# M.Sc. MICROBIOLOGY

## CHOICE BASED CREDIT SYSTEM (CBCS)

## Curriculum and Syllabus

## Regular (2025 – 2026)

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

**DEPARTMENT OF MICROBIOLOGY**

**FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT**


**KARPAGAM ACADEMY OF HIGHER EDUCATION**
**(Deemed to be University,Established Under Section 3 of UGC Act, 1956)**
**(Accredited with A+ Grade by NAAC in the second cycle)**
**Eachanari (Post), Coimbatore – 641 021.**
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**FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT**

**POST – GRADUATE PROGRAMMES**

**(REGULAR PROGRAMME)**

**REGULATIONS**

**(2025)**

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**Coimbatore - 641 021, Tamil Nadu, India**

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

## REGULAR MODE
## CHOICE BASED CREDIT SYSTEM (CBCS)

## REGULATIONS - 2025

**The following regulations shall apply to candidates admitted to Postgraduate (PG) Programmes in the Faculty of Arts, Science, Commerce and Management, Karpagam Academy of Higher Education (KAHE) from the academic year 2025-2026 onwards.**

### 1. PROGRAMMES OFFERED, MODE OF STUDY AND ADMISSION REQUIREMENTS

### 1.1. PG PROGRAMMES OFFERED

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

| S. No. | Programmes Offered |
|---|---|
| 1 | M.Sc. Microbiology |
| 2 | M.Sc. Biotechnology |
| 3 | M.Sc. Physics |
| 4 | M.Sc. Chemistry |
| 5 | M.Sc. Computer Science |
| 6 | M.Com. |

### 1.2. MODE OF STUDY

All Programmes are offered under Full-Time Regular mode.

### 1.3. ADMISSION 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 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. | Programme | Eligibility |
|---|---|---|
| 1 | M.Sc. Microbiology | B.Sc. Microbiology / Applied Microbiology / Industrial Microbiology / Medical Microbiology / Botany / Zoology / Biology / Biotechnology /Industrial Biotechnology/ Molecular Biology / Genetic Engineering / Biochemistry / Agriculture / Forestry / Medical Lab Technology / Life Sciences |
| 2 | M.Sc. Biotechnology | B.Sc. Degree with Biotechnology/ Industrial Biotechnology/ 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)/ Medical Biochemistry |
| 3 | M.Sc. Physics | B.Sc. Physics, B.Sc. Physics (CA) / B.Sc. Applied Sciences |
| 4 | M.Sc. Chemistry | B.Sc. Chemistry, Industrial Chemistry, Polymer Chemistry, B.Sc. Applied Sciences |
| 5 | M.Sc. Computer Science | B.Sc. Computer Science / B.Sc Computer Science related programmes / BCA/ B.Sc.Mathematics/ B.E/B.Tech Computer Science related programmes. |
| 6 | M.Com. | B.Com. / B.Com.(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 |

## 2. DURATION OF THE PROGRAMMES

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

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

**2.2.** Each semester normally consists of 90 working days or 450 instructional hours of study. End Semester Examination shall be conducted at the end of every semester for the respective courses.

## 3. CHOICE BASED CREDIT SYSTEM

Credits means the weightage given to each course of study by the experts of the Board of Studies concerned. All PG Programmes are offered under Choice Based Credit System with a minimum of 90 and up to a maximum of 94 credits.

## 4. STRUCTURE OF THE PROGRAMME

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

### 4.1. Major courses

Major Courses consist of theory and practical components of department domains.

### 4.2. Core Elective courses

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

### 4.3. Project Work

The project work shall start at the beginning of the Fourth semester in the Department/Industry/Research Institute (National/International) and the project report has to be submitted at the end of the fourth semester. The Head of the Department concerned shall assign a project supervisor who in turn shall monitor the project work of the student.

If the student undertakes the project work outside the Department, the faculty concerned within the Department shall be the Supervisor and the teacher/scientist of the host institute will be the Co-supervisor. The student shall bring the attendance certificate from the place where the project work was carried out.

A Project Assessing Committee (PAC) shall be constituted with HoD and two senior faculty members of the Department. The PAC shall announce the dates for the reviews and demonstration. Three reviews shall be conducted as part of internal assessment. The student shall make a presentation on the progress and demonstration of their project before the PAC in the presence of their supervisor on the scheduled dates.

### 4.4. Internship

The student shall undergo 15 days internship at 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. The Internship will be assessed internally and marks will be awarded out of 100.

### 4.5. Open Elective

The student may select one of the open elective courses offered by other departments in the third semester (List is given below). Students have to earn 2 credits from this course (The student cannot select a course offered by the parent department).

| S.No. | Name of the offering Department | Course Code | Course Name |
|---|---|---|---|
| 1 | English | 25EGPOE301 | English for Competitive Examinations |
| 2 | Commerce | 25CMPOE301 | Personal Finance and Planning |
| 3 | Management | 25MBAPOE301 | Organizational Behavior |
| 4 | Computer Applications | 25CAPOE301 | Robotic Process Automation |
| 5 | Computer Science | 25CSPOE301 | Cyber Forensics |
| 6 | Mathematics | 25MMPOE301 | Coding Theory |
| 7 | Physics | 25PHPOE301 | Electrical Appliances and Servicing |
| 8 | Chemistry | 25CHPOE301 | Industrial Chemistry |
| 9 | Microbiology | 25MBPOE301 | Fermentation Technology |
| 10 | Biotechnology | 25BTPOE301 | Nutrition and Dietetics |

## 5. ADVANCED LEARNERS AND ON-DEMAND EXAMINATION

Students who secure 7.5 CGPA and maintain an attendance of 80% in every semester and clear all the courses in their first appearance itself are referred to

as advanced learners. When a student fails to maintain any of the above conditions at any given time, the student cannot be an advanced learner further.

These students can request for an on-demand examination for the courses from second semester onwards. These students on prior registration can appear for examinations and complete all required courses well ahead of the prescribed duration of study and can progress for a full time Research Project / Internship / Minor Project during the remaining prescribed period of study. The Internal and External examinations will be conducted for these courses as like the other courses. One or more faculty mentors shall be allocated based on the number of students / courses enrolled for the on-demand examination. When the number of students enrolled for a particular course is less than 30, only self-learning mode is applicable and will be monitored by the mentor. Otherwise, a faculty will handle the course after regular working hours. The examination will be conducted along with the current semester courses in the same exam pattern.

Also, these advanced learners can register for online courses from NPTEL/SWAYAM/SWAYAM Plus portals on prior and proper approval from the department. The credits earned from those courses will be transferred to the mark statement of the students as in Clause 6.

## 6.TRANSFER OF CREDITS EARNED THROUGH ONLINE PLATFORM / INTERNATIONAL STUDIES

Students are encouraged to enroll in courses offered by NPTEL/Swayam/ Swayam Plus platforms and international institutions of higher learning, either virtually or in person. The equivalent credits for these courses will be determined by a committee named Subject & Grade Equivalence Committee comprising the Dean of the Faculty as Chairman, Dean (R&D, Industrial Relations), Head of the Department (HoD), and one faculty member nominated by the Vice Chancellor as members. The committee's decision will be submitted for ratification/approval by the Board of Studies (BoS) and the Academic Council. If the student fails in NPTEL/Swayam/ Swayam Plus course, he/she can appear for the examination conducted by the University for the equivalent course in the curriculum.

## 7. MEDIUM OF INSTRUCTION

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

## 8. SCHEME OF EXAMINATION

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

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

### 8.2 Marks for Project work

| S. No | Programme | Maximum Marks | CIA | ESE |
|---|---|---|---|---|
| 1 | M.Sc., and M.Com., | 200 | 80 | 120 |

## 9. 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 students' periodically (once in 2 weeks) on the Notice Board to enable the students to know their attendance status and satisfy clause **13** of this regulation.

## 10. ONLINE COURSE COORDINATOR

To help students for planning their online courses and for general orientation on online courses, the HoD shall nominate a coordinator for the online courses. The Online course coordinator shall identify the courses which students can select for their programme from the available online courses offered by different agencies periodically and inform the same to the students. Further, the coordinators shall orient the students regarding the online courses and monitor their participation.

## 11. CLASS COMMITTEE

Every class shall have a Class Committee consisting of the faculty members of various courses of the class concerned, student representatives (Minimum 2 boys and 2 girls of various capabilities and Maximum of 6 members) and the concerned HoD / senior faculty as Chairperson. The objective of the Class Committee Meeting is all about the teaching – learning process. The Class

Committee shall be convened at least once in a month. The constitution and 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 classroom 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.

## 12. COURSE COMMITTEE FOR COMMON COURSES

Each common course offered to more than one programme or department shall have a "Course Committee" comprising all the teachers handling the common course with one of them nominated as Course Coordinator. The nomination of the course coordinator shall be made by the respective Dean depending upon whether all the teachers handling the common course belong to a single department or to various other departments. The 'Course Committee' shall meet in order to arrive at a common scheme of evaluation for the tests to ensure a uniform evaluation of the tests. If feasible, the course committee shall prepare a common question paper for the Internal Assessment Test(s). The Course Committee Meeting is conducted once in a semester. To indicate the common course, the Course Code should be suffixed with the letter "G".

## 13. ATTENDANCE REQUIREMENTS TO APPEAR FOR THE END SEMESTER EXAMINATION

13.1 Every student is expected to attend all classes and should secure 100% attendance. However, in order to allow for certain unavoidable circumstances, the student is expected to have at least 75% of attendance and the conduct of the candidate has been satisfactory during the Programme.

13.2. A candidate who has secured attendance between 65.00% and 74.99% (both included), due to medical reasons (Hospitalization / Accident / Specific Illness) shall be given exemption from prescribed minimum attendance requirements and shall be permitted to appear for the examination on the recommendation of the Head of Department concerned and the Dean. The Head of Department has to verify and certify the genuineness of the case before recommending it to the Dean concerned. However, the candidate has to execute an undertaking and the parent along with the student should assure that this situation does not arise in the future. This permission is given only once during the entire period of study.

13.3. A candidate who has secured attendance between 55.00% and 64.99% (both included), due to medical reasons (Hospitalization / Accident / Specific Illness with all the medical records, bills and discharge summary), will not be presented to that semester examination. However, that candidate will be permitted to go to the next semester wherein he / she has to compensate for the previous semester's lack of attendance. In such a case, the candidate will be permitted to write both semester examinations at the end of the next semester. This combination of lack of attendance can be done only between subsequent semesters. That is 1 & 2 or 2 &3 or 3&4 or 4&5 or 5&6.

13.4. However, a Student who has secured less than 55% in any of the semesters due to any reasons, shall not be permitted to appear for the End Semester Examinations. But he/she will be permitted to appear for his/her arrear examinations. In order to redo the semester with lack of attendance, he/she has to attend the corresponding semester of the subsequent year(s) with approval of the Dean of the Faculty, Dean - Students Affairs and the Registrar.

## 14. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

**14.1**. **Attendance and Assessment:** Every Faculty is required to maintain an **Attendance and Assessment Record (Log book)** which consists of attendance of students marked for each lecture/practical/ project work, the CIA and Seminar marks and the record of class work completed (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 the date after due verification. The same shall be submitted every fortnight to the respective Dean. After the completion of the semester, the HoD should keep this record in safe custody for five years as records of attendance and assessment and shall be submitted for inspection as and when required by the KAHE/any other approved body.

**14.2. Continuous Internal Assessment (CIA)**: The performance of students in each course will be continuously assessed by the respective faculty. 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:

**For Theory Courses**

| S. No. | Category | Maximum Marks |
|---|---|---|
| 1 | Attendance | 5 |
| 2 | Seminar | 15 |
| 3 | Test – I (2 ½ units) | 10 |
| 4 | Test – II (2 ½ units) | 10 |
| | **Total** | 40 |

**For Community Engagement and Social Responsibility:**

| S. No. | Category | Maximum Marks |
|---|---|---|
| 1. | Field Visit | 15 |
| 2. | Attendance | 5 |
| 3. | Test – I (1 ½ Units) | 10 |
| 4. | Test – II (1 ½ Units) | 10 |
| | **Total** | 40 |

**For Internship:**

| S. No. | Category | Maximum Marks |
|---|---|---|
| 1. | Internship Report | 50 |
| 2. | Presentation | 30 |
| 3. | Viva Voce | 20 |
| | **Total** | **100** |

**For Practical Courses:**

| S. No. | Category | Maximum Marks |
|---|---|---|
| 1 | Attendance | 5 |
| 2 | Observation work | 5 |
| 3 | Record work | 5 |
| 4 | Internal Practical Assessment | 15 |
| 5 | *Viva – voce* [Comprehensive]* | 10 |
| | **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.

### 14.3 Pattern of Test Question Paper

**Theory Courses:**

**Maximum Marks :** 60* **Duration:** 2 ½ Hours

| Section | Marks |
|---|---|
| Part – A | Answer ALL the Questions (6 x 2 = 12 Marks) |
| Part - B | Answer ALL the Questions (3 x 6 = 18 Marks) (‘either – or’ type ) |
| Part - C | Answer ALL the Questions (3 x 10 = 30 Marks) (‘either – or’ type ) |

***** The 60 Marks is converted to 10 Marks.

### 14.4 Attendance

**Marks Distribution for Attendance**

| S. No. | Attendance (%) | Maximum Marks |
|---|---|---|
| 1 | 91 and above | 5 |
| 2 | 81 - 90 | 4 |
| 3 | 75-80 | 3 |

## 15. ESE EXAMINATIONS

**15.1 End Semester Examination (ESE)**: ESE will be conducted at the end of each semester for each course. The question paper is for a maximum of 100 marks.

### 15.2 Pattern of ESE Question Paper

**Theory Courses:**
**Maximum Marks: 100*** **Duration: 3 Hours**

| Section | Marks |
|---|---|
| Part – A | Answer ALL the Questions (10 x 2 = 20 Marks) |
| Part - B | Answer ALL the Questions (5 x 6 = 30 Marks)<br>( 'either – or' type ) |
| Part - C | Answer ALL the Questions (5 x 10 = 50 Marks)<br>('either – or' type ) |

***** The 100 Marks is converted to 60 Marks.

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

| S. No. | Category | Maximum Marks |
|---|---|---|
| 1. | Experiments | 40 |
| 2. | Record work | 10 |
| 3. | *Viva – voce* [Comprehensive] | 10 |
| | **Total** | **60** |

**Record Notebooks for Practical Examination**
Candidates taking the Practical Examination should submit a prescribed Bonafide Record Notebook 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.

### 15.3. Evaluation of Project Work

**15.3.1** The project shall carry a maximum mark as per (vide clause 8.2). ESE will be a combined evaluation of Internal and External Examiners.
The distribution of marks for the Continuous Internal Assessment (CIA) are given below:

**Maximum Marks: 80**

| S. No. | Category | Maximum Marks |
|---|---|---|
| 1. | Problem Selection | 20 |
| 2. | Progress of the work (3 reviews X 10 marks) | 30 |
| 3. | Presentation of the work (3 reviews X 10 marks) | 30 |
| | **Total** | **80** |

The pattern of distribution of marks for the End Semester Examination are given below:

**Maximum Marks: 120***

| S. No. | Category | Maximum Marks |
|---|---|---|
| 1. | Project Report | 60 |
| 2. | Project Presentation | 40 |
| 3. | Viva Voce | 20 |
| | **Total** | **120*** |

***Combined valuation of Internal and External Examiners.

**15.3.2** 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

**15.3.3** 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.

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

If a student 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. The resubmitted report shall be evaluated in the subsequent semester.

