata McGraw-Hill Publishing Company, New Delhi.
9. Powar. C.B and Daginnawala. H.F. 2010. General Microbiology (Vol-II). Himalaya Publishing house.
10. Atlas, R.M. Principles of Microbiology, 2nd edition 2015, Mc Graw Hill India.

Semester – I

23MBP102 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)

Students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand and predict the various metabolic reactions in microbial cell.	**Understand**
CO2	This will make them to predict the intermediate products which can be employed in industrial production processes.	**Apply**
CO3	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.	**Understand**
CO4	Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.	**Apply**
CO5	Understand how the organisms communicate to the population by using various mechanisms.	**Understand**

Mapping with programme outcomes:

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

S-Strong; M-Medium; L-Low

UNIT I - Prokaryotic cell structure (11 Hours)

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 (11 Hours)

Definition of growth and generation time, Measurement of microbial growth and specific growth rate. Structure of bacterial endospore, Molecular architecture of spores, induction and stages of sporulation cycle. Influence of different factors on sporulation. T.3ransport of Nutrients- Uptake of nutrients- Passive diffusion, Facilitated diffusion, active transport. Role of osmoregulatory protein.

UNIT III – Metabolic pathway (11 Hours)

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 (5 Hours)

Effect of oxygen toxicity, pH, osmotic pressure, heat shock on bacteria. Starvation stress and stringent response.

UNIT V - Photosynthetic bacteria & Bioluminescence (10 Hours)

Photosynthetic bacteria, photosynthetic pigments, 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. Doelle, H.W. (2005). *Bacterial Metabolism*. Elsevier India Pvt. Ltd., NewDelhi.
3. Moat, A,G., and Foster J.W., (2003). *Microbial Physiology*. John Wiley and Sons, NewYork.
4. Caldwell, D.R. (2008). *Microbial Physiology and Metabolism*. (2nd ed.). Wm C Brown Publishers,England.
5. Rose, A.H. (2008). *Chemical Microbiology – An Introduction to Microbial Physiology*.(International Ed.). Plenum Publishing Corporation.
6. Atlas, R.M., (1997). *Principles of Microbiology*. (2nd ed.). Wm. C. Brown Publishers, Lowa, US
7. White, D. (2003). *Physiology & Biochemistry of Prokaryotes*. (2nd ed.). Oxford University Press, NY.
8. Satyanarayana, U. and Chakrapani, U. 2013. Biochemistry, Fourth Edition Book and Allied Pvt. Ltd.,Kolkata.
9. Nelson, D.L. and Cox, M.M. 2012. Lehingers's Principles of Biochemistry, Sixth Edition, MacMillan worth Publishers, New Delhi.
10. Donald Voet and Judith G. Voet, 2011. Biochemistry. Third Edition, John Wiley and Sons, Inc.New York.
11. Michale G and Schomburg D (Ed)(2012) Biochemical pathway: An Atlas of Biochemistry andMolecular biology,p414..

23MBP103 MICROBIAL GENETICS AND MOLECULAR BIOLOGY **Semester –I 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 highlights the experimental tools used in modern molecular genetics with emphasis on prokaryotes and eukaryotes.
- The course inculcates the basic application of metabolism in research.
- 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)
Students will be able to

COs	Course Outcomes	Blooms Level
CO1	This course allows the candidate to recollect the basic history of molecular genetics and apply cognitive thinking to the application-oriented sectors of genetics.	Apply
CO2	Students would be able to practically apply this knowledge in different of enzymes required in different sectors of molecular labs with possibilities ranging from the treatment of human diseases to the development of novel medicines	Apply
CO3	A thorough understanding of the process of protein synthesis and operons along with of recombination DNA.	Understand
CO4	An in-depth knowledge of mutagenesis and genetic analysis with gene mapping.	Apply
CO5	Have conceptual knowledge about DNA as genetic material, enzymology, and replication strategies.	Apply

Mapping with programme outcomes:

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

S-Strong; M-Medium; L-Low

Unit I -Historical Preview of Genetics **(10 Hours)**

Mendelian principles and classical genetics, Genetic concepts, use of microorganisms in genetic studies. Chemical basis of heredity – early concepts of genes – the discovery of the chemical basis of heredity - experimental evidence – 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. DNA replication – prokaryotes and eukaryotes - theta and Plasmid DNA replication- rolling circle models of replication - Inhibitors of replication

UNIT – II –Transcription & Translation (10 Hours)

Organization of transcriptional units and regulation of gene expression. Mechanism of transcription of prokaryotes-, Genetic code, Importance and properties of genetic code. Direction of protein synthesis, RNA template, direction with experimental proof, tRNA as adaptor SD sequence in bacteria, initiator tRNA, elongation, translocation and termination of protein synthesis. Post-translational modification. Gene Regulation - Operon models - lactose, tryptophan and arabinose operon.

UNIT – III –Mutation and repair mechanism (10 Hours)

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.

UNIT IV - Genetic Recombination (9 Hours)

Genetic Recombination in Bacteria: Conjugation. F+ v/s F-, Hfr+ v/s F-, F' v/s F-, Transformation, Transduction: generalized and specialized. Mobile elements in prokaryotes and eukaryotes – Insertion sequences, transposons – properties: Linkage and genetic maps. Genetics of T4 and λ phages – Genetic mapping of T4 phage.

UNIT V- Vectors & Molecular markers (9 Hours)

Vectors: General characteristics of vectors, Plasmids, Ori site, selectable markers, multi-cloning sites, Phage vectors, Construction of genomic Library and cDNA library, Expression vectors and their importance. Transfer of recombinant DNA into host cells: Genetic transformation of bacteria, yeast, animal and plant cells. Principles and applications of DNA sequencing, DNA finger printing. Molecular Markers, RFLP, RAPD, AFLP and Isozyme Loci. CRISPR gene editing.

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

23MBP104 **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)

COs	Course Outcomes	Blooms Level
CO1	This enables students to be able to explain bioinstrumentation techniques, design andapplication.	understanding
CO2	To know the concepts and operation of various lab instruments and related terms.	understanding
CO3	Acquire knowledge and lab skills to perform experiments in laboratory.	Applying
CO4	Connect the concepts of physics, chemistry, and engineering principles in the instrumentation.	Evaluating
CO5	The students will be able to know all the basic principles, technology, and applications ofvarious instruments in life science.	understanding
CO6	Comprehend the techniques and the underlying principles in bioinstrumentation.	Applying

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

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

Properties of electromagnetic radiations. Instrumentation and applications of calorimetry, Visible spectrophotometer, UV-Visible spectrophotometer, Analysis of sample with Plastic, quartz and Glass Cuvette, spectrofluorimeter, atomic spectroscopy, double beam spectroscopy, FTIR, NMR spectroscopy and flow cytometer.

UNIT II – Centrifugation **(10 Hours)**

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 **(10 Hours)**

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, MALDI – TOF Nano-LC.

UNIT IV – PCR and Electrophoresis **(10 Hours)**

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), Isoelectric focusing, Immuno electrophoresis, pulse field gel electrophoresis, capillary electrophoresis, gel documentation – applications. Zone and moving boundary electrophoresis

UNIT V – Radio isotopic techniques **(8 Hours)**

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*. Wiley Publishers, US.
3. Keith Wilson and John Walker. (2010). *Principle and Techniques of Biochemistry and molecular biology.* (7th ed.). Cambridge university press, NY.
4. Boyer, R. (2000). *Modern Experimental Biochemistry*. (3rd ed.). Addison Wesley Longman, New Delhi.
5. Chatwal, G.R., and Anand, S.K., (2003). *Instrumental Methods of Chemical Analysis*. (5th ed.).Himalaya Publishing House, Mumbai
6. Friedfelder,D.(2001).*Physical Biochemistry: Applications to biochemistry and molecular biology.* 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.,(2010). Principles and Techniques of Biochemsitry and Molecular Biology (7th Low Price ed) Cambridge University Press, India.

WEB REFERENCE

1.https://www.coleparmer.com/tech-article/basics-of-centrifugation.
2. https://www.bu.edu/flow-cytometry/files/2010/10/BD-Flow-Cytom-Learning-Guide.pdf
3. https://www.bosterbio.com/protocol-and-troubleshooting/flow-cytometry-principle.
4. https://www.smacgigworld.com/blog/components-gel-documentation-system.php

Semester -I

23MBP105A **MARINE MICROBIOLOGY** **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 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 andmicrobial communities.
- To understand 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 marinemicrobes.
- To understand basic biological processes that occur in and between organisms in nature.

COURSE OUTCOME
Students will be able to

COs	Course Outcomes	Blooms Level
CO1	Capable of describing and explaining both biological interaction processes and theirimportance to ecosystems.	**Understand**
CO2	To acquire knowledge of the most common research methods used to develop ourknowledge of biological processes	**Apply**
CO3	learn to work independently in collecting and analysing scientific data, both in the field and in the laboratory.	**Understand**
CO4	Understand the architecture of the marine ecosystem and its essential role	**Apply**
CO5	Specify the biological significance of biomolecules from marine microbes.	**Understand**

Mapping with programme outcomes:

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

S-Strong; M-Medium; L-Low

UNIT I - Marine microorganisms **(10 Hours)**

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

UNIT-II- Extremophiles and Marine bio-diversity **(08 Hours)**

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

UNIT III- Marine food pathogens and microbial toxin (10 Hours)

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

UNIT IV – Xenobiotics and Marine nutrient cycles (10 Hours)

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

UNIT V – Marine Microbes bioproducts (10 Hours)

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

SUGGESTED READINGS

1. Colin Munn. (2011). *Marine Microbiology: Ecology & Applications*. (2nd ed.). Black Well Publishers.
2. David Sigee. (2005). *Freshwater Microbiology: Biodiversity and Dynamic Interactions of Microorganisms in the Aquatic Environment*. (1st ed.). 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. (5th ed.). 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

23MBP105B **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 computers in the field of life sciences.
- To obtain a good understanding of the interpretation of biological database. To uptakeknowledge in the latest tools and technology.
- To describe the history, scope and importance of Bioinformatics and the role of theinternet in Bioinformatics
- Provide an overview of the application areas of bioinformatics, with a focus on the topics thatwill be taught in the course
- To get introduced to the basic concepts of Bioinformatics and its significance inBiological data analysis
- Classify different types of Biological Databases.

Students will be able to

COs	Course Outcomes	Blooms Level
CO1	The students will have an understanding of the information on the search engines andvarious software tools involved in bioinformatics.	**Understand**
CO2	Additional knowledge of different operating systems would enable the candidate to work with versatility.	**Apply**
CO3	Provides computational skills on search engines and various software tools involved inbioinformatics	**Understand**
CO4	It will impart computational-based techniques which include genomics and proteomics in Bioinformatics.	**Apply**
CO5	Retrieve information from available databases and use them for microbial identifications and drug designing, gain the ability to modify gene and protein structures in simulated systems	**Understand**

Mapping with programme outcomes:

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

S-Strong; M-Medium; L-Low

UNIT – I **(08 Hours)**

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

UNIT – II **(08 Hours)**

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. DNA Barcoding.

UNIT – III **(11 Hours)**

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

UNIT – IV **(11 Hours)**

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 **(10 Hours)**

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 BiologicalScience 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 HarborLaboratoryPress.
5. Higginns, D., and Taylor, W., (2000). *Bioinformatics. Sequence, Structure and databanks – APractical Approach*, Oxford UniversityPress.
6. Baxevanis, A.D., and Francis Ouellette, B.F., (2001) *Bioinformatics – A Practical Guide to theAnalysis 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*, PearsonEducation 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

23MBP105C PHARMACEUTICAL MICROBIOLOGY 4H –4C

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

COURSE OBJECTIVE

- To Understand the basics of pharmaceutical microbiology and important microorganismplaying roles pharmaceutically
- To understand different products of microbial origin playing a key role in pharmaceuticalapplications.
- To understand the role of secondary metabolites in the pharmaceutical industry.
- Understand the functions of biomolecules.
- Understand nucleic acids and their importance to combining and analyzing information
- To understand good practices and regulations involved in utilizing the microbial productsfor pharmaceutical application

COURSE OUTCOME

Students will be able to

COs	Course Outcomes	Blooms Level
CO1	Have basic knowledge of pharmaceutical microbiology and well versed with the different microbial products used in pharmaceuticalapplications	**Understand**
CO2	Better understanding of good laboratory practices and regulations for utilizing themicrobial products in pharmaceutical applications	**Apply**
CO3	Get introduced to various drug discovery tools and appreciate the use of in silicomethods in drug designing.	**Understand**
CO4	Summarize the DNA & RNA structure and base pairing schemes	**Apply**
CO5	Understand the process of production of various biopharmaceuticals.	**Understand**

Mapping with programme outcomes:

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

S-Strong; M-Medium; L-Low

UNIT I

Microorganisms affecting the pharmaceutical industry **(10 Hours)**

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 the formulation. Sterilization in the pharmaceutical industry Good manufacturing practices in the pharmaceutical industry. Physical, chemical & mechanical method of sterilization. Sterility indicators.

UNIT II

Drug Metabolism **(10 Hours)**

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 **(10 Hours)**

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 **(08 Hours)**

The drug resistance – 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 **(10 Hours)**

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 REFERENCE

1. https://pharmacy.sgtuniversity.ac.in/syllabus-pharmaceutical-microbiology-theory-b-pharmacy/
2. https://www.umu.se/en/education/syllabus/3fa015/

23MBP111	MICROBIAL PHYSIOLOGY PRACTICAL	Semester – I 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

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

COs	Course Outcomes	Blooms Level
CO1	A student able to skillfully isolate and identify the microorganisms using different microbiological techniques needed in laboratory.	Apply
CO2	To enhance the ability of the student skills in medical laboratories and research sectors.	Apply
CO3	Demonstrate practical skills in the use of tools, technologies and methods common to microbiology.	Understand
CO4	To apply the scientific method and hypothesis testing in the design and execution of experiments	Analyze
CO5	To develop theoretical and practical skills in the design and execution of experiments.	Understand
CO6	Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement	Understand

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

EXPERIMENTS **(48 Hours)**

1. Micrometry
2. Staining techniques: Simple, Gram Staining, Capsule, Endospore and Acid fast staining (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*, (6thed.). Benjamin Cummings, NewYork.
2. Dubey, R.C., and Maheshwari, D.K., (2002). *Practical Microbiology*, (1sted.). S. Chand and Company Ltd, NewDelhi.
3. Gunasekaran, P. (1996). *Lab Manual in Microbiology*, (1sted.). New Age International (P) Ltd, Publishers, NewDelhi.
4. Brook,G.F., J., Butel, S., Stephen, A., and Morse, A., (2003). *Medical Microbiology*, (22nded.). McGraw Hill.
5. Chakraborty, P. (2003). *A Text book of Microbiology*. (2nded.). 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*. (28thed.). Lange Medical Publishers. NY

Semester–I

23MBP112 GENETICS AND INSTRUMENTATION PRACTICAL **4H –2C**

Instruction Hours / week: L0 T: 0P: 4 **Marks:** Internal: **40** External: **60** Total:**100**

End Semester Exam: 9 Hours

COURSE OBJECTIVES

- To acquire skills in the different molecular mechanisms 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 microorganisms.
- 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 organels level.

COURSE OUTCOME

Students will be able to

COs	Course Outcomes	Blooms Level
CO1	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	**Understand**
CO2	Imparts knowledge on the different aspects of genetics and pedigree analysis.	**Apply**
CO3	Students will apply their knowledge of to selected examples of changes or losses in cell function.	**Understand**
CO4	Identify the organs and tissue systems of plants, and explain their respective function.	**Apply**
CO5	Impart knowledge on applications of microorganisms in various fields Provides skill development on microbial products.	**Understand**

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

EXPERIMENTS **(48 Hours)**

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

SUGGESTED READINGS

1. Arora, B., and Arora, D.R., (2007). *Practical Microbiology*, (1st ed.). CBS Publishers andDistributors, 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 FirstCentury Publication, Madurai.

JOURNAL PAPER ANALYSIS AND PRESENTATION **2H**

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

Semester – II

23MBP201 **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 use 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)

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

COs	Course Outcomes	Blooms Level
CO1	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. .	Apply
CO2	Define the process of virus latency and describe in molecular terms control of the process and activation of viral genomes during reactivation.	Apply
CO3	Describe the growth behavior differences between normal cells and cells transformed by oncogenic DNA and RNA viruses.	Understand
CO4	Integrate experimental strategies learned in the context of viral systems into the design of experiments involving other systems.	Remember
CO5	Discern the replication strategies of representative viruses from the seven Baltimore classes	Create
CO6	To understand the interactions between viruses and the host immune system.	Apply

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

UNIT I - Viral classification and properties (08 Hours)

Historical perspective of virology - Scope of virology -Viral classification (Baltimore classification) and properties of viruses – Replication of viruses, cultivation of viruses (animal inoculation, Embryonated egg and tissue culture) - properties of viroids and Prions. Purification of virus: *in vivo* and *in vitro* methods.

UNIT II – Animal DNA viruses (08 Hours)

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 (08 Hours)

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 (09 Hours)

Plant viruses – RNA viruses – TMV, Cowpea mosaic virus, Bunchy top virus: Brome mosaic viruses, Satellite viruses – Double stranded DNA viruses - CaMV – Single stranded DNA viruses – Gemini virus. Structure and Replication of Bacteriophage (T4) – Filamentous phage (ΦX174). F2 phage, Ff phage.

UNIT V- Immunization and Virology Techniques (07 Hours)

Nosocomial infections, Viral Vaccines-Interferons - Antiviral drugs Types of vaccine and their immunization schedule in children and adults.

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., (2013). *Virology: Principles and Applications*. (2nd ed). Wiley.
3. Acheson, N.H. (2011). *Fundamentals of Molecular Virology*. (2nd ed), Wiley publication.
4. Cann, A.J. (2015). *Principles of Molecular Virology* (6th ed) Academic Press.
5. Dimmock, N.J., Easton, A.J., and Leppard, K.N., (2016). *Introduction to Modern Virology*, (7thed.). Blackwell Scientific Publications, Oxford,UK.
6. Flint, S.J., Racaniello, V.R., Enquist, L.W., Rancaniello, V. R., and Skalka, A. M., (2020). *Principles of Virology:Multi volume*. 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., (2016). *Medical Virology*, (5thed.). 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

23MBP202 **MEDICAL BACTERIOLOGY** **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

- 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

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

COs	Course Outcomes	Blooms Level
CO1	Demonstrate an understanding at an advanced level of microbial virulence mechanisms and host response to infection.	Understand
CO2	Application of molecular techniques to medical microbiology; biochemical and genetic mechanisms of antimicrobial agent activity, microbial susceptibility and resistance to antimicrobial agents.	Apply
CO3	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.	Understand
CO4	It also provides opportunities to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.	Analyze
CO5	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.	Understand
CO6	Recall the relationship of this infection to symptoms, relapse and the accompanying pathology	Remember

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

UNIT I- Isolation and identification of pathogens (8 Hours)

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 – Routine Laboratory diagnosis of bacterial pathogen – Antibiotic susceptibility testing.

UNIT II – Infections (8 Hours)

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 (8 Hours)

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 (9 Hours)

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 (7 Hours)

Nosocomial infection – Urinary tract infection, Respiratory tract infection, Sexually transmitted disease – Monoprophylaxis – Antimicrobial chemotherapy and Antibiotics. Antibacterial resistance- Inhibitors of nucleic acid synthesis, inhibitors of protein synthesis and inhibitors of cell membrane synthesis. 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.

Semester – II

23MBP203 BIOSTATISTICS AND RESEARCH METHODOLOGY 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 study about collection, interpretation and presentation of statistical data
- To study the analytics of data, probability, and hypothesis testing of samples
- To find the essential role of statistics in present, future use and applications of Biology.
- To generate the results through analytical techniques.
- To compare different groups of population.
- To know the significant among the groups.

COURSE OUTCOMES

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

COs	Course Outcomes	Blooms Level
CO1	Apply basic statistical concepts commonly used in health and medical sciences	Understand
CO2	Use basic analytical techniques to generate results	Apply
CO3	Interpret results of commonly used statistical analyses in written summaries.	Understand
CO4	Demonstrate statistical reasoning skills correctly and contextually and this course willsupport the employment in various bioscience sector.	Analyze
CO5	The analytics of data, probability, and hypothesis testing of samples	Understand
CO6	The essential role of statistics in present, future use and applications of Biology	Remember

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

UNIT I - Introduction of Biostatistics and Correlation (8 Hours)

Introduction to Biostatistics: Mean, Median, Mode, 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 (8 Hours)

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

UNIT III Analysis of Variance (8 Hours)

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

UNIT IV-Research **(8 Hours)**

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

UNIT V - Sampling Design **(8 Hours)**

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

SUGGESTED READINGS

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

Semester – II

23MBP204 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 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

Students will be able to

COs	Course Outcomes	Blooms Level
CO1	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.	**Understand**
CO2	To know detailed ideas about bio fertilizer production and plant disease.	**Apply**
CO3	To become Entrepreneurs after understanding this process and product development.	**Apply**
CO4	To determine the microbial role in nutrient cycling and water quality	**Analyze**
CO5	Explain the degradation of natural organic compounds and selected pollutants in the environment.	**Understand**

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

UNIT I

Aquatic environment **(08 Hours)**

Microbiology of water-water-borne diseases and their control measures. Microbes living around us. 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), solid waste microbial degradation.

UNIT II

Microbiology of air and Bioremediation (08 Hours)

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. Microalgal species involved in bioremediation of pesticides, Role of Microbiologist in pollution control. Case studies. Bioleaching – Biology of mineral leaching, recovery of metal from ores– oxidation of minerals – testing for biodegradability.

UNIT III

Microbes in agriculture and Biocontrol (08 Hours)

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. Biocontrol and its application: Biofungicides, bionematicides and Biopesticides. Biocontrol and its application.

UNIT – IV

Biological nitrogen fixation (08 Hours)

Symbiotic and non-symbiotic microorganisms, Plant virus interaction in nitrogen fixing nodules, root nodule formation, nitrogen fixers, Ureide 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 and Pink-pigmented facultative methylotrophic bacteria (PPFM).

UNIT V

Biofertilizers (08 Hours)

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-Mycorrhizae, Rhizobia, Azosprillum, Azotobacter, Azolla, Frankia, Blue green algae, Phosphate- solubilizers fluorescent Pseudomonas. Entrepreneurship development in biofertilizer. Women scheme to initiate the startup and small scale business.