**15.3.5** Copy of the approved project report after the successful completion of *viva voce* examinations, shall be kept in the KAHE library.

## 16. PASSING REQUIREMENTS

**16.1** Passing minimum: A student needs to secure a minimum of 20 marks out of 40 marks in CIA and 30 marks out of 60 marks in ESE. The overall passing minimum in each course is 50 marks out of 100 marks.

**16.2** If a student fails to secure a pass in a particular course (either CIA or ESE or Both) as per clause 16.1, it is mandatory that the student has to register and reappear for the examination in that course during the subsequent semester when examination is conducted for the same till the student receives pass both in CIA and ESE (vide Clause 2.1).

**16.3** The CIA marks secured by the student in the first passed attempt shall be retained by the Office of the Controller of Examinations and considered valid for all subsequent attempts till the student secures a pass in ESE.

**16.4** Students failed in internal assessment will be permitted to reappear to pass the internal assessment in the subsequent semesters by writing tests and by re-submitting Assignments/ Seminars.

The distribution of marks for this test shall be as given below.

| S. No. | Category | Maximum Marks |
|---|---|---|
| 1. | Attendance (Retained from the respective semester) | 5 |
| 2. | Seminar | 15 |
| 3. | Test* | 20 |
| | **Total** | **40** |

* Test shall be conducted in the ESE pattern for 100 marks and converted to 20 marks.

The examination must be completed within six weeks from the reopening date of the subsequent semester.

**16.5** A Student 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

## 17. ONLINE EXAMINATIONS

The students who are going for Project / Internship / Coursework at National level are permitted to write their CIA test through Online Mode and ESE in Offline/Online mode. When they go for an International Project / Internship / Coursework, both the CIA and ESE shall be conducted through online mode.

## 18. IMPROVEMENT OF MARKS IN THE COURSE ALREADY PASSED

The Students 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.

## 19. AWARD OF LETTER GRADES

All assessments of a course will be done on an absolute marks basis. However, for the purpose of reporting the performance of a student, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the student 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+ | 61 - 70 | 7 | GOOD |
| B | 56 - 60 | 6 | AVERAGE |
| C | 50 - 55 | 5 | PASS |
| RA | Below 50 | - | REAPPEARANCE |
| AAA | - | - | ABSENT |

## 20. 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 obtained.
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.

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

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

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

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

where,

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

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

## 21. REVALUATION

Candidates can apply for revaluation or retotaling 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.

## 22.TRANSPARENCY AND GRIEVANCE COMMITTEE

Revaluation and Retotaling are allowed on representation (clause 21). Students may get the Xerox copy of the answer script on payment of prescribed fee, if he / she wishes. The student may represent the grievance, if any, to the Grievance Committee, which consists of Dean of the Faculty, (if Dean is HoD, the Dean of another Faculty nominated by the KAHE), the HoD of Department concerned, the faculty of the course and Dean from other discipline nominated by the KAHE and the CoE. If the Committee feels that the grievance is genuine, the script may be sent for external valuation; the marks awarded by the External examiner will be final. The student has to pay the prescribed fee for the same.

## 23. 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 4 and gained the required number of total credits as specified in the curriculum corresponding to his / her Programme within the stipulated period.
- No pending disciplinary enquiry/ action against him/her.
- The award of the degree must be approved by the Executive Council.

## 24.CLASSIFICATION OF THE DEGREE AWARDED

**24.1.** Students who qualify for the award of the Degree (vide clause 23) 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.**

**24.2** Students who qualify for the award of the Degree (vide clause 23) having passed the examinations 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**.

**24.3** All other students (not covered in clauses 24.1 and 24.2) who qualify for the award of the degree (vide Clause 23) shall be declared to have passed the examination in **Second Class**.

## 25. RANKING

Candidates who qualify 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.

## 26. SUPPLEMENTARY EXAMINATION

Supplementary Examination will be conducted only for the final semester students within ten days from the date of publication of results for 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.

## 27.DISCIPLINE

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

**27.2.** 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.

## 28. KAHE ENTRANCE EXAMINATION

At the end of Fourth Semester, the KAHE Entrance Examinations will be conducted for those who are aspiring for Higher Education (Ph.D).

## 29. 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,** | |

## 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.

**PROGRAMME OUTCOMES (PO)**

PO1: Discipline knowledge: Understand and apply the concepts in Microbiology and to comprehend the fundamentals various disciplines in Microbiology.

PO2: Critical Thinking Skills: Critically analyse the claims and evidences on epidemic microbe-based diseases and environmental issues, formulate alternative microbe-based therapies and remediation.

PO3: Scientific Reasoning: Adopt techniques in Microbiology, analyze critically, infer the outcomes of data obtained and to apply the results in various sectors like food, health, energy and environment.

PO4: Laboratory Skills: Microbiology students will master the basic and advanced laboratory skills. They will be able to practice safe microbiology using appropriate protective and emergency procedures, biosafety regulatory framework.

PO5: 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.

PO6: Research related skills: Utilize various techniques for the benefit of living organisms. Research orientation will be improved in the form of papers and conference presentations. Work independently to evaluate diagnostic tests and assays and to develop experiment kits for various analyses in Microbiology.

PO7: Problem Solving Skills: Microbiology majors will be competent problem-solvers. They will use Advanced Microbiology techniques and reasoning to solve problems in the field for resolving the health and emerging diseases.

PO8: Industry related skills: Able to understand the importance of microorganisms in various industries such as clinical, Bioprocess, patenting, pharmaceutical, food, biofertilizers and biopesticides etc.

PO9: Analytical reasoning: Analyze, evaluate and interpret theories, claims, evidences and results in the arena of Microbiology and envisage the opinions for implementation in the society.

PO10: Leadership qualities: Focus on innovation and entrepreneurial thinking and mastered a set of advanced skills, to function effectively as professionals of Microbiology.

PO11: Moral and Ethical awareness/reasoning: Apply ethical values and oblige to ethics in the profession and responsibilities in practicing Microbiology techniques and in performing research related health using Microbiological techniques.

PO12: Multicultural competence: Develop multidisciplinary knowledge in microbiology, molecular biology, biotechnology, and biochemistry through the programme and involve and interact with different work groups.

PO13: Information and Digital literacy: Use and analyses computer tools to draw information on Biologicals and to apply Omics in the sectors of medicine and food.

PO14: Cooperation/Team work: Function effectively in a team with peers and demonstrate a commitment to the process of developing skills in Microbiology. Sharing knowledge though presentations and group work.

PO15: Lifelong learning: Acquire knowledge in Microbiology, apply for long time in learning/teaching processes, to prepare for and meet long term challenges in the working organization and society.

**PROGRAMME SPECIFIC OUTCOMES (PSO)**

PSO 1: To assist graduates become expert on the fundamental ideas in Microbiology and to be well proficient in techniques in Microbiology

PSO 2: To make students knowledgeable in Industrial applications of Microbiology that make them the entrepreneurs

**PROGRAMME EDUCATIONAL OUTCOMES (PEO)**

PEO 1: Graduates will be able to effectively conduct classes in Microbiology courses and demonstrate related practical.

PEO 2: Graduates can become entrepreneurs who will be capable of start their own industries related to Microbiology.

PEO 3: Graduates will respect social conscience, Intellectual rights and gratify ethics Microbiology profession.

**Mapping of POs and PEOs**

| PEOs | Programme Objectives (PO) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PO13** | **PO14** | **PO15** |
| **PEO1** | x | | | x | x | x | x | x | x | x | | | | | |
| **PEO2** | | | | | | | | | | | | | | x | x |
| **PEO3** | | | | | | | | | | | | | x | | |

**DEPARTMENT OF MICROBIOLOGY**
**FACULTY OF ARTS, SCIENCE, COMMERCE AND MANAGEMENT**
**PG PROGRAM (CBCS) – M. Sc –MICROBIOLOGY (FULL TIME)**
**(2025–2026 Batch and onwards)**

| Course Code | Name of the course | Category | Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | | Page No |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | PO | PSO | L | T | P | | CIA | ESE | Total | |
| | | | | | | | | | 40 | 60 | 100 | |
| **SEMESTER I** | | | | | | | | | | | | |
| 25MBP101 | Principles and Systematics of Microbiology | Major | 1, 3,4,5, 6, 11 | 1 | 4 | 0 | 0 | 4 | 40 | 60 | 100 | 1 |
| 25MBP102 | Microbial Physiology and Metabolism | Major | 1, 3, 4, 8 | 1 | 4 | 0 | 0 | 4 | 40 | 60 | 100 | 3 |
| 25MBP103 | Microbial Genetics and Molecular Biology | Major | 1, 3, 4, 8, 15 | 1 | 4 | 0 | 0 | 4 | 40 | 60 | 100 | 6 |
| 25MBP104 | Industrial Microbiology and Bioprocess Technology | Major | 1, 4, 8, 11,15 | 2 | 4 | 0 | 0 | 4 | 40 | 60 | 100 | 8 |
| 25MBP105A* | Marine Microbiology | Elective | 1, 3, 4, 5, 8 | 2 | 4 | 0 | 0 | 4 | 40 | 60 | 100 | 10 |
| 25MBP105B* | Advanced Bioinformatics | Elective | 1, 3, 4, 5, 10, 11 | 1, 2 | | | | | | | | 12 |
| 25MBP105C* | Pharmaceutical Microbiology | Elective | 1, 3, 4, 5, 6, 8, 10 | 2 | | | | | | | | 14 |
| 25MBP111 | Microbial Physiology-Practical | Major | 1, 4, 6, 8 | 1,2 | 0 | 0 | 4 | 2 | 40 | 60 | 100 | 16 |
| 25MBP112 | Molecular Biology and Industrial Microbiology-Practical | Major | 1, 4, 5, 8, 11 | 2 | 0 | 0 | 4 | 2 | 40 | 60 | 100 | 18 |
| | Journal Paper Analysis & Presentation | - | - | - | 2 | 0 | 0 | - | - | - | - | 20 |
| **Semester Total** | | | | | **22** | **00** | **08** | **24** | **280** | **420** | **700** | |

| Course Code | Name of the course | Category | Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | | Page No |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | PO | PSO | L | T | P | | CIA | ESE | Total | |
| | | | | | | | | | 40 | 60 | 100 | |
| **SEMESTER II** | | | | | | | | | | | | |
| 25MBP201 | Virology | Major | 1, 3, 4, 8 | 1 | 4 | 0 | 0 | 4 | 40 | 60 | 100 | 21 |
| 25MBP202 | Medical Bacteriology | Major | 1, 3, 4, 8, 10 | 1, 2 | 4 | 0 | 0 | 4 | 40 | 60 | 100 | 23 |
| 25MBP203 | Bioinstrumentation, Biostatistics and Research Methodology | Major | 3, 4, 5 | 1 | 4 | 0 | 0 | 4 | 40 | 60 | 100 | 25 |
| 25MBP204 | Environmental and Agricultural Microbiology | Major | 1, 4, 8, 15 | 1, 2 | 4 | 0 | 0 | 4 | 40 | 60 | 100 | 27 |
| 25MBP205A* | Plant and Animal Biotechnology | Elective | 1, 6, 13 | 2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 29 |
| 25MBP205B* | Microbial Enzymology | Elective | 1, 8, 10 | 1, 2 | | | | | | | | 31 |
| 25MBP205C* | Bioethics, Biosafety and IPR | Elective | 1, 4, 8, 11,13, 15 | 2 | | | | | | | | 33 |
| 25MBP206 | Community Engagement and Social Responsibility | Major | 4,5,7, 13,14, 15 | 1 | 2 | 0 | 0 | 2 | 40 | 60 | 100 | 35 |
| 25MBP211 | Environmental and Agricultural Microbiology-Practical | Major | 1, 4, 8, 11 | 1, 2 | 0 | 0 | 4 | 2 | 40 | 60 | 100 | 37 |
| 25MBP212 | Diagnostic Microbiology and Bioinstrumentation-Practical | Major | 3, 4, 5, 6, 7, 8, 11, 13 | 1, 2 | 0 | 0 | 4 | 2 | 40 | 60 | 100 | 39 |
| | Journal Paper Analysis & Presentation | - | - | - | 1 | 0 | 0 | - | - | - | - | 41 |
| **Semester Total** | | | | | **22** | **0** | **8** | **25** | **320** | **480** | **800** | |

| Course Code | Name of the course | Category | Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | | Page No |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | PO | PSO | L | T | P | | CIA | ESE | Total | |
| | | | | | | | | | 40 | 60 | 100 | |
| **SEMESTER III** | | | | | | | | | | | | |
| 25MBP301 | Advanced Immunology | Major | 1,4,6,8,11, 15 | 1,2 | 4 | 0 | 0 | 4 | 40 | 60 | 100 | 42 |
| 25MBP302 | Food Microbiology andQuality Control | Major | 1,4,6,8,11, 15 | 1,2 | 4 | 0 | 0 | 4 | 40 | 60 | 100 | 44 |
| 25MBP303 | Medical Mycology and Parasitology | Major | 1,4,6,8,11 | 1 | 4 | 0 | 0 | 4 | 40 | 60 | 100 | 46 |
| 25MBP304 | Recombinant DNA Technology | Major | 1,4,6,8,11, 13 | 2 | 4 | 0 | 0 | 3 | 40 | 60 | 100 | 48 |
| 25MBP305A* | Microbial Omics | Elective | 1,4,5,6,8,1 0 | 2 | 3 | 0 | 0 | 3 | 40 | 60 | 100 | 50 |
| 25MBP305B* | Entrepreneurial Microbiology | Elective | 1,4,5,6,8,1 1,15 | 2 | | | | | | | | 52 |
| 25MBP305C* | Bio Nanotechnology | Elective | 1,4,6,8 | 2 | | | | | | | | 54 |
| 25MBP311 | Immunology and Serology Practical- | Major | 1,4,5,6,8,1 1,15 | 2 | 0 | 0 | 3 | 2 | 40 | 60 | 100 | 56 |
| 25MBP312 | Food and Beverage - Practical | Major | 1,3,4,6,8,1 1 | 2 | 0 | 0 | 4 | 2 | 40 | 60 | 100 | 58 |
| | Journal Paper Analysis & Presentation | - | | | 1 | 0 | 0 | - | - | - | - | 60 |
| 25MBPOE301 | Open Elective | Open Elective | 1,4,6,8,11, 15 | 1,2 | 3 | 0 | 0 | 2 | 40 | 60 | 100 | 61 |
| 25MBP391 | Internship | - | | | 0 | 0 | 0 | 2 | 100 | - | 100 | 63 |
| **Semester Total** | | | | | **23** | **0** | **7** | **26** | **420** | **480** | **900** | |

| Course Code | Name of the course | Category | Outcomes | | Instruction hours/week | | | Credits | Maximum Marks | | | Page No |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | PO | PSO | L | T | P | | CIA | ESE | Total | |
| | | | | | | | | | 40 | 60 | 100 | |
| **SEMESTER IV** | | | | | | | | | | | | |
| 25MBP491 | Project and Viva Voce | Major | - | - | - | - | - | 15 | 80 | 120 | 200 | 64 |
| **Semester Total** | | | | | | | | **15** | **80** | **120** | **200** | |
| **Programme Total** | | | | | **67** | **0** | **23** | **90** | **1100** | **1500** | **2600** | |

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

| Elective – 1 (25MBP105) | | Elective – 2 (25MBP205) | | Elective – 3 (25MBP305) | |
|---|---|---|---|---|---|
| **Course code** | **Name of the Course (Theory)** | **Course Code** | **Name of the course (Theory)** | **Course Code** | **Name of the course (Theory)** |
| 25MBP105A | Marine Microbiology | 25MBP205A | Plant and Animal Biotechnology | 25MBP305A | Microbial Omics |
| 25MBP105B | Advanced Bioinformatics | 25MBP205B | Microbial Enzymology | 25MBP305B | Entrepreneurial Microbiology |
| 25MBP105C | Pharmaceutical Microbiology | 25MBP205C | Bioethics, Biosafety and IPR | 25MBP305C | Bio Nanotechnology |

**Elective courses***

**Open elective course**

| S.No. | Name of the Department | Course Code | Name of the Course |
|---|---|---|---|
| 1 | M.Sc Microbiology | 25MBPOE301 | Fermentation Technology |
| 2 | M.Sc Biotechnology | 25BTPOE301 | Nutrition and Dietetics |
| 3 | MCA | 25CAPOE301 | Robotics Process Automation |
| 4 | M.Sc Chemistry | 25CHPOE301 | Industrial Chemistry |
| 5 | M.Com | 25CMPOE301 | Personal Finance and Planning |
| 6 | M.Sc Computer Science | 25CSPOE301 | Cyber Forensics |
| 7 | M.A English | 25EGPOE301 | English for Competitive Examinations |
| 8 | MBA | 25MBAPOE301 | Organizational Behavior |
| 9 | M.Sc Mathematics | 25MMPOE301 | Coding Theory |
| 10 | M.Sc Physics | 25PHPOE301 | Electrical Appliances and Servicing |

**M.Sc. Microbiology** **2025-2026**

**Semester I**

**25MBP101 Principles and Systematics of Microbiology 4H–4C**

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

**End Semester Exam:** 3 Hours

**PREREQUISITE**:

- Not required

**COURSE OBJECTIVES (CO):**

- To provide a basic understanding on the fundamental aspects ofmicrobiology from historical development.
- To comprehend the various methods for identification of unknown microorganisms
- To understand physical and chemical means of sterilization and also learn techniques for isolation of pure cultures.

**COURSE OUTCOME (COs):**

Upon completion of this course students will be 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 practice 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. | Analyze |

**UNIT I Introduction and History of Microbiology 10 HOURS**

History of development of Microbiology, Timeline of the developments from pre historic era to 21st century. Contribution of Anton Van Leeuwenhoek, Louis Pasteur, Edward Jenner, Robert Koch, Alexander Fleming, Paul Erhlich, Development of vaccines and antibiotics. Structure of prokaryotic and eukaryotic cell, General properties of microorganisms- Bacteria, Algae, Fungi and Protozoa. Bacterial Taxonomy- Principles- Modern approaches- Numerical, Serotaxonomy and chemotaxonomy.

**UNIT II Classification of microorganisms 9 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 Systemic Biology 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 IV Microscopy and staining methods** **10 HOURS**

Microscopy –Simple, Compound, Dark-field, Phase contrast, Fluorescent microscopes, Electron microscopes (SEM and TEM), Confocal microscopy, Stains and Staining techniques: Simple and Differential staining methods.

**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. Microbial DNA and RNA barcoding.

**TOTAL: 48 HOURS**

**TEXT BOOKS**


1. Dubey, R.C., and Maheswari, D.K., (2010). *A Text book of Microbiology*. (3rd Ed), S. Chandand Company, New Delhi.
2. Modi, H. A. (1996). *Elementary Microbiology*. Vol.2, AKTA Prakashan Nadiad, Gujarat
3. Powar, C.B., and Daginawala, H.F., (2008). *General Microbiology*. Vol: 2. Himalaya PublishingHouse.
4. Singh, R.P. (2007). *General Microbiology*. Kalyani Publishers, New Delhi.
5. Pelczar Jr. M.J., Chan, E.C.S., and Kreig, N.R., (2004). *Microbiology*. (5thed.). TataMcGraw-Hill Publishing Company, New Delhi.
6. Powar. C.B and Daginnawala. H.F. 2010. General Microbiology (Vol-II). HimalayaPublishing house.


**REFERENCE BOOKS**


1. Christopher, J.W., Linda, S., and Joanne, W., (2016).*Prescott's Microbiology*. (10th Ed), McGraw Hill Education, UNITed States.
2. 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.
3. Frobisher, H., Hinsdil, R.D., Crabtree, K.T., and Goodhert, D.R., (2005). *Fundamentals of Microbiology*, Saunder and Company, London.
4. Tortora, G.J., Funke, B.R., and Case, C.L., (2010). *Microbiology: An Introduction*. (10thed.). Pearson Education, Singapore.
5. Stanier, R.Y., Ingraham, J.L., Wheelis, M.L., & Painter, P. R., (2008). *General Microbiology. (5thed.). Macmillan Press Ltd, London.*
6. Salle, A.J. (2007). *Fundamental Principles of Bacteriology*. (7th ed.)., Envins Press, NewYork.
7. Alcomo, I.E., (2006). *Fundamentals of Microbiology*. (8thed.). Jones and Bartlett Publishers, Sudbury, Massachusetts.


**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 | - |
| **CO2** | 3 | - | 2 | 3 | - | - | - | - | - | - | - | - | - | - | - | 3 | - |
| **CO3** | 3 | - | - | - | - | 3 | - | - | - | - | - | - | - | - | - | 3 | - |
| **CO4** | 3 | - | 2 | - | 3 | 3 | - | - | - | - | 3 | - | - | - | - | 3 | - |
| **CO5** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 | - |
| **Average** | **3** | **-** | **2** | **3** | **3** | **3** | **-** | **-** | **-** | **-** | **3** | **-** | **-** | **-** | **-** | **3** | **-** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester I**

**25MBP102** **Microbial Physiology and Metabolism** **4H–4C**

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

**End Semester Exam:** 3 Hours

**PREREQUISITE**:

- Principles and Systematics of Microbiology (25MBP101)

**COURSE OBJECTIVES (CO):**

- To provide information on sources of energy and its utilization by microorganisms and microbial transport systems in energy conservation.
- 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.

**COURSE OUTCOME (COs):**

Upon completion of this course students will be 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 practice 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. | Analyze |

**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. Distinguishing features of archaebacteria. Classification of bacteria based on source of nutrition (energy, carbon and electron etc.)

**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. Phases and types of growth curve and its industrial applicationTransport of Nutrients- Uptake of nutrients- Passive diffusion, Facilitated diffusion, active transport. Role of osmoregulatory protein.

**UNIT III Metabolic pathway** **11 HOURS**

Glycolysis, Substrate level and oxidative phosphorylation – ATP generation, TCA cycle. Metabolism of lactic acid bacteria, propionic acid bacteria. Aerobic respiration and anaerobic respiration. Electron transport chain in prokaryotes and eukaryotes, inhibitorsof electron transport chain. 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** **05 HOURS**

Effect of oxygen toxicity, Effect of pH on Microbial growth, Effect of osmotic pressure on bacteria, heat shock response on bacteria- Chaperons. Starvation stress and stringent response. **Aerobic to anaerobic transitions** Features enabling adaptation of thermophilic bacteria and extremophilic bacteria to stress.

**UNIT V Photosynthetic bacteria & Bioluminescence** **10 HOURS**

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

**TOTAL: 48 HOURS**

**TEXT BOOKS:**


1. Joanne, M.W., Linda, S., and Christopher, J.W., (2008). *Prescott, Harley, and Klein'sMicrobiology*. (7th Ed). McGraw-Hill Higher Education, UNITed States.
2. Berg, J.M., Tymoczko, J.L., Stryer, L., and Clarke, N.D., (2001). *Biochemistry*. (5thed.). WHFreeman &Co.


**REFERENCE BOOKS:**


1. Doelle, H.W. (2005). *Bacterial Metabolism*. Elsevier India Pvt. Ltd., New Delhi.
2. Moat, A, G., and Foster J.W., (2003). *Microbial Physiology*. John Wiley and Sons, New York.
3. Caldwell, D.R. (2008). *Microbial Physiology and Metabolism*. (2nded.). Wm C Brown Publishers, England.
4. Rose, A.H. (2008). *Chemical Microbiology – An Introduction to Microbial Physiology*. (International Ed.). Plenum Publishing Corporation.
5. Atlas, R.M., (1997). *Principles of Microbiology*. (2nded.). Wm. C. Brown Publishers, Lowa, US
6. Madigan, M.T., Martinko, J.M., and Parker, J., (2003). *Brock Biology of Microorganisms*. (10thed.). Prentice Hall, New Jersey.
7. White, D. (2003). *Physiology & Biochemistry of Prokaryotes*. (2nded.). Oxford University Press, NY.
8. Voet, D., and Voet J.G., (2003). *Biochemistry*. John Wiley and Sons, New York.
9. Satyanarayana, U. and Chakrapani, U. 2013. Biochemistry, Fourth Edition Book and Allied Pvt. Ltd., Kolkata.
10. Nelson, D.L. and Cox, M.M. 2012. Lehingers's Principles of Biochemistry, Sixth Edition, Mac Millan worth Publishers, New Delhi.
11. Donald Voet and Judith G. Voet, 2011. Biochemistry. Third Edition, John Wiley and Sons, Inc.New York.
12. Michale G and Schomburg D (Ed)(2012) Biochemical pathway: An Atlas of Biochemistry and Molecular biology,p414.
13. Swanson.M., Regurea G, Schaechter M and Neidhardt FC (2016), Microbe, 2nd Edition, ASMpress, P846.

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | 2 | | - | - | - | - | - | - | - | - | - | - | - | 3 | - |
| **CO2** | 2 | - | 2 | 3 | - | - | - | 2 | - | - | - | - | - | - | - | 3 | - |
| **CO3** | 2 | - | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | 3 | - |
| **CO4** | 3 | - | - | 2 | - | - | - | 2 | - | - | - | - | - | - | - | 3 | - |
| **CO5** | 3 | - | - | 2 | - | - | - | 2 | - | - | - | - | - | - | - | 3 | - |
| **Average** | **3** | **-** | **2** | **2** | **-** | **-** | **-** | **2** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **3** | **-** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester I**

**25MBP103 Microbial Genetics and Molecular Biology 4H–4C**

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

**End Semester Exam:** 3 Hours

**PREREQUISITE**:

- Not required

**COURSE OBJECTIVES (CO):**

- To inculcate the basic application of metabolism in research.
- To deal with the genome structure, stability, organization, and its expression.
- To provide molecular mechanisms underlying mutations, detection of mutations and DNA damage and repair

**COURSE OUTCOME (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Understand the basic history of molecular genetics and apply cognitive thinking to the application-oriented sectors of genetics. | Understand |
| **CO2** | Comprehend the molecular mechanisms underlying mutations, detection of mutations and DNA damage and repair | Apply |
| **CO3** | Understand of the process of protein synthesis and operons along with of recombination DNA. | Understand |
| **CO4** | Analyze mutagenesis and genetic analysis with gene mapping. | Analyze |
| **CO5** | Understand and explore genetic engineering techniques. | Understand |

**UNIT I Historical Preview of Genetics 10 HOURS**

Mendelian principles and classical genetics, 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 - 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**

Genome organization in viruses, bacteria and eukaryotes. Genetic Recombination in Bacteria: Conjugation. F+v/s F-, Hfr+ v/s F-, F' v/s F-, Trans- formation, 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, Construction of genomic Library and cDNA library, Expression vectors and their importance. Replication mechanism of plasmids, regulation of copy number and compatibility; Bacterial plasmids as research tools.Transfer of recombinant DNA into host cells: Genetic transformation of bacteria, yeast, animaland plant cells. Principles and applications of DNA sequencing, DNA finger printing. Molecular Markers, RFLP, RAPD, AFLP. CRISPR gene editing.

.

**TOTAL: 48 HOURS**

**TEXT BOOKS**


1. Snyder L. and Chapness W. (2007). Molecular Genetics of Bacteria. ASM Press.
2. Dale, J.W., Park, S.F. (2013). Molecular Genetics of Bacteria, 5th Edition, John Wiley & Sons.
3. Birge EA. (2006). Bacterial and Bacteriophage Genetics. 5th edition, Springer-Verlag New York.


**REFERENCE BOOKS**


1. Gardner JE, Simmons MJ & Snustad DP. (2006). Principles of Genetics. 8 Edition, John Wiley & Sons.
2. Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick (2018). Lewin's GENES XII, 12 Edition, Jones & Bartlett Learning.
3. Cronan, J., Freifelder, D., Maloy, S. R. (2008). Microbial Genetics, 2 Edition, Narosa.


**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | 1 | - | - | - | 1 | - | - | - | - | - | - | - | 3 | - |
| **CO2** | 2 | - | 2 | 3 | - | - | - | 2 | - | - | - | - | - | - | 1 | 2 | - |
| **CO3** | 3 | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | 3 | - |
| **CO4** | 2 | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | 3 | - |
| **CO5** | 3 | - | - | 3 | - | - | - | 2 | - | - | - | - | - | - | - | 3 | - |
| **Average** | **3** | - | **2** | **2** | - | - | - | **2** | - | - | - | - | - | - | **1** | **3** | - |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester I**

**25MBP104** **Industrial Microbiology and Bioprocess Technology** **4H–4C**

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

End Semester Exam: 3 **Hours**

**PREREQUISITE:**

- Microbial Physiology and Metabolism (25MBP102)

**COURSE OBJECTIVES (CO):**

- To encompasses the use of microorganisms in the manufacture of food or industrial products.
- To know the basics and concepts of fermentation techniques
- To elucidate the microbes in the production of microbial products.

**COURSE OUTCOMES (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Gain information about basics in industrial biotechnology process | Understand |
| **CO2** | Demonstrate the Scale up methods for the production in large scale fermenter. | Apply |
| **CO3** | Elucidate the upstream processing for novel bioproducts | Apply |
| **CO4** | Learn and practice the process and protocol for the synthesis of bioproducts | Apply |
| **CO5** | Design various bioreactors for microbial fermentation and the production of bioproducts | Apply |

**UNIT I Strain improvement & Preservation** **10 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.

**UNIT II Fermenter** **10 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: airlift, bubble column, tower fermentors, membrane bioreactors, Microbial growth kinetics: Batch cultures, continuous cultures- Chemostat and turbidostat, fed-batch cultures.

**UNIT III Fermentation media:** **9 HOURS**

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

**UNIT IV Physical factors and scale-up** **9 HOURS**

Transport phenomena in fermentation: Gas- liquid exchange and mass transfer, oxygen transfer, critical oxygen concentration, heat transfer, aeration/agitation, its importance. Scale-up of bioreactors, Upstream process.

**UNIT V Microbial Products and Downstream process** **10 HOURS**

Introduction, 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.