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*. (2nd ed.). Prentice Hall, New Delhi.
4. Rao, N.S. (1995). *Soil Microorganisms and plant Growth*. Oxford and IBH Publishing Co., New Delhi.
5. Sen, K., and Ashbolt, N.J., (2010). *Environmental Microbiology: Current Technology and Water Applications.*
6. Maier, R.M., Pepper, I,L., and Gerba, C.P., (2009). *Environmental Microbiology.* (2nd ed.). Elsevier Publisher.
7. Atlas, R.M., and Bartha, M., (2000). *Microbial Ecology - Fundamental and Applications*. (3rde d.). Redwood City CA. Benjamin/Cumming Science Publishing Co., New Delhi.
8. Maier, R.M., Pepper, I.L., and Gerba, C.P., (2000). *Environmental Microbiology*. (1st ed.). Academic Press, New York.
9. Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. 2000. Twelth Edition, Biology Microorganisms, Prentice Hall, New Jerry. 5.
10. Mark Wheelis, 2010. Principles of Modern Microbiology, Jones & Bartlett India Pvt. Ltd., New Delhi.
11. Bagyaraj D.J., and Rangaswami.G. 2009. Agricultural Microbiology (2nd edition). PHI Learning Pvt. Ltd.
12. R.P. Pareek and Navneet Pareek. 2019. Agricultural Microbiology. Scientific Publishers.
13. K. R. Aneja. 2017. Fundamental agricultural microbiology (19th edition). New Age International Private Limited.

Semester - II

23MBP205A **CYBER SECURITY** **4H -4C**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- Critical IT and national critical infrastructure.
- Understanding of the cyber- attacks that target computers, mobiles and persons
- Legal framework that is followed in other countries and legal and ethical aspects related to new technologies
- Understand the data protection bill 2019
- Risk- based assessment, requirement of security controls and need for cyber security audit

COURSE OUTCOME (CO'S)

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

Cos	Course Outcomes	Blooms Level
CO1	Understand the basic terminologies related to cyber security and current cyber security threat landscape.	Understand
CO2	Understanding of the cyber- attacks that target computers, mobiles and persons.	Understand
CO3	Understand the legal framework that exist in India for cybercrimes and penalties and punishments for such crimes	Understand
CO4	Understand the aspects related to personal data privacy and security.	Understand
CO5	Understand the main components of cyber security plan.	Understand

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

Unit I - Overview of Cyber security **(07 Hours)**

Cyber security increasing threat landscape- Cyber Security Terminologies-Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber Terrorism-Protection of end user machine- Critical IT and National Critical Infrastructure- Cyberwarfare-Case Studies.

Unit II - Cyber crimes **(09 Hours)**

Cybercrimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach- Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/ credit card fraud, Online payment fraud, Cyberbullying, website defacement, Cyber- squatting, Pharming, Cyber espionage, Cryptojacking, Darknet- illegal trades, drugtrafficking, human trafficking-Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, fake newscyber crime against persons - cyber grooming, child pornography, cyber stalking- Social Engineering attacks, Cyber Police stations, Crime reporting procedure- Case studies.

Unit III - Cyber Law **(08 Hours)**

Cybercrime and legal landscape around the world- IT Act-2000 and its amendments. Limitations of IT Act-2000. Cybercrime and punishments- Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IoT, Block chain, Dark net and Social media- Cyber Laws of other countries- Case Studies.

Unit IV - Data Privacy and Data Security **(08 Hours)**

Defining data, meta-data, big data, non- personal data- Data protection, Data privacy and data security- Personal Data Protection Bill and its compliance- Data protection principles- Big data security issues and challenges- Data protection regulations of other countries- General Data Protection Regulations(GDPR)-2016 Personal Information Protection and Electronic Documents Act (PIPEDA)-Social media- data privacy and security issues.

Unit V - Cyber Security Management, Compliance and Governance **(08 Hours)**

Cyber security Plan- cyber security policy, cyber crises management Plan-Business continuity- Risk Assessment-Types of security controls and their Goals-Cyber security audit and compliance- National cyber security policy and strategy.

Suggested Readings

1. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.
2. Information Warfare and Security by Dorothy F. Denning, Addison Wesley.

Reference:

1. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform.
2. Data Privacy Principles and Practice by Natraj Venkataramanan and Ashwin Shriram, CRC Press.
3. Information Security Governance, Guidance for Information Security Managers by W. KragBrothy, 1st Edition, Wiley Publication.
4. Auditing IT Infrastructures for Compliance by Martin Weiss, Michael G. Solomon, 2nd Edition, Jones Bartlett Learning.

Websites

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

Semester – II

23MBP205B **MICROBIAL ENZYMOLOGY** **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 enzymology with an emphasis on prokaryotes and eukaryotes.
- The theoretical grounds of methods and their applications in research will be discussed.
- The course also deals with enzyme structure, stability, organization, and expression.
- The courses include among others model systems, the enzymes behind complex diseases
- To know the production and purification of microbial enzymes.
- To understand the role of enzymes in microbial metabolism.

COURSE OUTCOME (CO'S)

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

COs	Course Outcomes	Blooms Level
CO1	This course allows the candidate to recollect the basics of enzymes and apply cognitive thinking to the application-oriented sectors of enzymes.	Understand
CO2	Students would be able to practically apply this knowledge in different sectors with possibilities ranging from the treatment of human diseases.	Apply
CO3	The development of novel medicines for treatment.	Apply
CO4	A thorough understanding of the process of translation and operons along with therecombination of DNA.	Analyze
CO5	An in-depth study of enzyme analysis with enzyme techniques.	Analyze
CO6	Full understanding of all aspects of all important techniques used for the study of enzymes.	Understand

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

Unit I - Bio energetics: **(08 Hours)**

Enzyme nomenclature, classification, general properties of enzymes, factors affecting enzyme activity, activation energy, transition state, turnover number, enzyme co-factors. Enzyme kinetics; General kinetic principles; steady-state enzyme kinetics, Michelis-Menton equation, importance of Km and Vmax.

Unit II-Enzyme regulation: **(08 Hours)**

Allosteric and cooperative effects, conquered model of Monod et al, and sequential model of Koshland et al, Principles of metabolic regulations; feedback regulations of multifunctional pathway.

Unit III Isolation and purification of enzymes: (08 Hours)

Enzyme extraction –soluble enzymes, membrane bound enzymes, purification-precipitation methods, concentration of biomolecules: salting with ammonium sulphate precipitation, dialysis, lyophilization, chromatographic methods, total activity and specific activity.

Unit IV- Assay techniques for microbial enzymes: (08 Hours)

Amylases, proteases, cellulases, and lipases, Basic principles of cell and enzyme immobilization. Microencapsulation and Nanoencapsulation techniques.

Unit V Uses of enzymes in analysis (08 Hours)

Enzyme electrodes. Enzyme as biosensor, potentiometric biosensor, industrial applications of enzymes. Commercial value: steroidal conversions, penicillin and antibiotic conversion, immunosensor. Recent advances and future prospects of enzyme engineering; artificial enzymes and applications.

SUGGESTED READINGS

1. WatsonJD, Baker TA, Bell SP, Gann A, Levine Mand LosickR(2008) Molecular Biologyof 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 BenjaminCummings Publishing, San Francisco.
3. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams andWilkins, Philadelphia.
4. KarpG(2010)Celland Molecular Biology:Conceptsand Experiments,6th edition, JohnWiley& Sons. Inc.
5. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4 Edition, Cold SpringHarbour Laboratory press.
6. Krebs J, Goldstein E, Kilpatrick S(2013). Lewin'sEssential Genes, 3rd Ed., Jonesand Bartlett Learning.
7. Gardner EJ, Simmons MJ, Snustad DP (2008).). Principles of Genetics.8th Ed. Wiley-India.

INDUSTRIAL MICROBIOLOGY AND BIOPROCESS TECHNOLOGY

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

COs	Course Outcomes	Blooms Level
CO1	This course will enable the students to design the vario microbial fermentation products and their productio purification for various applications	applying
CO2	To know the process protocol for the synthesis of bioproducts.	understanding
CO3	Explain the Scale up methods for the production in large scale fermenter.	applying
CO4	Gain knowledge about industrial biotechnology process	applying
CO5	Explain the application of biotechnology in medical and its allied fields, gene therapy,genetic counselling	applying
CO6	Address the bioethical issues & concerned linked to medical biotechnology	Evaluating

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

UNIT I – Fermenter (08 Hours)

Concepts and scope of Industrial microbiology, Primary and Secondary Screening of industrial microorganisms. Industrial fermentors: Basic functions, design and components. Different types of fermentors: Chemostat and turbidostat, tower fermentors, membrane bioreactors, scale up of fermentation process. Microbial growth kinetics: Batch cultures, continuous cultures, fed-batch cultures, industrial production of biomass and metabolites.

UNIT II - Fermentation media: (08 Hours)

Desired qualities, sources of nutrition. Solid state and submerged fermentation. Industrial production of penicillin, alcohol, glutamic acid, vitamin A and alcoholic beverages. Industrial enzymes: Production and applications of amylases, proteases, pectinases, cellulases and lipases. Immobilization of enzymes or cells.

UNIT III - Physical factors and scale-up (08 Hours)

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

UNIT IV – Microbial Products and Downstream process (08 Hours)

Enzymes- Introduction, Enzyme Kinetics, Immobilized Enzyme system, large scale production, extraction and purification- Vitamins (Vitamin C), Amino acids, Enzymes, Antibiotics, Organic acids, Vaccines, Cheese, and Exopolysaccharides. Bio transformation product (steroid). Downstream processing: objectives and criteria 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 (08 Hours)

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

SUGGESTED READINGS

1. Shuler, M.L., Kargi F., and DeLisa, M. *Bioprocess Engineering: Basic concepts*, 3rdEdition, 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 PrivateLimited
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. *Fermentatio Microbiology and Biotechnology*, 3rd Edition, 2011, CRC Press

Semester - II

23MBP211 MICROBIAL TECHNOLOGY PRACTICAL 4H – 2C

Instruction Hours / Week: 0 T: 0 P: 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.

COURSEOUTCOME (CO'S)

Students will be able to

COs	Course Outcomes	Blooms Level
CO1	This practical course renders a candidate the knowledge of advanced techniques involved in Microbial Biotechnology and Agricultural Microbiology.	**Understand**
CO2	Candidates would be able to understand and perform molecular techniques which forms an integral part of core Microbiology.	**Apply**
CO3	This practical course renders a candidate the knowledge of advanced techniques involved in microbial biotechnology.	**Understand**
CO4	He/she will be able to judge how microbes and enzymes could be applied in industry and develop entrepreneur skills for applications in biotechnology-based industries	**Analyze**
CO5	Candidates would be skilled enough to perform a molecular technique which forms an integral part of industrial microbiology.	**Apply**
CO6	Introducing the science of immunology and to study various types of immune systems their classification structure and mechanism of immune activation	**Understand**

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

EXPERIMENTS **(40 Hours)**

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 soilsamples
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. *Estimation of BOD and COD.*
12. Isolation and identification of VAM fungi
13. Lipase and Asparaginase enzyme production and purification.
14. Enumeration of microbes from industrial effluents.