**TOTAL: 48 HOURS**

**TEXT BOOKS:**


1. Peter Stanbury, Allan Whitaker., S, Stephen Hall. (2010). *Principles of Fermentation Technology*,3rd Edition, 2016, Elsevier Science and technology.
2. Richard H. Baltz., Arnold L. Demain., Julian E. Davies. *Manual of Industrial Microbiology and Biotechnology*, 3rd edition, American Society for Microbiology.
3. Michael J. Waites., Neil L. Morgan. (2001). *Industrial Microbiology: An Introduction*, Wiley-Blackwell
4. El-Mansi, E. M. T.,Bryce, C. F. A., Arnold L. Demain. Allman, A.R. (2011). *Fermentation Microbiology and Biotechnology*, 3rd Edition, CRC Press


**REFERENCE BOOKS:**


1. Shuler, M.L., Kargi F. and DeLisa, M. (2017). *Bioprocess Engineering: Basic concepts*, 3rd Edition, Prentice Hall, Engel wood Cliffs.
2. Casida, L.E.J.R. (2019). *Industrial Microbiology*, 2nd Edition, New Age International Private Limited


**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| **CO2** | 2 | - | - | 2 | - | - | - | 3 | - | - | 2 | - | - | - | - | - | 3 |
| **CO3** | - | - | - | 2 | - | - | - | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO4** | - | - | - | 2 | - | - | - | 2 | - | - | - | - | - | - | - | - | 3 |
| **CO5** | - | - | - | 2 | - | - | - | 3 | - | - | 2 | - | - | - | 2 | - | 3 |
| **Average** | **3** | **-** | **-** | **2** | **-** | **-** | **-** | **3** | **-** | **-** | **2** | **-** | **-** | **-** | **2** | **-** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**25MBP105A** **Marine Microbiology** **4H–4C**

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

End Semester Exam: 3 Hours

**PREREQUISITE:**

- Not required

**COURSE OBJECTIVES (CO):**

- To provide students with knowledge on the ecology of marine microorganisms,and their ecological role.
- To impart techniques for the characterization and study of marine microorganisms and microbial communities.
- To understand the ecological role of marine microorganisms and marine microbial communities.

**COURSE OUTCOMES (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Describe and explain both biological interaction processes and their impact to ecosystems | Understand |
| **CO2** | Gain information of marine microorganisms and their role in ecosystem | Apply |
| **CO3** | Learn and apply modern techniques for the characterization and study of marine microorganisms and microbial communities | Apply |
| **CO4** | Understand and analyses the architecture of the marine ecosystem and its essential role | Analyze |
| **CO5** | Analyze and isolate biomolecules from marine microbes | Analyze |

**UNIT I Marine microorganisms** **10 HOURS**

Introduction of coastal, shallow and deep sea. Marine microorganisms- Sampling equipment: water samplers such as Niskin sampler, HydroBios sampler, Rosette samplers; sediment samplers such as van Veen grabs and corers. Analysis of primary productivity: the radiocarbon method. Analysis of bacterial productivity: the thymidine uptake method.Constructions of Winogradsky column International and national collection centres. Use of remote sensing in Ocanography.

**UNIT II Extremophiles and Marine bio-diversity** **8 HOURS**

Thermopiles, basophiles, halophiles, psychrophiles, alkalinophiles, oligotroph, toxitolerant, xerotolerant, endolith – Extremophiles and their environment. Marine microbial habitats: estuaries, mangroves, salt marshes, beach and coastal ecosystems, reef and coral reefs, water column, sediments., Hydrothermal vents, and water currents. Habitat and food web in extreme marine environment.

**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 Marine Pollution and its effect on marine ecology** **10 HOURS**

Effect of marine pollution to marine ecology: Pollution of ocean due to hydrocarbons, oil, surfactants,

xenobiotics, pesticides, heavy metals, plastics, human activities and its impact on marine life. Microbial bioremediation in preserving marine life. Importance of microbes in marine nutrient cycles. Ocean acidification and its effect.

**UNIT V Marine Microbes bioproducts** **10 HOURS**

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

**TOTAL: 48 HOURS**

**TEXT BOOKS:**

1. Colin Munn. (2011). *Marine Microbiology: Ecology & Applications*. (2nded.). Black Well Publishers.
2. David Sigee. (2005). *Freshwater Microbiology: Biodiversity and Dynamic Interactions of Microorganisms in the Aquatic Environment*. (1sted.). Black well Publishers.
3. Joanne, M.W., Linda, S., and Christopher, J.W., (2008). *Prescott, Harley, and Klein'sMicrobiology*. (7th Ed). McGraw-Hill Higher Education, UNITed States.

**REFERENCE BOOKS:**

1. Se-Kwon Kim. (2013). *Bioactive compounds and biotechnological applications*.CLS Publishers
2. Dube, H.C. (1994). *A text book of fungi, bacteria and viruses*. Vikas Publishing House, New Delhi.
3. Dale, J.W. (1994). *Molecular genetics of Bacteria*. John Wiley and Stones.

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | 2 |
| **CO2** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| **CO3** | - | - | - | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | 2 |
| **CO4** | 2 | - | 2 | 3 | - | - | - | 2 | - | - | - | - | - | - | - | - | 2 |
| **CO5** | - | - | - | 3 | - | - | - | 2 | - | - | - | - | - | - | - | - | 2 |
| **Average** | **3** | **-** | **2** | **3** | **2** | **-** | **-** | **2** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **2** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester I**

**25MBP105B** **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

**PREREQUISITE:**

- Not required

**COURSE OBJECTIVES (CO):**

- To obtain a good understanding of the interpretation of biological database.
- 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

**COURSE OUTCOMES (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Understand the history, scope and importance of Bioinformatics and their role in world wide web | Understand |
| **CO2** | Acquire and analyze the information on the search engines and various software tools involved in bioinformatics. | Analyze |
| **CO3** | Learn and practice computational skills on search engines and various software tools involved in bioinformatics | Apply |
| **CO4** | Apply computational-based techniques which include genomics and proteomics in Bioinformatics. | Apply |
| **CO5** | Apply knowledge to retrieve information from available databases and use them for microbial identificationsand drug designing, gain the ability to modify gene and protein structures in simulated systems | Apply |

**UNIT I Introduction of Bioinformatics** **8 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 Biological Database** **8 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 Protein Structure Prediction** **11 HOURS**

Protein information resources –primary sequence database, Composite protein sequence database, secondary database, and Composite protein structure database. Protein Structural Alignment and Superposition, Protein Fold Classification, CATH, SCOP and FSSP Databases Protein structure prediction. Prediction of secondary and tertiary structure, Proteomic tools - ExPASy server.

**UNIT IV Phylogenetic Analysis** **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 Drug Design and Analysis** **10 HOURS**

DNA sequencing –Specialized genomic resources. DNA microarray – principles and databases – Genomics and Proteomics – genes prediction, splices sites and regulatory regions, SNP analysis, Modeling biological systems, Drug design - Applications of Neural Networks in Bioinformatics, Hidden Markov Models, Stochastic Grammar, and Linguistics.

**TOTAL: 48 HOURS**

**TEXT BOOKS:**

1. Rashidi, H., and Buehler, L.K., (2005). *Bioinformatics Basics: Applications in Biological Science and Medicine*. CRC Press/Taylor & FrancisGroup.
2. Bergeron, B. (2002). *Bioinformatics Computing*. Prentice Hall Publishres.
3. MountD. W. (2001). *Bioinformatics. Sequence and Genome Analysis*, Cold Spring HarborLaboratory Press.

**REFERENCE BOOKS:**

1. Higginns, D., and Taylor, W. (2000). *Bioinformatics. Sequence, Structure and databanks – APractical Approach*, Oxford UniversityPress.
2. Baxevanis, A.D., and Francis Ouellette, B.F. (2001) *Bioinformatics – A Practical Guide to theAnalysis of Genes and Proteins*, Wiley –Interscience.
3. Gibson, G., and Muse, S.V. (2002). *APrimer of Genome Science, Sinauer Associates*, Inc.Publishers.
4. Misener, S., and Krawetz, S.A. (2000). *Methods in Molecular Biology – Bioinformatics.Methods and Protocols*, Humana Press.

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - | 3 | - |
| **CO2** | 3 | - | 2 | 2 | - | - | - | - | - | 3 | - | - | - | - | - | - | 3 |
| **CO3** | - | - | 2 | 2 | 2 | - | - | - | - | 3 | - | - | - | - | - | - | 3 |
| **CO4** | - | - | - | 2 | - | - | - | - | - | 3 | - | - | - | - | - | - | 3 |
| **CO5** | - | - | 2 | 2 | - | - | - | - | - | 3 | 1 | - | - | - | - | - | 3 |
| **Average** | **3** | **-** | **2** | **2** | **2** | **-** | **-** | **-** | **-** | **3** | **1** | **-** | **-** | **-** | **-** | **3** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester I**

**25MBP105C** **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

**PREREQUISITE**:

- Not required

**COURSE OBJECTIVES (CO):**

- To understand the basics of pharmaceutical microbiology and important microorganismplaying roles pharmaceutically
- To understand different products of microbial origin playing a key role in pharmaceutical applications.
- To understand good practices and regulations involved in utilizing the microbial productsfor pharmaceutical application

**COURSE OUTCOME (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Understand pharmaceutical microbiology and well versed with the different microbial products used in pharmaceuticals | Understand |
| **CO2** | Understand and apply of good laboratory practices and regulations for utilizing the microbial products in pharmaceutical applications | Apply |
| **CO3** | Learn and practice various drug discovery tools and appreciate the use of in silico methods in drug designing. | Apply |
| **CO4** | Analyze nucleic acids and their importance to combining and analyzing information | Analyze |
| **CO5** | Understand and apply the process of production of various biopharmaceuticals from microbes | Apply |

**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. 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. Microbial products in pharmaceutical Industry.

**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: LD50 and ED50; 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** **8 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. Quality control and Quality assurance, GMP, Pharmacopeia, Good documentation practices in pharmaceutical industry. Application of cell cultures in pharmaceutical industry and research.

**TOTAL: 48 HOURS**

**TEXT BOOKS:**


1. Geoff Hanlon & Norman A (2013). *Hodges Essential Microbiology for Pharmacy and Pharmaceutical Science*, Wiley-Blackwell
2. Prahlad Singh Mehra (2011). *A Textbook of Pharmaceutical Microbiology*, I K International Publishing House


**REFERENCE BOOKS:**


1. Madhu Raju Saghee , Tim Sandle , Edward C. Tidswell (2011). *Microbiology andSterility Assurance in Pharmaceuticals and Medical Devices*, Business Horizons.
2. Geoff Hanlon, Norman A. Hodges (2013). *Essential Microbiology for Pharmacyand Pharmaceutical Science*, Wiley-Blackwell.
3. Stephen P. Denyer, Norman A. Hodges, Sean P. Gorman, Brendan F. Gilmore(2011). Hugo and *Russell's Pharmaceutical Microbiology*, Wiley-Blackwell.


**WEB REFERENCE:**

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

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| **CO2** | 2 | - | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| **CO3** | - | - | - | 2 | 2 | 2 | - | - | - | 2 | - | - | - | - | - | - | 3 |
| **CO4** | 3 | - | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| **CO5** | - | - | 2 | 2 | - | - | - | 3 | - | - | - | - | - | - | - | - | 3 |
| **Average** | **3** | **-** | **2** | **2** | **2** | **2** | **-** | **3** | **-** | **2** | **-** | **-** | **-** | **-** | **-** | **-** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**25MBP111** **Microbial Physiology - Practical** **4H–2C**

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

**End Semester Exam:** 9 Hours

**PREREQUISITE**:

- Microbial Physiology and Metabolism (25MBP102)

**COURSE OBJECTIVES (CO):**

- To equip the candidates on basic techniques in the isolation, characterization and identification of microorganism.
- To know various culture media and their applications and physical and chemical means of sterilization.
- To understand general bacteriology and microbial techniques for isolation of pure cultures.

**COURSE OUTCOME (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Practice sterilization, isolation and identification of the microorganisms using microbiological techniques | Apply |
| **CO2** | Demonstrate aseptic techniques and be able to perform routine culture handling tasks safely and effectively. | Apply |
| **CO3** | Learn the various methods for identification of unknown microorganisms | Analyze |
| **CO4** | Apply various Physical and Chemical growth requirements of bacteria and methods of bacterial growth measurement | Apply |
| **CO5** | Analyze the modes and mechanisms of energy conservation in microbial metabolism | Analyze |

**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
6. Measurement of microbial growth
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

8. Molecular identification using 16s r RNA sequencing.
9. Hydrolysis of polymers

**Total: 48 HOURS**

**TEXT BOOKS:**

1. Cappucino, J.G. and Sherman, N., (2001). *Microbiology A Laboratory Manual*, (6th ed.). Benjamin Cummings, New York.

2. Gunasekaran, P. (1996). *Lab Manual in Microbiology*, (1st ed.). New Age International (P) Ltd, Publishers, New Delhi.

**REFERENCE BOOKS:**

1. Dubey, R.C., and Maheshwari, D.K., (2002). *Practical Microbiology*, (1st ed.). S. Chand and Company Ltd, New Delhi.

2. Brook,G.F., J., Butel, S., Stephen, A., and Morse, A., (2003). *Medical Microbiology*,(22nd ed.). McGraw Hill.

3. Chakraborty, P. (2003). *A Text book of Microbiology*. (2nd ed.). New Central Book Agency (P) Ltd., Calcutta.

4. Dismukes, W.E., Pappas, P.G., and Sobel, D., (2003). *Clinical Mycology*. Oxford University Press, UK.

5. Jawetz, E., Melnic, J.L., and Adelberg, E.A., (2019). *Medical Microbiology*. (28th ed.). Lange Medical Publishers. NY

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | 2 | - | - | - | 2 | - | - | - | - | - | - | - | 3 | - |
| **CO2** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 | - |
| **CO3** | - | - | - | 3 | - | - | - | 2 | - | - | - | - | - | - | - | 3 | - |
| **CO4** | - | - | - | 3 | - | 2 | - | 2 | - | - | - | - | - | - | - | 3 | - |
| **CO5** | - | - | - | 2 | - | 2 | - | 2 | - | - | - | - | - | - | - | - | 3 |
| **Average** | **3** | **-** | **-** | **3** | **-** | **2** | **-** | **2** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **3** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**25MBP112 Molecular Biology and Industrial Microbiology -Practical 4H–2C**

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

**End Semester Exam:** 9 Hours

**PREREQUISITE**:

- Microbial Genetics and Molecular Biology (25MBP103)
- Bioinstrumentation (25MBP104)

**COURSE OBJECTIVES (CO):**

- To acquire skills in the different molecular mechanisms of gene transfer, mutations and separation of nucleic acids.
- To equip the students with practicalknowledge on basic techniques in Genetics.
- To learn and practice protein purification.

**COURSE OUTCOME (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Practice gene transfer, mutations and separation of nucleic acids techniques | Apply |
| **CO2** | Imparts knowledge in Bacterial transformation and conjugation | Apply |
| **CO3** | Learn and practice isolation of bacteriophages | Apply |
| **CO4** | Study microbial enzymes using screening techniques | Analyze |
| **CO5** | Learn and practice protein purification | Apply |

**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. Isolation of plasmid DNA from Bacteria
7. Isolation of chromosomal DNA from Bacteria
8. Estimation and purification of DNA.
9. Restriction digestion and electrophoresis.
10. Production and Estimation of Lipase enzyme.
11. Enumeration of microbes from industrial effluents to Screening of (enzyme /antibiotic) production strain.

**TOTAL: 48 hours**

**TEXT BOOKS:**

1. Palanivelu, P. (2004). *Analytical Biochemistry and Separation Techniques*, (3rd ed.).

**REFERENCE BOOKS:**


1. Arora, B., and Arora, D.R., (2007). *Practical Microbiology*, 1st Ed. CBS Publishers and Distributors, Bangalore.
2. Alfred Brown and Heidi Smith. (2015). *Benson's Microbiological Applications, Laboratory Manualin General Microbiology*, 13th Edition, McGraw-Hill.


**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | 2 | 2 | - | - | 2 | - | - | - | - | - | - | - | - | 3 |
| **CO2** | 3 | - | - | 2 | - | - | - | 2 | - | - | - | - | - | - | - | - | 3 |
| **CO3** | - | - | - | 2 | - | - | - | 2 | - | - | 2 | - | - | - | - | - | 3 |
| **CO4** | - | - | - | 3 | - | - | - | 2 | - | - | 2 | - | - | - | - | - | 3 |
| **CO5** | - | - | - | 3 | - | - | - | 2 | - | - | 2 | - | - | - | - | - | 3 |
| **Average** | **3** | **-** | **-** | **2** | **2** | **-** | **-** | **2** | **-** | **-** | **2** | **-** | **-** | **-** | **-** | **-** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester I**

**Journal Paper Analysis and Presentation** **2H**

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

**Semester II**

**25MBP201** **Virology** **4H –4C**

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

**End Semester Exam:** 3 Hours

**PREREQUISITE**:

- Not required

**COURSE OBJECTIVES (CO):**

- To learn structure, classification, evolution and architecture of viruses
- To know how viruses are classified and interactions between viruses and the host immune system.
- To isolate and culture them and their potential use in research and therapy.

**COURSE OUTCOME (COs):**

Upon completion 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. | Understand |
| **CO2** | Define and analyze the process of virus latency and describe in molecular terms control of the process and activation of viral genomes during reactivation and the interactions between viruses and the host immune system. | Analyze |
| **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. | Apply |
| **CO5** | Distinguish the replication strategies of representative viruses from the seven Baltimore classes | Analyze |

**UNIT I Viral classification and properties** **10 HOURS**

Historical perspective of virology - Scope of virology -Viral classification (Baltimore classification) and properties of viruses - Viral assay, 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** **10 HOURS**

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

**UNIT III Animal RNA viruses** **10 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** **10 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** **8 HOURS**

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

**TOTAL: 48 HOURS**

**TEXT BOOKS:**


1. Ananthanarayanan, R., and Panicker, C.K.J., (2005). *Text book of Microbiology*. (7thed.).Orient Longman, New Delhi.
2. Cann, A.J. (2015). *Principles of Molecular Virology* (6th ed) Academic Press.
3. Prescott, M., Harley, J.P., and Klein, D.A., (2007). *Microbiology*. (7thed.). McGraw-Hill Inc.New York.
4. White, D. O., and Fenner, F.J., (2016). *Medical Virology*, (5thed.). Academic Press, NewYork.
5. Levy, J. A., Fraenkel-Conrat, H., and Owens, O. S., (1994). *Virology*. (3rded.). Benjamin Cummings.
6. Knipe D.M., Howley P.M., and Griffin D.E., (2006). *Fields Virology*. (5thed). Vols - I, II. Lippincott, Williams &Wilkins.


**REFERENCE BOOKS:**


1. Carter, J., and Saunders, V., (2013). *Virology: Principles and Applications*. (2nd ed). Wiley. Acheson, N.H. (2011). *Fundamentals of Molecular Virology*. (2nd ed), Wiley publication.
2. Dimmock, N.J., Easton, A.J., and Leppard, K.N., (2016). *Introduction to Modern Virology*, (7thed.). Blackwell Scientific Publications, Oxford, UK.
3. 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.
4. 4.Jawetz, E., Melnic, J.L, and Adelberg, E.A., (2001). *Review of Medical Microbiology*. (22nded.). Lange Medical Publishers,NY.


**WEBSITES:**

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

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 | - |
| **CO2** | 3 | - | - | 2 | - | - | - | 2 | - | - | - | - | - | - | - | 3 | - |
| **CO3** | 3 | - | 2 | - | - | - | - | 2 | - | - | - | - | - | - | - | 3 | - |
| **CO4** | - | - | 3 | 3 | - | - | - | 2 | - | - | - | - | - | - | - | 3 | - |
| **CO5** | 2 | - | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - | 3 | - |
| **Average** | **3** | **-** | **2** | **2** | **-** | **-** | **-** | **2** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **3** | **-** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**25MBP202** **Medical Bacteriology** **4H – 4C**

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

**End Semester Exam:** 3 Hours

**PREREQUISITE**:

- Not required

**COURSE OBJECTIVES (CO):**

- To introduces basic principles and then applies clinical relevance of manyetiological agents.
- To provide the basic principles of medical microbiology and infectious disease, and mechanisms of infectious disease transmission, principles of aseptic practice
- To focus on pathogenic mechanisms in order to foster a student's ability to solve problemsin their future clinical career

**COURSE OUTCOME (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Demonstrate an advanced level of microbial virulence mechanisms and host response to infection. | Understand |
| **CO2** | Apply molecular techniques to medical microbiology | Apply |
| **CO3** | Demonstrate skin and respiratory tract infections to identify an unknown organism in clinical samples | Understand/ Apply |
| **CO4** | Apply diagnostic skills, and interpretation of laboratory tests in the diagnosis of infectious diseases. | Apply |
| **CO5** | Understand pathogenic bacteria in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue. | Understand |

**UNIT I Isolation and identification of pathogens** **11 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. Quality control in microbiology lab, clean room maintenance and surveillance, face mask porosity testing-Bacterial Filtration Efficiency (BFE).

**UNIT II Infections** **9 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.

**UNIT III Gram positive organisms** **9 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 andtreatment. *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** **10 HOURS**

Nosocomial infection - Urinary tract infection, Respiratory tract infection, sexually transmitteddisease - 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.

**TOTAL: 48 HOURS**

**TEXT BOOKS:**


1. Ananthanarayanan, R., and Panicker, C.K.J. (2017). *Text Book of Microbiology* (10$^{th}$ed.).The Orient Blackswan.
2. Carl Fraenkel (2012). *Text book of bacteriology*. Printing company publishers, NewYork.


**REFERENCE BOOKS:**


1. Salle, A.J. (2008). *Fundamentals principles of bacteriology*. T.M.H. Ed.). McGraw Hill.
2. Brook,G.F., J., Butel, S., Stephen, A., and Morse, A., (2003). *Medical Microbiology*,(22$^{nd}$ed.). McGraw Hill.
3. Jawetz, E., Melnic, J.L., and Adelberg, E.A., (2019). *Medical Microbiology*. (28$^{th}$ed.). Lange Medical Publishers. NY.


**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | 3 |
| **CO2** | 2 | - | 2 | 3 | - | - | - | 2 | - | - | - | - | - | - | - | 2 | 3 |
| **CO3** | 3 | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | 3 | 2 |
| **CO4** | - | - | - | 3 | - | - | - | - | - | 2 | - | - | - | - | - | 3 | - |
| **CO5** | 3 | - | 3 | 2 | - | - | - | 2 | - | - | - | - | - | - | - | - | 3 |
| **Average** | **3** | **-** | **3** | **3** | **-** | **-** | **-** | **2** | **-** | **2** | **-** | **-** | **-** | **-** | **-** | **3** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester II**

**25MBP203 Bioinstrumentation, 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:** 3 Hours

**PREREQUISITE**:

- Fundamental knowledge in algebra and probability and statistics.
- Basic understanding of research methodology and data collection techniques.

**COURSE OBJECTIVES (CO):**

- To introduce the fundamental concepts of biostatistics and correlation.
- To understand the principles and methods of tests of significance, ANOVA and sampling parameters.
- To gain knowledge about the scope, significance, and processes involved in research

**COURSE OUTCOME (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Apply the concepts of correlation and regression to analyze relationships between variables in bioscience. | Apply |
| **CO2** | Apply hypothesis testing methods, including t-tests, Z-tests, and F-tests, to bioscience data. | Apply |
| **CO3** | Understand the basic concepts of multivariate statistics and their significance in biostatistics. | Understand |
| **CO4** | Analyze the problems in research and characteristics of good research to enhance research quality. | Analyze |
| **CO5** | Learn and apply different types of sampling methods (random and non-random sampling) to collect data effectively. | Apply |

**UNIT I SPECTROSCOPY 10 HOURS**

Introduction to pH, pK, acids, bases and buffers, Henderson - Hasselbach equation, pH meter, Colorimetry & Spectrophotometry: Principles, types and applications, UV-VIS double beam spectrophotometry, Spectroflurometry, Mass spectroscopy, IR spectroscopy, Flame photometry. NMR Spectroscopy, Circular Dichroism and X- ray diffraction studies

**UNIT II CHROMATOGRAPHY AND CENTRIFUGATION TECHNIQUES 10 HOURS**

Principles, types and applications of chromatography, size exclusion, Ion Exchange chromatography, affinity chromatography. High performance liquid chromatography (HPLC), Gas chromatography (GC), Thin layer chromatography (TLC), Paper chromatography, Mass Spectrometry, MALDI TOF. Centrifugation: Principles, types and applications of centrifuges; Principles, types and applications of Electrophoresis. Agarose gel electrophoresis PAGE (SDS/Native), Gradient gel, Isoelectric focusing, 2-D gel electrophoresis (2-D PAGE), cellulose, Capillary electrophoresis. Applications of Radio isotope techniques. Detection based on gas ionization - Geiger Muller counter; Detection based on excitation - Liquid Scintillation counter

**UNIT III BASIC BIOSTATISTICS** **10 HOURS**

Biostatistics – Scope of Biostatistics, Measures of Central tendency – Arithmetic mean, Median and Mode. Calculation of mean, median, mode in series of individual observation discrete series, continuous open end classes.

**UNIT IV BIOSTATISTICS TOOL** **9 HOURS**

Classification and tabulation of data – Graphical and diagrammatic representations – scale diagrams – Histograms – frequency polygon - Frequency curves. Measures of Dispersion – standard deviation and Range. Chi – square test, student t test, regression, correlation, one way and two way ANOVA. Application of statistical software for biological research

**UNIT V RESEARCH AND SAMPLING DESIGN** **9 HOURS**

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

**TOTAL: 48 HOURS**

**TEXT BOOKS:**

1. Jerrold H. Zar. (2003). *Biostatistical Analysis*. (4th ed.). Pearson Education(P) Ltd, Delhi.

2. Kothari. C.R. (2004). *Research Methodology – Methods and Techniques*. (2nd ed.). New Age International Pvt. Ltd, New Delhi.

**REFERENCE BOOKS:**

1. Daniel, Wayne W. (1999). *Biostatistics: A Foundation for Analysis in the Health Sciences* (7th ed.). John Wiley & Sons, Inc.

2. Sokal, Robert R., and Rohlf, F. James. (1995). *Biometry: The Principles and Practice of Statistics in Biological Research* (3rd ed.). W.H. Freeman and Company.

3. Altman, Douglas G. (1991). *Practical Statistics for Medical Research*. Chapman & Hall/CRC.

**WEBSITES:**

1. https://www.coursera.org/courses?isNewUser=true&query=biostatistics

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | - | - | 3 | 3 | - | - | - | - | - | - | - | - | - | - | - | - |
| CO2 | - | - | - | 3 | 3 | - | - | - | - | - | - | - | - | - | - | - | - |
| CO3 | - | - | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CO4 | - | - | 3 | - | 3 | - | - | - | - | - | - | - | - | - | - | - | - |
| CO5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | - |
| Average | - | - | **3** | **3** | **3** | - | - | - | - | - | - | - | - | - | - | **2** | - |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester II**

**25MBP204** **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:** 3 Hours

**PREREQUISITE**:

- Not required

**COURSE OBJECTIVES (CO):**

- To study the biofertilizers, plant disease and increasing soil fertility.
- To impart a skilled knowledge on Microbes and environment and ecological importance.
- To understand the role of microbes in biogeochemical processes in different ecosystems.

**COURSE OUTCOME (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Understand the areas of Environmental microbiology and applications in environmental management. | Understand |
| **CO2** | Learn and practice bio fertilizer production | Apply |
| **CO3** | Apply the basic microbiological principles, the methods in microbial ecology and their theoretical and practical use | Apply |
| **CO4** | Analyze the microbial role in nutrient cycling and water quality | Analyze |
| **CO5** | Become Entrepreneurs after understanding the process and product development. | Create |

**UNIT I - Aquatic environment** **9 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** **9 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, Bioleaching – Biology of mineral leaching, recovery of metal from ores, testing for biodegradability. Microbes and climate change or emission of green house.

**UNIT III - Microbes in agriculture and Biocontrol** **10 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: Microbial Technology for Composting.

**UNIT IV - Plant microbes interaction** **10 HOURS**

Symbiotic and non-symbiotic microorganisms, 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** **10 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 start up and small scale business.

**TOTAL: 48 HOURS**

**TEXT BOOKS:**


1. Rangaswami, G., and Bhagyaraj, D.J., (2001). *Agricultural Microbiology*. (2nd ed.). Prentice Hall, New Delhi.
2. Saxena., and Sanjai., (2015). *Applied Microbiology*. Springer, Germany.
3. Bagyaraj D.J., and Rangaswami.G. (2009). *Agricultural Microbiology* (2nd edition). PHI Learning Pvt. Ltd.
4. Atlas, R.M., and Bartha, M., (2000). *Microbial Ecology - Fundamental and Applications*. (3rd ed.). Redwood City CA. Benjamin/Cumming Science Publishing Co., New Delhi.


**REFERENCE BOOKS:**


1. Denise., G.A., Sarah, S., and Deborah, A., (2015). *Nester's Microbiology*. McGraw-Hill Education.
2. Sen, K., and Ashbolt, N.J., (2010). *Environmental Microbiology: Current Technology and Water* Applications.
3. K. R. Aneja. 2017. *Fundamental agricultural microbiology* (19th edition). New Age International Private Limited.


**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 2 | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO3** | 2 | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - | 2 | - |
| **CO4** | 2 | - | - | 2 | - | - | - | 3 | - | - | - | - | - | - | - | 1 | 3 |
| **CO5** | 2 | - | - | 2 | - | - | - | 3 | - | - | - | - | - | - | 2 | 2 | - |
| **Average** | **2** | **-** | **-** | **2** | **-** | **-** | **-** | **3** | **-** | **-** | **-** | **-** | **-** | **-** | **2** | **3** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester II**

**25MBP205A** **Plant and Animal Biotechnology** **3H–3C**

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

**End Semester Exam:** 3 Hours

**PREREQUISITE**:

- Not required

**COURSE OBJECTIVES (CO):**

- To take learners through a captivating journey of fundamentals, cell culture and characterization of animal tissue culture.
- To orient learners about contaminations, understand significance of preservation of cell lines.
- Acquire knowledge about molecular markers and their use in development of stress resistant crop plants.
- Impart the basics of nanoparticle synthesis, characterization and application

**COURSE OUTCOME (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Develop skill in raising transgenics resistant to biotic & abiotic stresses & quality characteristics and their role in crop improvement | Understand |
| **CO2** | Apply the practical skills for entrepreneurial development. | Apply |
| **CO3** | Employ transgenic animal for various therapeutic purposes, as disease model and livestock improvement | Understand |
| **CO4** | Analyze method invitro fertilizations to interpret embryonic stem cell culture to judge ethical issues pertaining to it. | Analyze |
| **CO5** | Comprehend various features of primary cell culture, methods, and characterizations by discussing suitable examples | Understand |

**UNIT I - Introduction to Plant Tissue Culture** **7 HOURS**

Tissues culture media - Composition and preparation; Plant Propagation - Conventional & Invitro techniques; Cell and tissue culture techniques for plants - Micro propagation, Callus culture, somatic embryogenesis, suspension culture, embryo culture, haploid culture, protoplast culture, protoplast fusion; Somaclonal variation; Artificial seeds; hardening.