REFERENCES

1. Green and Sambrook. *Molecular Cloning: A Laboratory Manual*, 4th Edition, 2012, ColdSpring 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

23MBP212 **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 themicrobiology laboratory.
- To understand the importance of diagnostic procedures and gain skills related to the laboratoryexperiments.
- 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 laboratoryexperiments.
- It helps the students to study the advanced laboratory diagnosis procedures.

COURSE OUTCOME (CO'S)

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

COs	Course Outcomes	Blooms Level
CO1	This course provides the current medical aspects on the clinical diagnosis of infection providing the combined treatment of bacteriology and virology.	Understand
CO2	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.	Apply
CO3	It will also provide opportunities to understand the student about the morphology, pathogenesis and lab diagnosis of pathogenic bacteria	Apply
CO4	The significance of bacterial genetic variation (in drug resistance, pathogenesis or virulence and variation, diagnosis, and vaccination), and manipulation of cloned DNA.	Analyze
CO5	To know the Virulence of bacteria, bacterial virulence factors and their regulation.	Analyze
CO6	To understand drug resistance, drug-bacteria relationship, clinical implications, and prevention	Understand

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

EXPERIMENTS **(40 Hours)**

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 (embryonated egg inoculation),
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 - Detection of bacterial hazards.
10. Antibiofilm formation.

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*. (3rd ed.). 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*. (2nd ed.). A.I.T.B.S Publishers and Distributors, Delhi
9. Baron, E.O., and Finegold, S., (1990). *Bailey and Scott's Diagnostic Microbiology*. (8th ed.). C VMosby Company, StLouis.
10. Gaud, R.S., and Gupta, G.D., (1999). *Practical Microbiology*. (1st ed.). Nirali Prakashan ,Pune.
11. Mukherjee, K.L. (2005). *Medical Laboratory Technology*, Vol. 3, Tata McGraw-Hill PublishingCompany Ltd, NewDelhi.
12. Reddy, S.M., and Reddy, S.R., (2004). *Microbiology A Laboratory Manual*. (3rd ed.). SriPadmavathi Publication, Hyderabad.
13. Sundararaj, T. (2005). *Microbiology laboratory manual.*AswathySundararaj Publishers.Chennai.
14. Vandepilte, J., Verhaegan, J., Engbaek, K., Rohner, P., Prot, P., and Heuck, C.C., (2004). *Basic Laboratory Procedures in Clinical Bacteriology*. (2nd ed.). 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

Semester - II

23MBP301 ADVANCED IMMUNOLOGY 4H –4C

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- Imparting advanced technological knowledge through a detailed study of topics such as immune diagnosis, assessment of cell-mediated immunity and current trends in the 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)

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COs	Course Outcomes	Blooms Level
CO1	To strengthen the knowledge on the immune system, their structure and classification, genetic control of antibody production, Types, the structure of antigens and immunodiagnostics	Apply
CO2	To obtain knowledge of Molecular immunology, the hypersensitive immune reaction of the Latest trends in immunology.	Apply
CO3	Upon completion students will obtain knowledge on the immune system, cells involved along with complement system and autoimmunity.	Understand
CO4	Develop an understanding of the immune system, antigen-antibody interactions.	Apply
CO5	Gain theoretical knowledge of various diseased conditions generated due to the interplay of immune system components.	Apply
CO6	Introducing the employment aspect of immunology and studying various types of immune systems their classification structure and mechanism of immune activation	Understand

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

UNIT – I Immune system **(8 Hours)**

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 **(10 Hours)**

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 **(10 Hours)**

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 humoral immunity (HI), cell-mediated immunity (CMI), – cell mediated cytotoxicity, Autoimmunity, Hypersensitivity. Delayed-type Hypersensitivity (DTH) response- hypersensitivity types and Immunodeficiencies

UNIT – IV Vaccines **(10 Hours)**

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.

UNIT – V Immunonological Techniques **(10 Hours)**

Antigen-antibody interactions: Precipitation, agglutination andcomplement-mediatedd immune reactions; Advanced immunological techniques –RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence, flow cytometry and immunoelectron microscopy; forensic serology, Immunohaematology – ABO, RH incompatibility Erythroblastosis fetalis and Immunological biosensor

SUGGESTED READINGS

1. Kuby. Immunology, 7th edition 2013. W. H. Freeman and Company • New York.
2. Ramesh, S.R. *Immunology*, 1st edition, 2017, McGraw Hill Education India Private Limited.
3. Massoud Mahmoudi. *Immunology made ridiculously simple*. 1st edition 2009, Med master
4. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt. *Roitt's Essential Immunology*, 13th Edition, 2017, Wiley-Blackwell
5. Doan, Thao; Melvold, Roger; Viselli, Susan. *Lippincott's Illustrated Reviews, Immunology*, 2nd Edition, 2012, Lippincott Williams & Wilkins (LWW)
6. Jenni Punt, Sharon Stranford, Patricia Jones, Judy Owen. *Kuby Immunology*, 8th Edition, 2019, W. H. Freeman
7. Ian Tizard. Immunology: An Introduction, 4th Edition, 2005, Cengage Learning.

Web Link

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

Semester - III

23MBP302 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 encompass the employability by the use of microorganisms in the manufacture of food or industrial products.
- The aim of the course is to give the students about theoretical and practical skills in food and industrial microbiology.
- This paper adds information about the role of microorganisms in many foods, 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 explore their practical skills in entrepreneurial activities.
- It will deliver the large-scale production of microbial products techniques at an advanced level.

COURSE OUTCOME (CO'S)

Students will be able to

COs	Course Outcomes	Blooms Level
CO1	Provides knowledge in the large-scale production of industrial products, providing the trends to cater to the needs of industry.	Understand
CO2	This will help the students to enhance their employment knowledge of microbiology-based food products.	Apply
CO3	The aim of the course is to give the students broad theoretical and practical skills in food microbiology.	Apply
CO4	To encode the importance of the role of microorganisms in food industries both in beneficial and harmful ways.	Analyze
CO5	To obtain a good understanding of food microbiology and become qualified as a microbiologist in food and other industries	Understand
CO5	Candidate able to become an entrepreneur after understanding this entire course.	Apply

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

UNIT – I Food Microbes **(10 Hours)**

Food and microorganisms –Morphological Characteristics-Industrial Importance-Fungi, Bacteria; Intrinsic and extrinsic, Factors 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 **(08 Hours)**

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 **(10 Hours)**

Spoilage of food and fermented food products - Sources, contamination, spoilage, preservation and control - cereals and cereals products, vegetables and fruits, meat and meat products, sugar and sugar products, egg and poultry, fish and sea foods, canned foods. Fermented food – bread, sauerkraut and soy sauce.

UNIT – IV Methods for detection **(10 Hours)**

Applications of microorganisms in food and microbial fermentation. Intestinal Beneficial Bacteria-Concept of Prebiotics and Probiotics, Genetically modified foods. Biosensors in food. Sample and enumeration of bacteria from food, chemicals, biological and physical methods for determining microorganisms and their products in food.

UNIT – V Food Control Agencies **(10 Hours)**

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). Good Manufacturing in Food Industry (GMP).

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.
8. William C Frazier, Dennis C. Westhoff, N.M. Vanitha, Food Microbiology, 5th Edition, MC Gram Hill Publications.

MEDICAL MYCOLOGY AND PARASITOLOGY

23MBP303 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 Mycology and parasitology introduces basic principles and 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
- It focuses on pathogenic mechanisms in order to foster a student's ability to solve problems in their future clinical career and able to establish a medical laboratory.
- This course provides learning opportunities in the field of clinical research on 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)

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

COs	Course Outcomes	Blooms Level
CO1	Identify the different types of parasites, Classify the structure and life cycles.	Analyze
CO2	Compare the information from a variety of sources relevant to parasitology.	Apply
CO3	Assess the reasons of infection with parasites and Investigate the different ways by which the parasites damage their hosts and the response of the host.	Understand
CO4	Conduct procedures related to isolation and identification of parasites.	Analyze
CO5	Functioning in multi-disciplinary teams to advise the population on scientific basis to prevent infections with parasites.	Understand
CO6	Report the best identification method for parasites causing some diseases and communicate with patients and their families to avoid further exposure to parasites	Apply

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

UNIT – I **(10 Hours)**

General characteristics of Fungi – Classification of fungi – morphological and systemic classification. Mycotoxicoses. Medically important fungi – routine mycological techniques - Antifungal agents and its mode of action.

UNIT – II **(10 Hours)**

Mycosis – Types of mycosis. Superficial mycosis. Cutaneous mycosis – Dermatophytoses – Trichophyton, Microsporum and Epidermophyton. Deep mycosis –Opportunistic mycosis, Mycotic Poisoning.

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UNIT – III **(10 Hours)**

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 **(10 Hours)**

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

UNIT – V **(8 Hours)**

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
9. Ananthanarayanan, R. and C.K.J. Panicker, 2009. Text Book of Parasitology. 6th Edition. Jaypee brothers medical publishers (p) Ltd, New Delhi.

Semester - III

23MBP304 **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)

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

Cos	Course Outcomes	Blooms Level
CO1	learn the basic tools in recombinant technology	Learning
CO2	Understand the various concepts of cloning vectors	Understand
CO3	learn the cloning strategies	Learning
CO4	familiarize with the principles of bioethical concepts	Remember
CO5	understand the IPR issues in patents in biotechnology innovations	Understand
CO6	apply their knowledge in new product development	Apply

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

UNIT – I Microbial technology (10 Hours)

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 (10 Hours)

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 (10 Hours)

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 (08 Hours)

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 (10 Hours)

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.)., ScientificAmerican 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.

Semester - III

23MBP305A

METAGENOMICS AND FORENSIC MICROBIOLOGY 3H –3C

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

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

COURSE OUTCOME (CO'S)

Students will be able to

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

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

UNIT I Introduction about metagenomics (6 Hours)

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

UNIT II Metagenomic Techniques (6 Hours)

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

UNIT III Genomics (8 Hours)

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

UNIT IV Molecular and Epidemiological tools (8 Hours)

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

UNIT V Protein arrays: (8 Hours)

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

SUGGESTED READINGS

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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

23MBP305B **ENTREPRENEURIAL MICROBIOLOGY** **3H–3C**

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

End Semester Exam: 3Hours

COURSE OBJECTIVES

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

COURSE OUTCOME

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

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

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

Unit I Entrepreneurship: **(10 Hours)**

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

Unit II Production of microbial metabolites and Single cell proteins: (10 Hours)

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

Unit III Biofertilizers and Biopesticides: (10 Hours)

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

Unit IV Commercial Products: (10 Hours)

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

Unit V Government regulatory practices and policies: (08 Hours)

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

SUGGESTED READINGS

1. Stanbury, P.F, and Whitekar. A. (1999), Principles of Fermentation Technology, 2nd Edition. Butterworth-Heinemann: Oxford.
2. Stockholm, K.T.H., Sven-OlofEnfors, and Lena Haggstrom. (2000), Bioprocess Technology: Fundamentals and Applications, Royal Institute of Technology: Sweden.
3. Ashton Acton, Q., (2012). Biological Pigments– Advances in Research and Application.Scholorly Editions: Atlanta, Georgia.
4. Crueger, W, and Crueger. A. (2000), Biotechnology: A Text Book of Industrial microbiology, 2nd Edition, SinauerAssociates :Sunderland.Mass.
5. Hugo, W.B. and Russel, A.D. (2003), Pharmaceutical Microbiology, 6th Edition. Blackwell Scientific Publications: U K.

Semester - III

BIO NANOTECHNOLOGY

23MBP305C 3H-3C

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES

- This course 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 knowledge to develop Nanomaterials.

COURSE OUTCOME (CO'S)

Students will be able to

COs	Course Outcomes	Blooms Level
CO1	Students get an idea about application of nanotechnology in biology.	Understand
CO2	It provides analytical knowledge of trends and developments in the field of nanotechnology	Apply
CO3	Acquire knowledge in nanotechnology and how it will support the employment greatly.	Apply
CO4	Students able to understand the bionanomaterial synthesis.	Apply
CO5	Able to apply the nanomaterial in different fields.	Remember
C06	Students have an enhanced knowledge and understanding of chemical transformation and biomolecular sensing	Understand

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

UNIT – I Nano particles (08 Hours)

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

UNIT – II Bionanomachines (06 Hours)

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

UNIT – III Natural bio nanotechnology designing (06 Hours)

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

UNIT – IV Drug delivery (8 Hours)

Nanoparticles in cancer therapy, Biosensors - DNA Microarrays - Cell Biochips- Nanoparticles for Bioimaging - Military applications of Nanotechnology - Nanomaterials for food Applications - Toxicity of Nanoparticles - Future Perspectives.

UNIT – V Ethics of Nanotechnology (08 Hours)

Future of Bio nanotechnology: Problems in bionanotechnology – Abide finger problem – Sticky finger problem – role of enzyme to solve these problems – Core studies – nomotuble synthesis, nano scale assembler, nano surveillance – ethical consideration.

SUGGESTED READINGS

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

Semester - III

23MBP311 IMMUNOLOGY AND SEROLOGY PRACTICAL 3H – 2C

Instruction Hours / Week: L: 0 T: 0 P: 3 **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.
- To understand the Technical skill of immunology.

COURSE OUTCOME (CO'S)

Students will be able to

COs	Course Outcomes	Blooms Level
CO1	This practical course renders a candidate the knowledge of advanced techniques involved in Immunology	Understand
CO2	Candidates would be able to understand and perform molecular techniques which forms an integral part of core Microbiology.	Apply
CO3	This practical course renders a candidate the knowledge of advanced techniques involved in microbial biotechnology.	Understand
CO4	Understand the antigen antibody interactions for diagnosis	Analyze
CO5	Candidates would be skilled enough to perform a Immunological test.	Apply

Mapping with Programme Outcomes

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

EXPERIMENTS (48 Hours)

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
10. Parasite identification by Salt floatation technique.

SUGGESTED READING:

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.

Semester - III

23MBP312 **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. And disease mechanisms.
- To enhance knowledge in the field of research and development.
- To give employment opportunities to meet the current food demands.
- To understand food spoilage and the role of microorganisms.

COURSE OUTCOME (CO'S)

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

Cos	Course Outcomes	Blooms Level
CO1	This practical adds a technical skill and good understanding of industrial microbiology.	Understand
CO2	Students can develop the skills of an efficient microbiologist in the food and beverage industries.	Apply
CO3	Provides necessary entrepreneurial information on the food, dairy Microbiology in safety and quality perspective.	Apply
CO4	It will help to study the importance in the prevention of contamination that might be caused by the microorganisms.	Analyze
CO5	To Learn various methods for their isolation, detection and identification of microorganisms in food and employ in industries.	Understand
CO6	Identify ways to control microorganisms in foods and thus know the principles involving various methods of food preservation.	Analyze

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

EXPERIMENTS (48 Hours)

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

SUGGESTED READINGS

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.
6. Garg, N., Garg, K.L., and Mukerji, K.G., (2010). *Laboratory Manual of Food Microbiology*. I.K. International Publishing House, New Delhi.
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, USADemain, A.L., and Davies, J.E., (1999). *Manual of Industrial Microbiology and Biotechnology* (2nd ed.). ASM Press, Washington.
10. Garg, N., Garg, K.L., and Mukerji, K.G., (2010). *Laboratory Manual of Food Microbiology*. I.K. International Publishing House, New Delhi.
11. Harry, W., Seeley, Jr., and Denmark, P.N., (1984). *Microbes in Actions: A lab Manual of Microbiology*. D. B. Taraporwalla and Sons.
12. Jay, J.M., Loessner, M.J., Golden, D.A., (2005). *Modern Food Microbiology*. Springer Science, USA.
13. Davies, J.E., and Demain, A.L., (2009). *Manual of Industrial Microbiology and Biotechnology* ASM Publisher, USA.
14. Baltz, R.H., Davies, J.E., and Demain, A.L., (2010). *Manual of Industrial Microbiology and Biotechnology*. (3rd ed.). ASM Publisher, USA.

M.Sc. Microbiology	2023-2024
JOURNAL PAPER ANALYSIS AND PRESENTATION	Semester - III 1H

Instruction Hours / week: L: 1 T: 0 P: 0

Semester - III

23MBPOE301 **FERMENTATION TECHNOLOGY** **3H– 2C**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVE

- To encompass the use of microorganisms in the manufacture of food or industrial products on the basis of employment.
- Get equipped with a theoretical and practical understanding of industrial microbiology
- Appreciate how microbiology is applied in the manufacture of industrial products
- Know how to source microorganisms of industrial importance from the environment
- Know about the design of bioreactors, factors affecting growth and production, heat transfer, oxygen transfer
- Understand the rationale in medium formulation & design for microbial fermentation, and sterilization of medium and air.

COURSE OUTCOME (CO'S)

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

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

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

Unit I - Basics of fermentation processes **(08 Hours)**

Definition, scope, history, and chronological development of the fermentation industry. Component parts of the fermentation process. y. Component parts of fermentation process. Microbial growth kinetics, batch and continuous, direct, dual or multiple fermentations; scaleup of fermentation, comparison of batch and continuous culture as investigative tools, examples of the use of fed batch culture.

Unit II Isolation and Preservation (06 Hours)

Isolation, preservation, and strain improvement of industrially important microorganisms. Use of recombination system (Parasexual cycle, protoplast fusion techniques), application of recombinant strains, and the development of new fermentation products.

Unit III –Screening and Inoculum development (08 Hours)

Screening (primary and secondary screening); detection and assay of fermentation products (Physico-chemical assay, biological assays). Inoculum development, criteria for transfer of inoculum, development of inoculum: Bacteria, Fungi and Yeast.

Unit IV–Microbial Production (08 Hours)

Fermentation type reactions (Alcoholic, bacterial, mixed acid, propionic acid, butanediol and acetone-butanol). Microbial production of enzymes (amylases, Proteases, cellulases, pectinases and lipases) primary screening for producers, large scale production. Immobilization methods.

Unit V – Alcohols and Beverages (06 Hours)

Fermentative production of industrial alcohol, production of beverages. Production of organic acids: citric acid, aminoacids: glutamic acid, production of vitamins. fungal enzymes and Single cell protein.

References;

1. Casida, L.E.2007. Industrial microbiology, New age international (P) Ltd., New Delhi.
2. Clark, D.P and Pazdernik, N.J.2009. Biotechnology applying the genetic revolution, Elsevier Academic Press, UK.
3. Glazer, A and Nikaido.1995. Microbial biotechnology fundamentals of applied microbiology, W.H.Freemn and company, USA.
4. Glick, B.R and Pasternak, J.J.2003. Molecular Biotechnology Principles and Applications of Recombinant DNA, 3rd edition, ASM Press, USA.
5. Harider, S.I. and Ashok, A. 2009. Biotechnology, A Comprehensive Training Guide for the Biotechnology Industry, CRC Press, New York.
6. Sridhar, S.2010. Industrial Microbiology, Dominant Publishers, New Delhi.
7. Tanuja.S and Purohit, S.S. 2008. Fermentation Technology, Agrobios Publication, Jodhpur, India.

Semester - III

23BCPOE301 NUTRITION AND DIETETICS **3H–2C**

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

End Semester Exam: 3 Hours

Course Objectives

- To equip the students with
- Fundamentals of food, nutrients and their relationship to health
- Respect to deriving maximum benefit from available food resources
- Understanding of the consequences of vitamin and mineral deficiency/excess of vitamin
- Respect to the nutrition in adult age
- Nutrition deficiency diseases and their consequences
- Food adulteration and prevention of food adulteration

Course Outcomes (CO's)

After successful completion, the students will understand:

COs	Course Outcomes	Blooms Level
CO1	The fundamentals of nutrition and their relationship to health	Understand
CO2	To derive maximum benefits from available food resources	Understand
CO3	The consequences of vitamin and mineral deficiency/excess of vitamin	Understand
CO4	The nutrition in adult age	Remember
CO5	Nutrition deficiency diseases and their consequences	Remember
CO6	The sources of food adulteration and measures to prevent it	Create

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	L						
CO2							
CO3		L					
CO4		L					
CO5	L						
CO6	L						

S-Strong; M-Medium; L-Low

UNIT 1 (07 Hours)

Basic concepts in food and nutrition- Understanding relationship between food, nutrition and health, Functions of food- Physiological, psychological and social. Dietary guidelines for Indians food pyramid. Junk foods and its causes.

UNIT II (07 Hours)

Nutrients - Functions, dietary sources and clinical manifestations of deficiency/ excess of the following nutrients: Carbohydrates, lipids and proteins, Fat soluble vitamins-A, D, E and K, Water soluble vitamins – thiamin, riboflavin, niacin, pyridoxine, folate,

vitamin B12 and vitamin C, Minerals – calcium, iron and iodine

UNIT III (08 Hours)

Adult nutrition

Physiological changes, RDA, nutritional guidelines, nutritional concerns and healthy food choices -Adult, Pregnant woman, Lactating mother, Elderly. Nutrition during childhood -Growth and development, nutritional guidelines, nutritional concerns and healthy food choices -Infants, Preschool children, School children, Adolescents. Nutritional needs of nursing mothers and infants, determinants of birth weight and consequences of low birth weight, Breastfeeding biology, Breastfeeding support and Counselling, Infant and young child feeding and care - Current feeding practices and nutritional concerns, guidelines for infant and young child feeding, Breast feeding, weaning and complementary feeding. Assessment and management of moderate and severe malnutrition among children, Micronutrient malnutrition among preschool children. Child health and morbidity, neonatal, infant and child mortality.

UNIT IV (07 Hours)

Introduction to Nutritional deficiency diseases -Causes, symptoms, treatment, prevention of the following: Protein Energy Malnutrition (PEM), Vitamin A Deficiency (VAD), Iron Deficiency Anaemia (IDA), Iodine Deficiency Disorders (IDD), Zinc Deficiency, Flurosis Nutritional needs during pregnancy, common disorders of pregnancy (Anaemia, HIV infection, Pregnancy induced hypertension), relationship between maternal diet and birth. Maternal health and nutritional status, maternal mortality and issues relating to maternal health.