**UNIT II - Transformation techniques and its application** **8 HOURS**

Genetic transformation techniques in plants: Gene transfer methods in plants – Direct DNA transfer methods, *Agrobacterium* mediated nuclear transformation. Ti and Ri plasmids, binary & cointegrated vector systems; genetic markers; reporter genes. Role of genetic transformation techniques in production of Biodegradable Plastics, Therapeutic proteins, antibodies, plant vaccines, herbal drugs, bioethanol and biodiesel. Phytoremediation; Proteomics and Plant biotechnology

**UNIT III – Animal Tissue culture preparation** **7 HOURS**

Introduction to Animal Tissue Culture: Background, Advantages, Limitations and applications. Culture Environment, Cell Adhesion, Cell Proliferation and Cell differentiation. Media preparation.

**UNIT IV – Cell culture Techniques** **7 HOURS**

Primary Culture: Isolation of Tissue, Steps involved in primary cell culture, Cell Lines, Nomenclature, Subculture and Propagation, Immortalization of cell lines, Cell line designations, Routine maintenance.

Characterization of Cell Line.

**UNIT V – Transgenic Animal and Cloning** **7 HOURS**

Transgenic Animals: Production Methodology-Embryonic Stem Cell method, Microinjection method; Applications of transgenic animals-in therapeutic protein production; livestock improvement; Transgenic animals as disease models. Gene targeting, silencing and knockout technologies. Animal cloning.

**TOTAL: 36 HOURS**

**TEXT BOOK:**

1. H. S. Chawla, 2017. Introduction to Plant Biotechnology, 3rd Edition. Oxford & Ibh Publishing
2. Ashutosh Shukla Siavash Iravani 2018, Green Synthesis, Characterization and Applications of Nanoparticles, 1st Edition, Elsevier.
3. Animal Biotechnology by N. Arumugam, V. Kumaresan from Saras Publication, 2019

**REFERENCE BOOK:**

1. Abdin, M. Z., Kiran, U., Kamaluddin, M., Ali, A. (Eds.), 2017. Plant Biotechnology: Principles and Applications, Springer Publication.
2. Animal Biotechnology by P.K. Gupta from Rastogi publications, 2020

**WEBSITES:**

1. Websites etc. 1 https://swayam.gov.in/nd1_noc20_me04/preview/https://gac.gov.in/

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - |
| **CO2** | 2 | - | - | - | - | 2 | - | - | - | - | - | - | 3 | - | - | - | 3 |
| **CO3** | 2 | - | - | - | - | - | - | - | - | - | - | - | 3 | - | - | | - |
| **CO4** | 2 | - | - | - | - | - | - | - | - | - | - | - | 3 | - | - | | 3 |
| **CO5** | 2 | - | - | - | - | - | - | - | - | - | - | - | 3 | - | - | - | 3 |
| **Average** | **2** | **-** | **-** | **-** | **-** | **2** | **-** | **-** | **-** | **-** | **-** | **-** | **3** | **-** | **-** | **-** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester II**

**25MBP205B** **Microbial Enzymology** **3H–3C**

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

**End Semester Exam:** 3 Hours

**PREREQUISITE**:

- Not required

**COURSE OBJECTIVES (CO):**

- To deal with enzyme structure, stability, organization, and expression.
- To know the production and purification of microbial enzymes.
- To understand the role of enzymes in microbial metabolism.

**COURSE OUTCOME (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Understand the basics of enzymes with an importance of prokaryotes and eukaryotes | Understand |
| **CO2** | Analyze enzyme structure, stability, organization, and expression. | Analyze |
| **CO3** | Learn the role of enzymes in microbial metabolism | Understand |
| **CO4** | Learn and apply the production and purification of microbial enzymes | Apply |
| **CO5** | Analyze the enzymes behind complex diseases | Analyze |

**UNIT I Bio energetics** **7 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 inhibition and Enzyme regulation** **8 HOURS**

Enzyme inhibition and types- competitive, noncompetitive and uncompetitive inhibitors. Inhibition kinetics. 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** **7 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– Immobilization technique, structural aspects of enzyme** **7 HOURS**

Basic principles of cell and enzyme immobilization. Microencapsulation and Nanoencapsulation techniques. Protein Interaction. Primary, secondary and Tertiary structure of enzyme. Structure prediction of enzyme using *in silico* methods.

**UNIT V –Uses of enzymes in analysis** **7 HOURS**

Enzyme electrodes. Enzyme as biosensor, potentiometric biosensor, immunosensor. Applications of enzymes in industry, pharmaceutical, agriculture and health care. Recent advances and future prospects of enzyme engineering; artificial enzymes and applications.

**TOTAL: 36 HOURS**

**TEXT BOOKS:**

1. Voet, D and Voet, J.G. (2011) *Biochemistry.* 4rd edition, John Wiley and Sons.
2. Berg, J.M., Tymoczko, J.L., and Stryer, L. (2011) *Biochemistry*, W. H. Freeman and Company.
3. Enzymes by P. Asokan, (2005). Chinna publications, 2nd edition.

**REFERENCE BOOKS:**

1. Nelson David l. and Cox, M.M. Macmillan. (2000). Principles of Biochemistry.
2. Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, *Harpers Biochemistry* 24th edition, Prentice Hall International. Inc.
3. Hames & N.M. Hooper, *Instant Notes in Biochemistry*, 2nd Edition

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 | 2 |
| **CO2** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| **CO3** | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO4** | 2 | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO5** | 2 | - | - | - | - | - | - | 3 | - | 2 | - | - | - | - | - | - | 3 |
| **Average** | **3** | - | - | - | - | - | - | **3** | - | **2** | - | - | - | - | - | **3** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**25MBP205C** **Bioethics, Biosafety and IPR** **3H–3C**

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

End Semester Exam: 3 **Hours**

**PREREQUISITE:**

- Not required

**COURSE OBJECTIVES (CO):**

- The course has been designed to sensitize students about the importance of Personnel Protective Equipment (PPE), general biosafety rules and different biosafety levels.
- The course further aims to make students aware about the ethical issues involving biological material.
- The course further includes the different forms Intellectual Property, which a researcher could utilize to protect its intellectual output

**COURSE OUTCOMES (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Gain knowledge about basics in industrial biotechnology process | Understand |
| **CO2** | Demonstrate the Scale up methods for the production in large scale fermenter. | Apply |
| **CO3** | Elucidate the upstream processing for novel bioproducts | Apply |
| **CO4** | Learn and practice the process and protocol for the synthesis of bioproducts | Apply |
| **CO5** | Design various bioreactors for microbial fermentation and the production of bioproducts | Apply |

**UNIT I Bioethics** **7 HOURS**

Introduction to ethics/bioethics – framework for ethical decision making; biotechnology and ethics – benefits and risks of genetic engineering – ethical aspects of genetic testing – ethical aspects relating to use of genetic information – genetic engineering and biowarfare

**UNIT II Biotechnology and Ethics** **7 HOURS**

Ethical implications of cloning: Reproductive cloning, therapeutic cloning; Ethical, legal and socioeconomic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research-GM crops and GMO's – biotechnology and biopiracy – ELSI of human genome project

**UNIT III Biosafety** **8 HOURS**

Introduction to biosafety – biosafety issues in biotechnology – risk assessment and risk Management – safety protocols: risk groups – biosafety levels – biosafety guidelines and regulations (National and International) – operation of biosafety guidelines and regulations – types of biosafety containment

**UNIT IV Introduction to Intellectual Property Rights** **7 HOURS**

Introduction to intellectual property and intellectual property rights – types: patents, copy rights, Trade marks, design rights, geographical indications – importance of IPR - world intellectual Property rights organization (WIPO)

**UNIT V Nature of Patent** **7 HOURS**

What can and what cannot be patented? – Patenting life – legal protection of biotechnological Inventions – Patenting in India: Indian patent act.

**TOTAL: 36 HOURS**

**TEXT BOOKS:**

1. Principles of cloning, Jose Cibelli, Robert P. lanza, Keith H. S . Campbell, Michael D.West, Academic Press.

**REFERENCE BOOKS:**

1. "Intellectual Property and Biodiversity: Rights to Animal Genetic Resources" by Michelangelo Temmerman

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | - | - | - | - | 3 | - | - | - | 3 |
| **CO2** | 2 | - | - | 2 | - | - | - | 3 | - | - | 2 | - | - | - | - | - | 3 |
| **CO3** | - | - | - | 2 | - | - | - | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO4** | - | - | - | 2 | - | - | - | 2 | - | - | - | - | - | - | - | - | 3 |
| **CO5** | - | - | - | 2 | - | - | - | 3 | - | - | 2 | - | 3 | - | 2 | - | 3 |
| **Average** | **3** | **-** | **-** | **2** | **-** | **-** | **-** | **3** | **-** | **-** | **2** | **-** | **3** | **-** | **2** | **-** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**25MBP206** **Community Engagement and Social Responsibility** **2H-2C**

**Instruction Hours/week: L:2 T:0 P:0** **Marks:** Internal**:40** External**: 60 T**otal**:100**

**End Semester Exam: 3** Hours

**PREREQUISITE:**

- Not required

**COURSE OBJECTIVES (CO):**

- To gain insights into the structures, challenges, and opportunities within communities
- To explore ethical frameworks and dilemmas related to community engagement and social responsibility
- To develop skills in monitoring, evaluating, and reporting on the outcomes of community engagement efforts to ensure effectiveness and accountability.

**COURSE OUTCOMES (COs):**

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

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Understand the concept, ethics, and spectrum of community engagement | Understand |
| **CO2** | Recognize the significance in local community development and rural culture. | Understand |
| **CO3** | Know the rural development programs, institutions | Understand |
| **CO4** | Comprehend methods for waste management | Understand |
| **CO5** | Implement policies for hygiene and sanitation among waste management workers | Apply |

**UNIT I INTRODUCTION AND PRINCIPLES** **5 HOURS**

Concept, Ethics and Spectrum of Community engagement, Local community, Rural culture and Practice of community engagement - Stages, Components and Principles of community development, Utility of public resources. Contributions of self-help groups

**UNIT II RURAL DEVELOPMENT** **5 HOURS**

Rural Development Programs and Rural institutions Local Administration and Community Involvement- Social contribution of community networking, Various government schemes. Programmes of community engagement and their evaluation.

**UNIT III COMMUNITY AND RESEARCH** **5 HOURS**

Community Engaged Research and Ethics in Community Engaged Research Rural Distress, Rural Poverty, Impact of COVID-19 on Migrant Laborers, Mitigation of Disaster.

**Unit IV Waste management** **5 HOURS**

Waste management in rural and sub-urban areas; Government schemes on waste management; Types of waste. Collection, segregation, handling and dispersion of waste. Biomedical waste – Color code. The role of microorganisms in Waste management.

**Unit V Personal care** **4 HOURS**

Personal care and hygiene for the waste management workers. Psychological wellbeing of the workers. Women folk health care and sanitary practices.

**TOTAL: 24 HOURS**

**TEXT BOOK:**

1. *Principles of Community Engagement*, (2011).2nd Edition, NIH Publication No. 11-7782.
2. Tripathy, S.N., and Panda, S., (2011). *Fundamentals of Environmental Studies*; 3rdEdition, Vrianda Publications Private Ltd., New Delhi.
3. Kumar, A., (2004). *A Textbook of Environmental Science*; APH Publishing Corporation, New Delhi.

**REFERENCE BOOKS:**

1. Singh, M.P., Singh, B.S., and Dey, S.S., (2004). *Conservation of Biodiversity and Natural Resources.* Daya Publishing House, Delhi.
2. Uberoi, N.K., (2010). *Environmental Studies*, Excel Books Publications, New Delhi, India.
3. Maier RM, Pepper IL, Gerba CP (2019). *Environmental Microbiology*, Elsevier.
4. Bruce E Rittmann and Perry L McCarty. *Environmental Biotechnology. Principles and Applications*. McGraw-Hill International (2020) 2ndedition.

**WEBSITES:**

1. https://youtu.be/-SQK9RGBt7o
2. https://www.uvm.edu/sites/default/files/community_engagement_handout.pdf (Community Engagement)
3. https://www.atsdr.cdc.gov/communityengagement/pce_concepts.html (Perspectives of Community)
4. https://egyankosh.ac.in/bitstream/123456789/59002/1/Unit1.pdf (community concepts)
5. https://sustainingcommunity.wordpress.com/2013/07/09/ethics-and-community-engagement/(Ethics of community engagement)
6. https://www.preservearticles.com/sociology/what-are-the-essential-elements-of-community/4558 (Elements of Community)
7. https://www.yourarticlelibrary.com/sociology/rural-sociology/rural-community-top-10-characteristics-of-the-rural-community-explained/34968 (features of rural community)
8. https://www.mapsofindia.com/my-india/government/schemes-for-rural-development-launched-by-government-of-india (Government programmes for rural development)
9. https://www.yourarticlelibrary.com/sociology/rural-sociology/rural-community-top-10-characteristics-of-the-rural-community-explained/34968 (rural lifestyle)
10. https://www.insightsonindia.com/social-justice/issues-related-to-rural-development/government-schemes-for-rural-development-in-india/ (schemes for rural development)
11. https://www.mpgkpdf.com/2021/09/community-development-plan-in-hindi.html?m=1
12. https://images.app.goo.gl/sNF2HMWCuCfkqYz56
13. https://images.app.goo.gl/VaMNNMEs77XyPMrP7

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | POS2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| **CO2** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO3** | - | - | - | | - | - | 3 | - | - | - | - | - | - | - | - | - | - |
| **CO4** | - | - | - | 3 | 2 | - | - | - | - | - | - | - | - | 2 | 2 | 2 | - |
| **CO5** | - | - | - | 3 | 2 | - | - | - | - | - | - | - | 2 | - | - | 2 | - |
| **Average** | - | - | - | **3** | **2** | - | 3 | - | - | - | - | - | **2** | **2** | **2** | **2** | - |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester II**

**25MBP211 Environmental and Agricultural Microbiology - Practical 4H–2C**

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

**End Semester Exam: 9** Hours

**PREREQUISITE:**

- Environmental And Agricultural Microbiology (25MBP204)

**COURSE OBJECTIVES (CO):**

- To obtain practical skill in protein estimation, separation and purification
- To provide the basics of microbiology to build a foundation production of enzymes and antibiotics
- To study microbe enumeration from industry effluents.

**COURSE OUTCOMES (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Execute advanced techniques for protein estimation, separation and purification | Apply |
| **CO2** | Perform techniques for the production of enzymes and antibiotics | Apply |
| **CO3** | Practice production of microbial media from agricultural waste | Apply |
| **CO4** | Accomplish estimation of BOD and COD and enumeration of microbes from effluents | Apply |
| **CO5** | Achieve identification of VAM and estimation of lipase | Apply |

**EXPERIMENTS** **48 HOURS**

1. Estimation of Protein by Lowry's Method.
2. Determination of molecular weight by SDS Polyacrylamide gel electrophoresis
3. Protein Purification using microfiltration.
4. Formulation of cost effective alternative bacterial culture media from agricultural waste
5. Maintenance of culture on agar slants/glycerol stock
6. Isolation of symbiotic nitrogen fixers from root nodule –*Rhizobium*
7. Estimation of BOD and COD.
8. Identification of VAM fungi
9. MPN test
10. Nuclear staining for nucleic acid identification.
11. Analysis of amino acid by Paper chromatography
12. Separation of plant pigments by Paper chromatography
13. Analysis of amino acid by Thin layer chromatography
14. Purification of proteins by column chromatography

**TOTAL: 48 HOURS**

**TEXT BOOKS:**

1. Prakash S. Bisen. (2014). *Laboratory protocols in applied life sciences*. CRC Press, Taylor & Francis Group.
2. Alfred Brown and Heidi Smith. (2015). *Benson's Microbiological Applications, Laboratory Manual in General Microbiology*, 13th Edition, McGraw-Hill.