UNIT V (07 Hours)

Dietetics: Diet for diabetes mellitus-Nutrition recommendations for patient with diabetes, Meal planning, Exchange list of different food groups, Glycemic index based formulation of diet for diabetic individual, Diabetic diets menu wise. Diet for Cardiovascular Diseases -Dietar manage ment and general guidelines for coronary heart disease, Dietary recommendations of WHO. Diet for Acute cardiac diseases. Influence of diet on carcinogenesis, Dietary risk factors and cancers at various sites in the human body, diet therapy, diet for cancer patients, Nutrition and dietetics managing eating problems during treatment. Hormonal imbalance-Poly cystic ovarian syndrome, hypogonadism, cushing syndrome. Causes of hormonal imbalance. Treatment-Dietary and stress management protocols to be followed.

SUGGESTED READING

1.Gordon M, Wardlaw and Paul M. (2012).Perspectives in Nutrition: U.S.A. McGraw Hill Publishers. 9rd Edition. New Delhi

2.Srilakshmi.B (2014) Nutrition Science: New Age International Ltd. Publishers.4th Edition. New Delhi.

3.Srilakshmi.B. (2015) Food Science:. New Age International (P) Ltd. Publishers. 6nd Edition., New Delhi

4.Darshan Sohi (2012). A Comprehensive Textbook of Nutrition & Therapeutic Diets. Jaypee Brothers Medical Publishers Pvt. Ltd.

23CAPOE301 **ROBOTICS AND AUTOMATION PROCESS** **Semester III**
3H-2C

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

Course objectives

Enable the student

- Learn the concepts of RPA, its benefits, types and models
- Gain the knowledge in application of RPA in Business Scenarios
- Identify measures and skills required for RPA
- Adopt to the implementations of Automation
- Able to process information and draw inference
- Understand the concepts of robot skills

Course Outcomes (CO's)

After successful completion, the students will understand:

COs	Course Outcomes	Blooms Level
CO1	Demonstrate the benefits and ethics of RPA K1, K2	Understand
CO2	Understand the Automation cycle and its techniques K2	Understand
CO3	Draw inferences and information processing of RPA K3, K4	Understand
CO4	Understand the Automation concepts	Remember
CO5	Implement & Apply RPA in Business Scenarios K5	Remember
CO6	Analyze on Robots & leveraging automation	Create

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	M						
CO2					M		
CO3					M		
CO4					M		
CO5				M			
CO6					M		

S-Strong; M-Medium; L-Low

Unit I - Introduction

Introduction to RPA - Overview of RPA - Benefits of RPA in a business environment - Industries & domains fit for RPA - Identification of process for automation - Types of Robots - Ethics of RPA & Best Practices - Automation and RPA Concepts - Different business models for implementing RPA - Centre of Excellence – Types and their applications - Building an RPA team - Approach for implementing RPA initiatives.

Unit II - Automation

Role of a Business Manager in Automation initiatives - Skills required by a Business Manager for successful automation - The importance of a Business Manager in automation - Analyzing different business processes - Process Mapping frameworks - Role of a Business Manager in successful implementation – Part 1 - Understanding the Automation cycle – First 3 automation stages and activities performed by different people

Unit III - Automation Implementation

Evaluating the Automation Implementation Detailed description of last 3 stages and activities performed by different people - Role of a Business Manager in successful completion – Part 2 - Activities to be performed post-implementation - Guidelines for tracking the implementation success - Metrics/Parameters to be considered for gauging success - Choosing the right licensing option - Sending emails - Publishing and Running Workflows

Unit IV – Robot

Ability to process information through scopes/systems - Understand the skill of information processing and its use in business - Leveraging automation - Creating a Robot - New Processes. Establish causality by variable behavior - Understand the skill of drawing inference or establishing causality by tracking the behavior of a variable as it varies across time/referenced variable - Leveraging automation for this skill - Robot & new process creation.

Unit V – Robot Skill

Inference from snapshots of curated terms – Omni-source data curation - Multisource trend tracking - Understand the skill of drawing inference from the behavior of curated terms by taking snapshots across systems in reference to time/variable(s) - Leveraging automation for this skill – Robot creation and new process creation for this skill.

Suggested Readings

Tom Taulli, February 2020. “The Robotic Process Automation Handbook” Apress , Reference Books 1 Steve Kaelble” Robotic Process Automation” John Wiley & Sons, Ltd.

Alok Mani Tripathi, March 2018. “Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool”, Packet Publishing Limited

Websites

1. https://www.tutorialspoint.com/uipath/uipath_robotic_process_automation_introduction.htm
2. https://www.javatpoint.com/rpa 3 https://onlinecourses.nptel.ac.in/noc19_me74/preview

M.Sc. Chemistry **2023-2024**
23CHPOE301

SEMESTER-III

CHEMISTRY IN EVERYDAY LIFE

3H-2C

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

External Semester Exam: 3 Hours

Course Objectives

This course enables the students

- Gain knowledge in the importance of chemistry in food industry.
- To understand the chemistry of medicines and cosmetics.
- To study about chemistry in energy utilization and storage process.
- Know about the chemistry of soaps, detergents and textiles.
- To learn about the chemistry behind the polymers, fuel and agriculture.

Course Outcomes (CO's)

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

COs	Course Outcomes	Blooms Level
CO1	Illustrate the importance of chemistry in food industry.	Apply
CO2	Explain the chemistry of medicines and cosmetics.	Understand
CO3	Utilization of chemistry concepts in energy storage devices	Apply
CO4	Discuss about the chemistry of soaps, detergents and textiles.	Understand
CO5	Apply the concept of chemistry in polymers, fuel and agriculture industry.	Apply

Mapping with Programme Outcomes

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

UNIT - I Importance of Chemistry in food (08 Hours)

Chemicals in food, colouring agents, artificial preservatives, flow stabilizers, binding substance, flavours and sweeteners, antioxidants, minerals, vitamins. Chemistry at the breakfast table, raising agents- gluten, the taste maker- glutamic acid, stimulants-Caffeine, chemistry of onion, garlic and curcumin.

UNIT - II Chemistry in medicines and cosmetics (08 Hours)

Elements in the human body, drugs and their classification, drug-target interaction, action of

different classes of drugs, antiseptics and disinfectants.Cosmetics: Chemistry behind the lotions, fragrances, talcum powder, sunblock and sunscreen, toothpaste, lipsticks, nail polishes.

UNIT - III Chemistry in energy (08 Hours)

Solar energy - fuel from sun light - splitting of water - hydrogen from sunlight - hydrogen economy - fuel cells - batteries - photovoltaics - stealing the sun - nuclear energy - nuclear fission and fusion - production of electricity by a nuclear reactor - radioactivity and the hazards of radioactivity - living with nuclear power.

UNIT - IV Importance of chemistry in soaps, detergents and textiles (06 Hours)

Detergents and soaps, types of soaps and detergents, saponification, cleansing action of soaps and detergents, perfumes used in soaps.Textiles: Chemistry behind wool, silk, jute, cotton, glass fibre, polyester, acrylic, nylon, and other raw materials.

UNIT - V Chemistry of polymers, fuel and agriculture (06 Hours)

Polymers, types, polyethylene, plastics, disposal of plastics, degradation of polymers and plastics using nano materials. Petrochemistry, petrol, diesel, LPG, CNG, kerosene, oils, and other fuels. Agriculture: fertilizers, herbicides, insecticides, and fungicides.

SUGGESTED READINGS

1. Tripathy, S. N., & Sunakar Panda (2004). *Fundamentals of Environmental Studies* Edition). New Delhi: Vrianda Publications Private Ltd.
2. Arvind Kumar (2004). *A Textbook of Environmental Science*. New Delhi: APH Publishing Corporation.
3. Anubha Kaushik, C. P., & Kaushik (2004). *Perspectives in Environmental Studies*. New Delhi: New Age International Pvt. Ltd. Publications.
4. Seymour R. B., & Charles, E. (2003). *Seymour's Polymer Chemistry: An Introduction.* Marcel Dekker, Inc.
5. Stocchi. E, (1990). *Industrial Chemistry* (Vol–I). UK: Ellis Horwood Ltd.
6. Jain, P. C., & Jain, M. (2004). *Engineering Chemistry*. Delhi: Dhanpat Rai & Sons.
7. Sharma, B. K., & Gaur, H. (1996). *Industrial Chemistry.* Meerut: Goel Publishing House.

M.Sc.,Biotechnology **2023-2024**

Semester–III

23BTPOE301 **OPEN ELECTIVE** **3H – 2C**

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

End Semester Exam:3Hours

Course Objectives

The main objectives of the course are

- To apply knowledge and skills of seribiotechnology for development new mulberry variety and silkworm breeds suitable for varied agro-climatic zones.
- To apply tools and techniques of biostatics for critical analysis and interpretation of data accrueded.
- To use bioinformatics tools and techniques for the analysis and interpretation of bimolecular data for better understating mulberry and silkworm.
- To demonstrate communication skills, scientific writing, data collection and interpretation abilities in all the fields of seribiotechnology.
- Thorough knowledge and application of good laboratory and good manufacturing practices in sericulture and biotech industries.
- To demonstrate entrepreneurship abilities, innovative thinking, planning, and setting up small-scale enterprises.

Course Outcomes

On completion of the course, students are able to

COs	Course Outcomes	Blooms Level
CO1	Know the different components and chain link of sericulture industry.	Understand
CO2	Understand concepts of sericulture industry and demonstrate interdisciplinary skills acquired in mulberry plant cultivation and silkworm rearing.	Understand
CO3	Demonstrating the Laboratory and field skills in mulberry cultivation and silkworm rearing with an emphasis on technological aspects.	Create
CO4	To transfer the knowledge and technical skills to the Seri-farmers.	Understand
CO5	To analyze the environmental issues and apply in management of mulberry garden and silkworm rearing at field.	Analyze
CO6	Demonstrate comprehensive innovations and skills in improvement of mulberry and silkworm varieties for betterment of sericulture industry and human welfare.	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S						
CO2		S					
CO3	S						
CO4							
CO5			M				
CO6		M					

S-Strong; M-Medium; L-Low

UNIT I

Introduction to Sericulture - History of Sericulture – Sericulture organization in India, By products of silk industry. Mulberry and Non – mulberry silkworm types–Morphology and Life cycle of Bombyxmori,

UNIT II

Mulberry Cultivation: Mulberry Varieties – Methods of Irrigation –Nutrient Management and Weed control. Pruning and Harvesting – Crop improvement – Me chanism in Moriculture – Pest and Disease, deficiencies and symptoms in Mulberry.

UNIT III

Rearing of silkworm – Rearing Appliances – rearing operation. Harvesting and marketing of cocoons. Cocoon processing and reeling - Appliances used for reeling. Pre reeling process – Cocoon boiling. Reeling technology – re-reeling technology.

UNIT IV

Non – Mulberry Sericulture Scope of Non-mulberry Sericulture - Non-mulberry silk varieties and fauna, tasar, muga, eri – Silk Production and Marketing – Tropical tasar / muga – Morphology, anatomy grainage

UNIT V

Diseases of silkworm –Pebrine Protozoan, Flacheriebacterial,Nuclear Polyhedrosisviral and Muscardine fungal diseases. Pests of Silkworm.