**REFERENCE BOOKS:**

1. Green and Sambrook. (2012). *Molecular Cloning: A Laboratory Manual*, 4th Edition, Cold Spring Harbor Laboratory Press, U.S.

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | POS2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - | 3 | 2 |
| **CO2** | - | - | - | 2 | - | - | - | 3 | - | - | - | - | - | - | - | 3 | 2 |
| **CO3** | - | - | - | 2 | - | - | - | 3 | - | - | - | - | - | - | - | 2 | 3 |
| **CO4** | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - | 2 | 3 |
| **CO5** | 2 | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - | 3 | 3 |
| **Average** | **3** | - | - | **2** | - | - | - | **3** | - | **-** | **-** | **-** | **-** | **-** | **-** | **3** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**25MBP212 Diagnostic Microbiology and Bioinstrumentation - Practical 4H–2C**

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

**End Semester Exam: 9** Hours

**PREREQUISITE:**

- Medical Microbiology (25MBP202)

**COURSE OBJECTIVES (CO):**

- To acquire practical knowledge in numerous diagnostic tests of clinical specimen
- To learn techniques for cultivation of virus
- To understand the techniques in biofilm formation

**COURSE OUTCOME (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Understand the clinical diagnosis of infection providing the combined treatment of bacteriology and virology. | Understand |
| **CO2** | Develop skills in biomedical waste Segregation and Disposal | Apply |
| **CO3** | Learn and practice antimicrobial sensitivity tests | Analyze |
| **CO4** | Apply techniques for cultivation of virus | Apply |
| **CO5** | Practice and apply techniques in biofilm formation | Apply |

**EXPERIMENTS** **48 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. ELISA.
9. Examination of plant viral diseases: Wilt of potato, Citrus canker, Rice dwarf virus.
10. MALDI TOF - Detection of bacterial hazards.
11. Antibiofilm formation.
12. Estimation of virus yields-- plaque assay & TCID50.
13. Handling of animals: Rules & Regulation.

**TEXT BOOKS:** **TOTAL: 48 HOURS**

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. Mukherjee, K.L. (2005). *Medical Laboratory Technology*, Vol. 3, Tata McGraw-Hill Publishing

Company Ltd, New Delhi.
4. Sundararaj, T. (2005). *Microbiology laboratory manual.* Aswathy Sundararaj Publishers.Chennai.

**REFERENCE BOOKS:**

1. Baron, E.O., and Finegold, S., (1990). *Bailey and Scott's Diagnostic Microbiology*. (8th ed.). C V Mosby Company, StLouis.
2. Gaud, R.S., and Gupta, G.D., (1999). *Practical Microbiology*. (1st ed.). Nirali Prakashan, Pune.
3. Reddy, S.M., and Reddy, S.R., (2004). *Microbiology A Laboratory Manual*. (3rd ed.). SriPadmavathi Publication, Hyderabad.
4. 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.

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | 3 | - | 3 | 2 | - | - | - | - | - | - | - | - | 2 | 3 |
| **CO2** | - | - | - | - | 3 | 3 | - | 2 | - | - | - | - | - | - | - | 2 | 2 |
| **CO3** | - | - | - | - | - | 3 | - | 2 | - | - | 2 | - | - | - | - | 3 | 2 |
| **CO4** | - | - | 2 | 2 | - | - | 2 | 3 | - | - | - | - | - | - | - | 2 | 2 |
| **CO5** | - | - | - | - | 2 | 2 | - | 3 | - | - | - | - | 2 | - | - | 2 | 3 |
| **Average** | **-** | **-** | **2** | **3** | **3** | **3** | **2** | **3** | **-** | **-** | **2** | **-** | **2** | **-** | **-** | **2** | **2** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester II**

**Journal Paper Analysis and Presentation** **1 H**

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

**Semester III**

**25MBP301** **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

**PREREQUISITE:**

- Not required

**COURSE OBJECTIVES (CO)**:

- To impart advanced knowledge through immune diagnosis, assessment of cell-mediated immunity and immunology of diseases.
- to identify the cellular and molecular basis of immune responsiveness.
- to describe immunological response and how it is triggered and regulated.

**COURSE OUTCOMES (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Strengthen the knowledge on the immune system, genetic control of antibody production, antigens and immunodiagnostics | Understand |
| **CO2** | Gain information on the immune system, cells involved along with complement system and autoimmunity. | Understand |
| **CO3** | Develop an understanding of the immune system, antigen-antibody interactions. | Analyze |
| **CO4** | Analyze various diseased conditions generated due to the interplay of immune system components. | Analyze |
| **CO5** | Practice employment aspect of immunology and types of immune systems and mechanism of immune activation | Apply |

**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 - Antibody genes and antibody engineering –chimeric and hybrid monoclonal antibodies; Monoclonal and polyclonal antibodies. Complement system – mode of activation-Classical, Alternate and Lectin pathways, biological functions. Generation of antibody diversity. Cytokines and chemokines.

**UNIT III Immune response** **10 HOURS**

Antigen recognition – T-cell receptors (TCRs), B-cell receptor (BCR), Receptor ligand interaction, 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, host vs graft reaction Hypersensitivity Delayed-type Hypersensitivity (DTH) response- hypersensitivity types- Type I, II, III and IV.

**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; Catalytic antibodies and generation of immunoglobulin gene libraries.

**UNIT V Immunological Techniques** **10 HOURS**

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

**TOTAL: 48 HOURS**

**TEXT BOOKS:**


1. Ramesh, S.R. (2017). *Immunology*, 1st edition, McGraw Hill Education India Private Limited
2. Jenni Punt, Sharon Stranford, Patricia Jones, Judy Owen. (2019). *Kuby Immunology*, 8th Edition, W. H. Freeman
3. Ian Tizard. (2005). *Immunology: An Introduction*, 4th Edition, Cengage Learning.
4. Tanuja.S and Purohit, S.S. (2008). *Fermentation Technology*, Agrobios Publication, Jodhpur, India.


**REFERENCE BOOKS:**


1. Kuby. (2013). Immunology, 7th edition. W. H. Freeman and Company • New York.
2. Massoud Mahmoudi. (2009). *Immunology made ridiculously simple*. 1st edition. Med master.
3. Doan, Thao; Melvold, Roger; Viselli, Susan. (2012). *Lippincott's Illustrated Reviews, Immunology*, 2nd Edition, Lippincott Williams & Wilkins (LWW).
4. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt. (2017). *Roitt's Essential Immunology*, 13th Edition, Wiley-Blackwell


**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | POS2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 | 1 |
| **CO2** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| **CO3** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| **CO4** | - | - | - | 2 | - | 2 | - | 3 | - | - | 2 | - | - | - | - | - | 3 |
| **CO5** | - | - | - | 2 | - | 2 | - | 3 | - | - | 2 | - | - | - | 2 | - | 3 |
| **Average** | **3** | **-** | **-** | **2** | **-** | **2** | **-** | **3** | **-** | **-** | **2** | **-** | **-** | **-** | **2** | **3** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester III**

**25MBP302 Food Microbiology and Quality Control 4H–4C**

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

**End Semester Exam:** 3 Hours

**PREREQUISITE:**

- Principles and Systematics of Microbiology (25MBP101)
- Microbial Physiology and Metabolism (25MBP102)

**COURSE OBJECTIVES (CO)**:

- To encompass the use of microorganisms in the manufacture of food or industrial products.
- To add information about the role of microorganisms in foods, beverage and pharma industries in production and spoilage processes.
- to discuss the role of microorganisms in industry, to carry out experiments to produce microbial metabolites

**COURSE OUTCOME (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Gain information in the large-scale production of industrial products, providing the trends to cater to the needs of industry. | Understand |
| **CO2** | Gain theoretical and practical skills in food microbiology. | Understand |
| **CO3** | Analyze the role of microbes in food spoilage | Analyze |
| **CO4** | Analyze the importance of the role of microorganisms in food industries both in beneficial and harmful ways. | Analyze |
| **CO5** | Enhance their employment opportunities of microbiology-based food products. | Create |

**UNIT I Food Microbes 10 HOURS**

Food and microorganisms – Morphological Characteristics-Industrial Importance-Fungi, Bacteria; Intrinsic and extrinsic factors affecting microbial growth Impact of Climate Change on Food-borne Pathogens – sources of contamination of food. Food plant sanitation – Indicator microorganisms and Microbiological criteria – Coliform bacteria. Lactic antagonism and hurdle concept.

**UNIT II Preservation 9 HOURS**

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

**UNIT III Food Toxins and Control 9 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, 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. Methods for detection discusses the fermentation, pre and probiotics. Genetically modified foods. Phage based biosensor for the detection of pathogenic bacteria. Sample and enumeration of bacteria from food, chemicals, biological and physical methods for determining microorganisms and their products in food.An Artificial Intelligence Approach Toward Food Spoilage Detection and Analysis

**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).

**TOTAL: 48 HOURS**

**TEXT BOOKS:**


1. Sridhar, S. (2010). *Industrial Microbiology*, Dominant Publishers, New Delhi.
2. Tanuja. S and Purohit, S.S. (2008). *Fermentation Technology*, Agrobios Publication, Jodhpur, India.
3. Harider, S.I. and Ashok, A. (2009). *Biotechnology, A Comprehensive Training Guide for theBiotechnology Industry*, CRC Press, New York.


**REFERENCE BOOKS:**


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. Freeman 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.


**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | POS2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | 3 |
| **CO2** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| **CO3** | 2 | - | - | 2 | - | - | - | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO4** | 1 | - | - | 3 | - | 2 | - | 3 | - | - | 2 | - | - | - | 2 | - | 3 |
| **CO5** | - | - | - | 2 | - | 2 | - | 3 | - | - | 2 | - | - | - | 2 | - | 3 |
| **Average** | **2** | **-** | **-** | **2** | **-** | **2** | **-** | **3** | **-** | **-** | **2** | **-** | **-** | **-** | **2** | **2** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester III**

**25MBP303** **Medical Mycology and Parasitology** **4H–4C**

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

**End Semester Exam:** 3 Hours

**PREREQUISITE:**

- Principles and Systematics of Microbiology (25MBP101)

**COURSE OBJECTIVES (CO)**:

- To introduce principles and clinical relevance of many etiological agents responsible for infectious diseases.
- To explain mycotic poisoning caused by fungi and covers classification of parasites and lab techniques
- To cover mechanisms of parasite disease transmission

**COURSE OUTCOME (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Identify the different types of fungi, classify the structure and life cycles. | Analyze |
| **CO2** | Assess the reasons of infection with parasites and investigate ways by which the parasites damage their hosts and the response of the host. | Understand |
| **CO3** | Conduct procedures related to isolation and identification of parasites. | Analyze |
| **CO4** | Function in multi-disciplinary teams to advise the population on scientific basis to prevent infections with parasites. | Apply |
| **CO5** | Report the identification method for parasites | Apply |

**UNIT I Mycology** **8 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 Fungal infections** **10 HOURS**

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

.

**UNIT III Parasitology** **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 Protozoan Life cycle** **10 HOURS**

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

**UNIT V Helminthic Life cycle** **10 HOURS**

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

**TOTAL: 48 HOURS**

**TEXT BOOKS:**


1. Ananthanarayanan, R., and Panicker, C.K.J., (2005). *Text Book of Microbiology* (7th ed.). Orient Longman, New Delhi..
2. Chakraborty, P. (2003). *A Text book of Microbiology*. (2nded.). New Central Book Agency (P) Ltd., Calcutta.
3. Ananthanarayanan, R. and C.K.J. Panicker, (2009). *Text Book of Parasitology*. 6th Edition. Jaypee brothers medical publishers (p) Ltd, New Delhi.
4. Mehrotra, R.S., and Aneja, K.R., (2007). *Introduction to Mycology*. New Age International Ltd, New Delhi.
5. Panjarathinam, R. (2007). *Text book of Medical Parasitology*, (2nd ed.). Orient Longman Publishers.
6. Parija, S.C. (2008). *A Text book of Medical Parasitology*. (3rd ed.). All India Publishers and Distributors, New Delhi.


**REFERENCE BOOKS:**


1. Casida, L.E. (2007). *Industrial microbiology*, New age international (P) Ltd., New Delhi.
2. Carl Fraenkel. (2012). *Text book of bacteriology*. Printing company publishers, New York.
3. Dismukes, W.E., Pappas, P.G., and Sobel, D., (2003). *Clinical Mycology*. Oxford University Press. UK.
4. Jawetz, E., Melnic, J.L., and Adelberg, E.A., (2001). *Review of Medical Microbiology*. (22nd ed.). Lange Medical Publishers, New York.


**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | POS2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | 2 | - | - | - | 2 | - | - | - | - | - | - | - | - | 3 |
| **CO2** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| **CO3** | 2 | - | - | 3 | - | - | - | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO4** | - | - | - | 2 | - | 2 | - | 3 | - | - | 2 | - | - | - | - | - | 3 |
| **CO5** | - | - | - | 2 | - | 2 | - | 3 | - | - | 2 | - | - | - | - | - | 3 |
| **Average** | **3** | **-** | **-** | **3** | **-** | **2** | **-** | **3** | **-** | **-** | **2** | **-** | **-** | **-** | **-** | **-** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester III**

**25MBP304** **Recombinant DNA Technology** **4H–3C**

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

**End Semester Exam:** 3 Hours

**PREREQUISITE:**

- Principles and Systematics of Microbiology (25MBP101)

**COURSE OBJECTIVES (CO)**:

- To deal rDNA technology using microorganisms
- To create awareness on the Intellectual property rights and patenting of biotechnological processes.
- To discuss recent developments in IPR laws in India and types of IPR

**COURSE OUTCOME (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Understand and apply rDNA technology with emphasis on plasmid Biology and blotting techniques. | Apply |
| **CO2** | Understand and apply the use of various concepts of cloning vectors. | Understand/ Apply |
| **CO3** | Analyze importance of transgenic plants. | Analyze |
| **CO4** | Familiarize with the principles of bioethical concepts. | Evaluate |
| **CO5** | Analyze the IPR issues in patents in biotechnology innovations and patenting methods for various products and processes | Apply |

**UNIT I Microbial technology** **9 HOURS**

Introduction to microbial technology, restriction enzymes – nomenclature – types – and itsproperties, 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** **9 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 and Animal** **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. GMO, GMO Crops and Animals

**UNIT IV Patenting** **10 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. Prior art, novelty, non-obviousness, inventive step, copyright, trademark, trade secret and GI

**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. Preparation of manuscript: writing scientific paper and format of an original manuscript, publication process covered by specific journal, different types of journal metrics, authorship, ghostwriting

**TOTAL: 48 HOURS**

**TEXT BOOKS:**


1. Ananthanarayanan, R., and Panicker, C.K.J., (2005). *Text Book of Microbiology* (7th ed.). Orient Longman, New Delhi..
2. Chakraborty, P. (2003). *A Text book of Microbiology*. (2nd ed.). New Central Book Agency (P) Ltd., Calcutta.
3. Ananthanarayanan, R. and C.K.J. Panicker, 2009. *Text Book of Parasitology*. 6th Edition. Jaypee brothers medical publishers (p) Ltd, New Delhi.
4. Mehrotra, R.S., and Aneja, K.R., (2007*). Introduction to Mycology*. New Age International Ltd, New Delhi.