REFERENCES:

1. Krisnamoorthy S., Improved Method of Rearing Young Age Silk Worms: Reprinted by CSB, Bangalore, 1986.

2. Tanaka Y., Sericology, CSB, Pub., Bangalore, 1964.

3. Ullal S.R., and Narasimhan M.N., Hand Book of Practical Sericulture, CSB, Bangalore, 1987.

4. HisaoAruga, Principles of sericulture, Oxford and IBH Publishing Company, 1994.

5. Hrccrama Reddy, G. 1998. Silkworm Breeding, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.

6. Otsuki el.al. 1987. Silkworm Egg Production (Translated from Japanese Language), Oxford wild IBH Publishing Co. Pvt. Ltd., New Delhi.

7. Yasuji Hamamura, 2001 Silkworm Rearing on Artificial Diet (Translated from Japanese Language), Oxford wild IBH Publishing Co. Pvt. Ltd., New Delhi.

8. Mahadevappa, D. Halliyal, V.G., Sankar, D.G and Bhandiwad, R. 2000. Mulberry Silk Reeling Technology, Oxford wild IBH Publishing Co. Pvt. Ltd., New Delhi.

9. Dandin, S.B et.al. 2003. Advances in Tropical Sericulture, National Academy of Sericulture Sciences India, Central Silk Board, Bangalore, India.

10. Ganga G., Sulochanachetty. J. An Introduction of Sericulture. Oxford, New Delhi – 1977.

11. Johnson M., and Kesary M., Sericulture, CSI Press, Marthandam, 2008.

12. Text Book of Tropical Sericulture, Pub., Japan Overseas Volunteers, 1975

23CMPOE301 **PERSONAL FINANCE AND PLANNING** **3H-2C**

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

End Semester Exam: 3 Hours

COURSE OBJECTIVES:

To make the students

- To familiarize with regard to the concept of Investment Planning and its methods
- To examine the scope and ways of Personal Tax Planning;
- To analyze Insurance Planning and its relevance
- To develop an insight in to retirement planning and its relevance.
- To construct an optimal portfolio in real life situations

COURSE OUTCOMES:

Learners should be able to

COs	Course Outcomes	Blooms Level
CO1	Familiarize with regard to the concept of Investment Planning and its methods	Understand
CO2	Examine the scope and ways of Personal Tax Planning;	Analyze
CO3	Analyze Insurance Planning and its relevance	Analyze
CO4	Develop an insight in to retirement planning and its relevance.	Create
CO5	Construct an optimal portfolio in real life situations	Create

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1		S					
CO2	S						
CO3		S					
CO4			M				
CO5	M						
CO6		M					

S-Strong; M-Medium; L-Low

UNIT I

Introduction to Financial Planning - Financial goals, Time value of money, steps in financial planning, personal finance/loans, education loan, car loan & home loan schemes. Introduction to savings, benefits of savings, management of spending & financial discipline, Net banking and UPI, digital wallets, security and precautions against Ponzi schemes and online frauds such as phishing, credit card cloning, skimming.

UNIT II

Investment Planning - Process and objectives of investment, Concept and measurement of return & risk for various assets class, Measurement of portfolio risk and return, Diversification & Portfolio formation. Gold Bond; Real estate; Investment in Greenfield and brownfield Projects; Investment in fixed income instruments- financial derivatives & Commodity market in India. Mutual fund schemes including SIP; International investment avenues.

UNIT III

Personal Tax Planning - Tax Structure in India for personal taxation, Scope of Personal tax planning, Exemptions and deductions available to individuals under different heads of income and gross total income, Special provision u/s 115BAC vis-à-vis General provisions of the Income-tax Act, 1961. Tax avoidance versus tax evasion.

UNIT IV

Insurance Planning - Need for Protection planning. Risk of mortality, health, disability and property. Importance of Insurance: life and non-life insurance schemes. Deductions available under the Income-tax Act for premium paid for different policies.

UNIT V

Retirement Benefits Planning - Retirement Planning Goals, Process of retirement planning, Pension plans available in India, Reverse mortgage, New Pension Scheme. Exemption available under the Income-tax Act, 1961 for retirement benefits.

SUGGESTED READINGS

1. Indian Institute of Banking & Finance. (2017). Introduction to Financial Planning. New Delhi: Taxmann Publication.
2. Pandit, A. (2014). The Only Financial Planning Book that You Will Ever Need. Mumbai: Network Publications Ltd.
3. Sinha, M. (2008). Financial Planning: A Ready Reckoner. New York: McGraw Hill Education.
4. Halan, M. (2018). Let’s Talk Money: You've Worked Hard for It, Now Make It Work for You. New York: HarperCollins Publishers.
5. Tripathi, V. (2017). Fundamentals of Investment. New Delhi: Taxmann Publication.

SEMESTER-III

23EGPOE301 Elective- ENGLISH FOR COMPETITIVE EXAMINATION (THEORY) 3H-2C

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

EndSemesterExam:3Hours

C

Course Objectives

•To train learners to crack competitive exams
•To know of various tools that is essential for Competitive Exams
•To enhance their ability to speak in English and face an interview.
•To make the student apply, prepare and clear the competitive exams.
•To prepare the student to concentrate, stay positive and confident.
•To take even failure at ease and continue the target of clearing competitive exams.

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	The student may settle in life with a government job.	Apply
CO2	The student may develop various skills	Understand
CO3	The successful student may guide other students to success.	Understand
CO4	Analyse logical reasoning questions, error analysis, and correct usage of words.	Analyse
CO5	Develop the knowledge of grammatical system of English language.	Apply
CO6	Elaborate on the correct structure of sentence	Understand

MMapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

UNIT I Grammar

Number-Subject, Verb and Agreement-Articles-Sequences of Tenses-Common Errors

UNIT II Word Power

Idioms and Phrases-One word Substitution-Synonyms-Antonyms-Words often confused

UNIT III Paragraph

Expansion of an idea

UNIT IV Writing

Essay- Letters-Memos-Agenda-Resume writing

UNIT V Speaking

Public Speaking-Group discussion-Interview-Spoken English

SUGGESTED BOOKS

V. Saraswathi, Maya K. Mudbhatkal (2014). English for Competitive Examinations. Emerald: Chennai.

M.Sc Computer Science **2023-2024**
23CSPOE301

SEMESTER-III
CYBER FORENSICS
(THEORY) **3H – 2C**

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

Course Objectives
To understand about computer forensics and investigations.
To know about digital evidence and crime.
To analyse and validate forensics data.
To know about e-mail investigation.
To understand about Mobile device forensics.

Course Outcomes (COs)
At the end of this course, students will be able to

COs	Course Outcomes	Blooms Level
CO1	Define, understand and explain various investigation procedures and summarize duplication of digital evidence.	Remember
CO2	Apply the knowledge of digital evidences.	Understand
CO3	Design and develop various forensics tools and analyse the network forensics.	Create
CO4	Demonstrate the systematic study of high-tech forensics	Understand
CO5	Understand the importance of reports.	Evaluate

Mapping with Programme Outcomes

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

S-Strong; M-Medium; L-Low

Unit I – Computer forensics and investigations **(7 HOURS)**
Computer forensics and investigations as a profession – Preparing for computer investigations – Taking a systematic approach–Procedures for corporate high-tech investigations–Data recovery work stations and software– Conducting an investigation.

Unit II – Data Acquisition **(7 HOURS)**
Data acquisition – Storage formats for digital evidence – Validating data acquisitions – Processing crime and incident scenes–Identifying digital evidence–Collecting evidence in private sector incident scenes – Preparing for search-seizing digital evidence at the scene-storing digital evidence –Reviewing a case.

Unit III – Computer Forensics Tools **(7 HOURS)**
Current computer forensics tools–Software tools–Hardware tools–The Macintosh file structure and boot process – Computer forensics analysis and validation – Addressing data – Hiding techniques.

Unit IV – Network Forensics **(7 HOURS)**

Virtual machines – Network forensics – Developing standard procedures – Live acquisitions – email investigations – Investigating e-mail crimes and violations – Understanding e-mail servers – Cell phone and mobile device forensics.

Unit V – Mobile Device Forensics **(8 HOURS)**

Understanding mobile device forensics – Acquisition procedures –Report writing for high-tech investigations – Importance of reports – Guidelines for writing reports –Expert testimony in high-tech investigations.

SUGGESTED READINGS

1. Bill Nelson, Amelia Phillips and Christopher Steuart. (2018). Computer Forensics and Investigations, Cengage Learning, 5th Edition.
2. Eoghan Casey. (2017). "Handbook of Digital Forensics and Investigation", Academic Press, 1st Edition,
3. John R Vacca,.(2016)."Computer Forensics", Cengage Learning, 2nd Edition.

WEB LINKS

1. www.cps.brockport.edu/~shen/cps301/figures/figure1.pdf
2. www.forensicsguru.com/devicedataextractionsimcell.php
3. www.nptel.ac.in/courses/106101060
4. www.samsclass.info/121/ppt/ch11.ppt
5. www.garykessler.net/library/role_of_computer_forensics.html
6. www.ukessays.com/essays/information-technology/computer-forensics-and-crime investigations-information-technology-essay.php

M.Sc. Mathematics **2023-2024**
23MMPOE301

SEMESTER-III

CODING THEORY **3H-2C**

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

Course Objectives

This course enables the students to learn

- Elements of coding theory and its applications.
- Understand the concept of bounds in coding theory.
- About the encoding and decoding.
- Analyze the concept of cyclic coding
- Acquiring the knowledge special cyclic codes.

Course Outcomes

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

COs	Course Outcomes	Blooms Level
CO1	Recognize the basic concepts of coding theory.	Apply
CO2	Understand the importance of finite fields in the design of codes.	Understand
CO3	Detect and correct the errors occur in communication channels with the help of methods of coding theory.	Apply
CO4	Apply the tools of linear algebra to construct special type of codes.	Apply
CO5	Use algebraic techniques in designing efficient and reliable data transmission methods.	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1							**S**			
CO2							**S**			
CO3							**S**			
CO4							**S**			
CO5							**S**			

S-Strong; M-Medium; L-Low

UNIT I - ERROR DETECTION, CORRECTION AND DECODING

Communication channels – Maximum likelihood decoding – Hamming distance – Nearest neighbourhood minimum distance decoding – Distance of a code.

UNIT II - LINEAR CODES

Linear codes – Self orthogonal codes – Self dual codes – Bases for linear codes – Generator matrix and parity check matrix – Enconding with a linear code – Decoding of linear codes – Syndrome decoding.

UNIT III - BOUNDS IN CODING THEORY:

The main coding theory problem – lower bounds - Sphere covering bound – Gilbert Varshamov bound – Binary Hamming codes – q-ary Hamming codes – Golay codes – Singleton bound and MDS codes – Plotkin bound.

UNIT IV - CYCLIC CODES:
Definitions – Generator polynomials – Generator matrix and parity check matrix – Decoding of Cyclic codes.

UNIT V - SPECIAL CYCLIC CODES:
BCH codes – Parameters of BCH codes – Decoding of BCH codes – Reed Solomon codes.

SUGGESTED BOOKS

- San Ling and Chaoping Xing (2004). Coding Theory: A first course, Cambridge University Press.
- Lin. S & Costello. D. J. (1983). Jr., Error Control Coding: Fundamentals and Applications, Prentice-Hall, Inc., New Jersey.
- Vera Pless (1982). Introduction to the Theory of Error Correcting Codes, Wiley, New York.
- Berlekamp E.R. (1968). Algebriac Coding Theory, Mc Graw-Hill.
- H. Hill (1986). A First Course in Coding Theory, OUP.

WEB LINKS

1. https://www.youtube.com/watch?v=XepXtl9YKwc
2. https://www.youtube.com/watch?v=oeQWxhlnCHM
3. https://www.youtube.com/watch?v=Z-QGtxlQWak

M B A	22MBAPOE301	ORGANIZATIONAL BEHAVIOUR	Semester – III 3 H – 2C

Instruction Hours / week: L: 3 T: 0 P: 0 **Marks: Internal: 50** **Total: 50**

2022-2023

COURSE OBJECTIVES:

To make the students

- To understand the basic concepts of organizational behavior.
- To analyze the individual behavior traits required for performing as an individual or group.
- To obtain the perceiving skills to judge the situation and communicate the thoughts and ideas.
- To understand how to perform in group and team and how to manage the power, politicsandconflict.
- To recognize the importance of organizational culture and organizationalchange.
- To realise the importance of groups and teamwork and managing of conflict between themembers ofthe organization

COURSEOUTCOMES:

Learners should be able to

COs	Course Outcomes	Blooms Level
CO1	Analyse organizational behavior issues in the context of the organizational behavior theories and concepts.	Apply
CO2	Assess the behavior of the individuals and groups in organization and manage the stress.	Understand
CO3	Manage team, power, politics and conflict arising between the members.	Apply
CO4	Explain how organizational change and culture affect the working relationship within organizations.	Apply
CO5	Understand and exhibit the communication skills to convey the thoughts and ideas of case analysis to the individuals andgroup.	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1							S			
CO2							S			
CO3							S			
CO4							S			
CO5							S			

S-Strong; M-Medium; L-Low

UNIT I Organization behaviour : Introduction

Organization Behavior: Meaning and definition - Fundamental concepts of OB - Contributing disciplines to the OB field – OB Model - Significance of OB in the organization success - Challenges and Opportunities for OB.

UNIT II Behaviour and Personality

Attitudes – Sources - Types - Functions of Attitudes. Values – Importance - Types of Values. Personality – Determinants of personality- Theories of Personality - psycho-analytical, social learning, job-fit, and trait theories.

UNIT III Perception

Perception – factors influencing perception - Person Perception – Attribution Theory – Frequently Used Shortcuts in Judging Others- Perceptual Process- Perceptual Selectivity - Organization Errors of perception – Linkage between perception and Decision making.

UNIT IV Group and Stress Management

Foundation of Group Behavior - Types of Groups - Stages of Group Development - Group Norms - Group Cohesiveness – Stress – Causes of stress – Effects of Occupational Stress- Coping Strategies for Stress.

UNIT V Organization Culture and Change

Organizational culture- Characteristics of Culture- Types of Culture – Creating and Maintaining an Organizational Culture. Organizational change – Meaning - Forces for Change - Factors in Organizational Change - Resistance to change- Overcoming resistance to change.

SUGGESTED READINGS:

1. Fred Luthans. (2017). *Organizational Behavior: An Evidence - Based Approach*, 12th edition,Mcgraw Hill Education, NewDelhi.
2. Steven Mcshane and Mary Ann VonGlinow (2017), *Organizational Behavior*, 6th edition, McGrawHill Education, NewDelhi
3. Robbins, S. P., and Judge, T.A. (2016). *Organizational Behaviour*.(16th edition).New Delhi: PrenticeHall of India.
4. Laurie J. Mullins (2016), *Management and Organisationalbehaviour*, 10th edition, PearsonEducation, NewDelhi
5. Robbins, S. P., and Judge, T.A. (2016). *Essentials of Organizational Behavior*.13 edition, PearsonEducation.

E- Resources:

- https://nptel.ac.in/courses/110/105/110105033/

SEMESTER – III

OPEN ELECTIVE

23PHPOE301 TERIALS CHARACTERIZTION 3H--2C

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

End Semester Exam: 3 Hours

Course Objectives

- To Study materials is always important, for any application, including fabrication of satellites.
- To introduce various methods available for characterizing the materials. The characterization of materials specifically addresses that portfolio with which researchers and educators must have working familiarity.
- To provide an introduction to materials characterization and its importance
- To discuss different types of characterization techniques and their uses.
- To introduce the students to the principles of optical and electron microscopy, X-ray diffraction and various spectroscopic techniques Introduction:
- To understand the materials characterization and available techniques

Course Outcomes (COs)

After completing the course the students will / can able to

COs	Course Outcomes	Blooms Level
CO1	Handle with X-ray, thermal, microscopic, and electrical methods of characterization.	Apply
CO2	Understand and describe the fundamental principles behind the methods of characterization which are included in the curriculum	Understand
CO3	Analyze, interpret and present observations from the different methods.	Apply
CO4	Evaluate the uncertainty of observations and results from the different methods.	Apply
CO5	Understand the history of materials science with basic understanding of metals, binary alloys, magnetic materials, dielectric materials and polymers	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1							**S**			
CO2				**S**						
CO3				**S**						
CO4							**S**			
CO5					**S**					

S-Strong; M-Medium; L-Low

UNIT -1 X-ray techniques for materials characterization X-ray diffraction: Principle, measuring system and applications for characterization of powdered materials. X-ray diffraction profile and analysis: FWHM and line broadening, Crystallite size effect and Scherrer formula, Effect of strain (tensile vs compressive, uniform vs. non-uniform) Introduction to Extended X-ray absorption fine structure (EXAFS), Surface extended X-ray absorption (SEXAFS).

UNIT - II Microscopic techniques Principles, instrumentations and applications of Optical microscope, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM) for characterization of different samples. Energy dispersive X-ray microanalysis (EDS) - Basic aspects of Atomic force microscopy (AFM).

UNIT - III Spectroscopic methods Principle, instrumentation and applications of UV-Visible Diffuse Reflectance (UV-Vis DRS) spectroscopy, Ft-Ir, Raman and Fluorescence spectroscopy. Hand of experience on operation of UV-Vis-DRS, FT-IR, Raman and data analysis..

UNIT -IV Thermoanalytical Methods Principle, instrumentation and applications of Thermogravimetric Analysis (TGA), Differential Temperature Analysis (DTA) and Differential Scanning Calorometry (DSC). Factors affecting the TGA/DTA/DSC results and their interpretations. Hand on on experience of operation of TG/DSC and data analysis.

UNIT -V Electroanalytical Techniques Voltammetric principles, hydrodynamic voltammetry, stripping voltammetry, cyclic voltammetry, criteria of reversibility of electrochemical reactions, quasi-reversible and irreversible processes, qualitative and quantitative analysis current-potential relation applicable for Linear Sweep Voltammetry (LSV) and Cyclic Voltammetry (CV), interpretation of cyclic voltammograms and parameters obtainable from voltammograms. Hand on experience on operation of CV and data analysis.

SUGGESTED READINGS:

1) Theory and Applications of UV Spectroscopy, H.H.Jaffe and M.Orchin, IBH-Oxford.
2) Inorganic spectroscopic methods, A.K. Brisdon, Oxford Chem. Primers, 1997, New York.
3) Applied Electron Spectroscopy for Chemical Analysis Ed. H. Windawi and F.L.Ho, Wiley Inter science.
4) Introduction to Spectroscopy, Pavia, Brooks/Cole Cenage, 4th edition, 2009, Belmont.
5) Introduction to Photoelectron Spectroscopy, P.K.Ghosh, John Wiley.
6) Fundamental of Molecular Spectroscopy, C. N. Banwell and E. McCash, Tata McGraw Hill, 4th edition, 1994, New Delhi.

SEMESTER – III

OPEN ELECTIVE

23PHPOE302 NUMERICAL METHODS AND PROGRAMMING 3H-2C

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

End Semester Exam: 3 Hours

Course Objectives

- Computational physics may be broadly defined as 'the science of using computers to assist in the solution of physical problems, and to further physics research.
- To equip the students of M.Sc. Physics with knowledge of programming in C, roots of equation, interpolation, curve fitting, numerical differentiation, numerical integration, solution of ordinary differential equations
- To introduce students to computational methods for simulating physical systems and solving problems arising in physics and astronomy, as well as in other related fields
- Computers now play a role in almost every branch of physics like large scale quantum mechanical calculations in nuclear, atomic, molecular and condensed matter physics, large scale calculations in such fields as hydrodynamics, astrophysics, plasma physics, meteorology and geophysics etc.
- The huge increase in the power of computers in recent years has made an impact on the role of computational physics.
- This paper gives idea about different types of computations involved in Physics, like curve fitting, interpolation, extrapolation, numerical calculations etc.

Course Outcomes (COs)

After completing the course the students will/able to

COs	Course Outcomes	Blooms Level
CO1	Programme numerical methods and their implementation like applying to problem in	Apply
CO2	physics, including modeling of classical physics to quantum system as well as data analysis (Linear and non linear).	Understand
CO3	Analysis techniques for propagating error, representing data graphically. Create, solve and interpret basic mathematical tool.	Apply
CO4	Program independently computers using leading-edge tools,	Apply
CO5	formulate and computationally solve a selection of problems in physics,	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1			**S**							
CO2			**S**							
CO3							**S**			
CO4				**S**						
CO5							**S**			

S-Strong; M-Medium; L-Low

UNIT – 1

Errors, different type of errors. Representation of numbers in computer, computer arithmetic, zero in floating point number.

UNIT – 2

Operators –finite differences, average, differential, etc., their inter-relations. Difference of polynomials. Difference equation. Interpolation. Lagrange's methods, error terms. Uniqueness of interpolating polynomial.

UNIT – 3

Newton's fundamental interpolation. Forward, backward and central difference interpolations. Interpolation by iteration. Spline interpolation, comparison with Newton's interpolation. Hermite's interpolation. Bivariate interpolation, Lagrange and Newton's methods. Inverse interpolation.

UNIT -4

Approximation of function. Least square method. Use of orthogonal polynomials. Approximation by Chebyshev polynomials, Max-min principle. Economization of power series.

UNIT- 5 :

Python Programming –Loops- Conditional statements- Functions- Object-oriented programming- Array computing- 2 and 3d visualizations

SUGGESTED READINGS:

1. E. Balagurusamy, "Numerical Methods", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1999
2. W.H. Press, B.P. Flannery et al., "Numerical Recipes: Art of Scientific Computing", 3rd Edition, Cambridge Press, 2007.
3. J. M. Mathews and K. Fink, "Numerical Methods using MATLAB ", 4rd Edition, Prentice Hall Publication, 2004
4. Dr. B.S. Grewal, "Numerical Methods in Engineering and Science ", Khanna Publication.
5. Robert J schilling, Sandra l harries , " Applied Numerical Methods for Engineers using MATLAB and C.", Thomson Brooks/cole.
6. Richard L. Burden, J. Douglas Faires, "Numerical Analysis", Thomson / Brooks/cole
7. John. H. Mathews, Kurtis Fink ,"Numerical Methods Using MATLAB" ,Prentice Hall publication
8. JAAN KIUSALAAS , "Numerical Methods in Engineering with MATLAB", Cambridge Publication
9. https://archive.nptel.ac.in/content/

Semester - III

23MBP391	**INTERNSHIP PROGRAMME**	**2C**

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

Semester – IV

23MBP491	**PROJECT VIVA VOCE**	**15C**

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