**REFERENCE BOOKS:**


1. Casida, L.E.2007. *Industrial microbiology*, New age international (P) Ltd., New Delhi.
2. Carl Fraenkel. (2012). *Text book of bacteriology*. Printing company publishers, NewYork.
3. Dismukes, W.E., Pappas, P.G., and Sobel, D., (2003). *Clinical Mycology*. Oxford University Press. UK.
4. Jawetz, E., Melnic, J.L., and Adelberg, E.A., (2001). *Review of Medical Microbiology*. (22nd ed.). Lange Medical Publishers, New York.


## CO, PO, PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | POS2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | 2 | - | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO2** | 3 | - | - | - | - | 3 | - | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO3** | 2 | - | - | - | - | 2 | - | 3 | - | - | - | - | 2 | - | - | - | 3 |
| **CO4** | 3 | - | - | 2 | - | 2 | - | 1 | - | - | - | - | - | - | - | - | 3 |
| **CO5** | 2 | - | - | 2 | - | 2 | - | 3 | - | - | 2 | - | - | - | - | - | 3 |
| **Average** | **3** | **-** | **-** | **2** | **-** | **2.2** | **-** | **3** | **-** | **-** | **2** | **-** | **2** | **-** | **-** | **-** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester III**

**25MBP305A** **Microbial Omics** **3H–3C**

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

**End Semester Exam:** 3 Hours

**PREREQUISITE:**

- Not required

**COURSE OBJECTIVES (CO):**

- To detail the importance of Omics in the field of life sciences
- To provide an overview of various bioinformatics tools, databases available and sequence analysis
- To provide knowledge on gene and protein analysis, and omics methods

**COURSE OUTCOME (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Provide computational skill and basic concepts of genomics, transcriptomics and proteomics and metagenomics techniques | Understand |
| **CO2** | Make use of biological databases for nucleic acid, genome, protein sequence and structure, Understand and analyze the Human genome project | Apply |
| **CO3** | Retrieve information from available databases and use them for microbial identifications and drug designing | Apply |
| **CO4** | Learn and practice Omics technology | Analyze |
| **CO5** | Understand and perform sequence alignment and analysis and Protein structure prediction | Apply |

**Unit I Biological database** **7 HOURS**

Biological databases – nucleic acid, genome, protein sequence and structure, gene expression databases, Database of metabolic pathways, Specialized Databases. Data submission & retrieval from NCBI, EMBL, DDBJ, Uniprot, PDB, SWISS- Prot.

**Unit II Sequence analysis tools** **8 HOURS**

Local and Global Sequence alignment, pairwise and multiple sequence alignment. Scoring an alignment, scoring matrices, PAM & BLOSUM series of matrices. Types of phylogenetic trees, Different approaches of phylogenetic tree construction. Genome annotation, sequence analysis of transcriptome and proteome.

**Unit III Omics** **7 HOURS**

Omics: Stream of omics- Proteomics, Genomics, Metabolomics, Lipidomics and Epigenomics. Sequencing Genes and Genome. NGS (Next generation sequencing), Binning, Annotation, Data analysis. Diversity of Genomes: Viral, prokaryotic & eukaryotic genomes.

**Unit IV Genome projects** **7 HOURS**

The Human genome project (HGP). Timeline, sequencing strategies, features of human genome and application of HGP. Introduction to Genomics, transcriptomics, proteomics, lipidomics and infectomics. Major features of completed genomes: Bacteriophage φX174, *E. coli*, *S. cerevisiae*, *Arabidopsis*.

**Unit V Structural biology** **7 HOURS**

Structural Classes, Motifs, Folds and Domains. Protein structure prediction in presence and absence of structure template Structure evaluation by Ramachandran plot. Protein structure and rational drug design. Use of AI in protein structure prediction. Recent software and tools.

**Total: 36 HOURS**

**TEXT BOOKS:**


1. Saxena Sanjay (2003). *A First Course in Computers*, Vikas Publishing.
2. Lesk M.A. (2008). *Introduction to Bioinformatics*. Oxford Publication, 3rd International Student Edition.
3. Pradeep and Sinha Preeti (2007). *Foundations of Computing*, 4th ed., BPB Publications.


**REFERENCE BOOKS:**


1. Rastogi S.C., Mendiratta N. and Rastogi P. (2007). *Bioinformatics: methods and applications, genomics, proteomics and drug discovery*, 2nd ed. Prentice Hall India Publication.
2. Primrose and Twyman (2003). *Principles of Genome Analysis & Genomics*. Blackwell.
3. Brown T. A., (2020). *Gene Cloning and DNA Analysis: An Introduction.* 8th Edition. John Wiley & Sons.
4. Mount, D. (2004). *Bioinformatics: Sequence and Genome Analysis*. Cold Spring Harbor Laboratory Press, New York.


**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | POS2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | 2 | - | - | - | - | 2 | 2 | 3 | - | - | - | - | - | 3 | - |
| **CO2** | - | - | - | - | - | - | - | 2 | - | 3 | - | - | - | - | - | - | 3 |
| **CO3** | 2 | - | - | 2 | - | - | - | - | - | 2 | - | - | - | - | - | - | 3 |
| **CO4** | - | - | - | - | 2 | - | - | - | - | 2 | - | - | - | - | - | - | 3 |
| **CO5** | 3 | - | - | - | 2 | - | - | - | - | 2 | - | - | - | - | - | - | 3 |
| **Average** | **3** | - | **2** | **2** | **2** | - | - | **2** | **2** | **2** | - | - | - | - | - | **3** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester III**

**25MBP305B** **Entrepreneurial Microbiology** **3H–3C**

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

**End Semester Exam:** 3 Hours

**PREREQUISITE:**

- Not required

**COURSE OBJECTIVES (CO):**

- To detail the entrepreneurship in field of life sciences.
- To obtain good understanding about the interpretation of biological products.
- To uptake metabolic pathways and control mechanisms of commercially important metabolites.

**COURSE OUTCOMES (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Describe and apply entrepreneurial ideas and business theories in practical framework | Understand |
| **CO2** | Clarify the metabolic pathways and control mechanisms of commercially important metabolites | Analyze |
| **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 Biofertilizers and Bioinsecticides | Analyze |
| **CO5** | Analyze production of Monoclonal antibodies, Cytokines. TPH and teaching kits, Biofuels, Bioplastics and Bio pigments | Analyze |

**Unit I Entrepreneurship** **8 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** **7 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** **7 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** **7 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** **7 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.

**TOTAL: 36 HOURS**

**TEXT BOOKS:**


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


**REFERENCE BOOKS:**


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


**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | - | - | 2 | - | - | - | - | - | 3 |
| **CO2** | 3 | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | 3 |
| **CO3** | 2 | - | - | - | - | 2 | - | 3 | - | - | 2 | - | - | - | - | - | 3 |
| **CO4** | 2 | - | - | - | - | 2 | - | 3 | - | - | 2 | - | - | - | - | - | 3 |
| **CO5** | 3 | - | - | 2 | - | 2 | - | 3 | - | - | 2 | - | - | - | 2 | - | 3 |
| **Average** | **2** | - | - | **2** | **2** | **2** | - | **3** | - | - | **2** | - | - | - | **2** | - | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester III**

**25MBP305C** **Bionanotechnology** **3H–3C**

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

**End Semester Exam:** 3 Hours

**PREREQUISITE:**

- Not required

**COURSE OBJECTIVES (CO):**

- To provide knowledge about the Bio nanomaterials synthesisand its advancement.
- To give knowledge of the Nanoscience and Applications
- To understand the synthesis of nanomaterials and their application

**COURSE OUTCOME (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Understand the basics in nanotechnology | Understand |
| **CO2** | Understand fundamentals of nanomaterials and their properties | Understand |
| **CO3** | Learn and practice biosynthesis of nanoparticles | Apply |
| **CO4** | Apply knowledge in characterizing the synthesized nanoparticles | Apply |
| **CO5** | Interpret the data on the characterized particles | Analyze |

**Unit 1 Introduction to nanotechnology** **7 HOURS**

History and scope of nanotechnology, Introduction to nanoparticles, nano definitions nanoscale, unique properties of nanoparticles with bulk materials, physical and chemical properties of Gold, silver, and copper nanoparticles.

**Unit II Synthesis of nanoparticles** **7 HOURS**

Synthesis of nanoparticles by top down, bottom approach. synthesis of nanoparticles by physical method- homogenizer, Sonication, chemical and. Synthesis of nanoparticles by biological methods- plants, microorganisms and its importance.

**Unit III Characterization of nanoparticles** **8 HOURS**

Nanoparticles characterization by atomic force microscope (AFM), scanning electron microscope (SEM), Transmission Electron Microscope (TEM), Dynamic Light Scattering Method, Characterization of particles by FTIR, X-ray diffraction (XRD), Nuclear Magnetic Resonance (NMR), UV-Visible spectrophotometer.

**UNIT IV Drug delivery** **7 HOURS**

Nanoparticles in cancer therapy, Nanocarriers and its types. Biosensors - DNA Microarrays - Cell Biochips- Nanoparticles for Bioimaging - Military applications of Nanotechnology - - Toxicity of Nanoparticles - environmental issue.

**UNIT V Nanoparticles application** **7 HOURS**

Application of nanoparticles in medicine, and in various industries (cosmetics, paints etc), hazards of nanoparticles, ; biosafety and ethical issue in application of nanoparticles. Nanomaterials for food Applications. Future Perspectives.

**Total Hours: 36 HOURS**

**TEXT BOOKS:**


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. 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


**REFERENCE BOOKS:**


1. Goosell, D.S. (2004). *Bionanotechnology: Lessons from nature.* John Wiley & Sons Inc. publication.
2. Goodsell, D.S. (1996). *Biomolecules and Nanotechnology.* Ancient Scientist, 88, 230 –237.
3. Blundell, T.L., and Johnson, L.N., (1976). *Protein crystallography.* New York.
4. Eisenberg, D., and Crothers, D., (1979). *Physical Chemistry with Applications to the Life Sciences.* Benjamin Cummings, Menlo Park, California.


**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| **CO2** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| **CO3** | 2 | - | - | - | - | 2 | - | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO4** | 2 | - | - | 2 | - | 2 | - | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO5** | 1 | - | - | 2 | - | 2 | - | 3 | - | - | - | - | - | - | - | - | 3 |
| **Average** | **2** | **-** | **-** | **2** | **-** | **2** | **-** | **3** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester III**

**25MBP311** **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

**PREREQUISITE:**

- Advance Immunology (25MBP301)

**COURSE OBJECTIVES (CO):**

- To Identify and enumerate immune cells and also perform agglutination reactions.
- To Realize the role of immune cells in developing immunity against microbial diseases
- To develop the technical skill of immunology.

**COURSE OUTCOME (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Gain knowledge of advanced techniques involved in Immunology | Understand |
| **CO2** | Understand and perform Immunology techniques which forms an integral part of Microbiology. | Apply |
| **CO3** | Learn and practice advanced techniques involved in Serology and Immunology | Apply |
| **CO4** | Analyze the antigen antibody interactions for diagnosis | Analyze |
| **CO5** | Generate an Immunological kit for the assays | Create |

**EXPERIMENTS** **HOURS: 36 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.
6. WIDAL - slide and tube test
7. RA test.
8. RPR test.
9. ASO test.
10. CRP test.
11. β -HCG test
12. ELISA- thyroid hormone analysis
13. Ouchterlony's Double Immunodiffusion test (ODD)
14. Rocket Immuno electrophoresis
15. Inoculation of antigen to animal to raise antibodies (Demo).

**TOTAL: 36 HOURS**

**TEXT BOOKS:**

1. Wilmore Webley, (2017). *Immunology Lab Manual*, 12th Edition, LAD CustomPublishing.
2. Patricia Tille. (2018). *Bailey & Scott's Diagnostic Microbiology,* 14th Edition, Elsevier eBook on Vital Source.

**REFERENCE BOOKS:**

1. Alfred Brown and Heidi Smith. (2015). *Benson's Microbiological Applications, Laboratory Manual in General Microbiology*, 13th Edition, McGraw-Hill

2. Ian Freshney, R. (2010). *Culture of Animal Cells: A Manual of Basic Technique and SpecializedApplications*, 6th Edition, John Wiley & Sons, Inc.

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | POS2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | 2 | - | - | 2 | - | - | - | - | - | - | - | - | 3 |
| **CO2** | 3 | - | - | - | 2 | - | - | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO3** | 2 | - | - | - | - | 2 | - | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO4** | 1 | - | - | 2 | - | 2 | - | 3 | - | - | 2 | - | - | - | - | - | 3 |
| **CO5** | 1 | - | - | 2 | - | 2 | - | 3 | - | - | 3 | - | - | - | 3 | - | 3 |
| **Average** | **2** | **-** | **-** | **2** | **2** | **2** | **-** | **3** | **-** | **-** | **3** | **-** | **-** | **-** | **3** | **-** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester III**

**25MBP312** **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

**PREREQISITE:**

- Food Microbiology and Quality Control (25MBP302)

**COURSE OBJECTIVES (CO):**

- To provide information on fermented food product production in food industries.
- To develop the skill in Isolation of pathogen and disease mechanisms
- To give employment opportunities to meet the current food demands and understand food spoilage and the role of microorganisms.

**COURSE OUTCOME (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Understand contamination of food products which may include bacteria and fungi | Understand |
| **CO2** | Identify ways to control microorganisms in foods and thus know the principles involving various methods of food preservation. | Apply |
| **CO3** | Analyze the importance in the prevention of contamination that might be caused by the microorganisms. | Analyze |
| **CO4** | Apply techniques for mushroom cultivation, milk quality analysis and immobilization techniques. | Apply |
| **CO5** | Develop the skills of an efficient microbiologist in the food and beverage industries. | Evaluate |

**EXPERIMENTS** **HOURS: 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 and Yoghurt quality by Methylene Blue and Resazurin Dye Reduction Test
6. Detection of coliforms from water - MPN test
7. Mushroom Cultivation on agro biomass
8. Immobilization technique (Sodium alginate method).
9. Isolation and identification of *Candida albicans*
10. Wet mount preparation of parasites- Saline, iodine

**TEXT BOOKS:**

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.

**REFERENCE BOOKS:**


1. Cappucino, G.J., and Sherman, N., (2001). *Microbiology A Laboratory Manual*. (6th ed.). Benjamin Cummings, New York.
2. Demain, A.L.,and Davies, J.E., (1999).*Manual of Industrial Microbiology and Biotechnology* (2nd ed.). ASM Press, Washington.
3. Garg, N., Garg, K.L., and Mukerji, K.G., (2010). *Laboratory Manual of Food Microbiology*.I.K. International Publishing House, New Delhi.
4. Harry, W., Seeley, Jr., and Denmark, P.N., (1984). *Microbes in Actions: A lab Manual of Microbiology*. D. B. Taraporwalla and Sons.
5. Jay, J.M., Loessner, M.J., Golden, D.A., (2005). *Modern Food Microbiology*. Springer Science, USA.
6. Davies,J.E., and Demain, A.L.,(2009). *Manual of Industrial Microbiology and Biotechnology* ASM Publisher, USADemain,


**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | POS2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | 2 | 2 | - | - | - | 2 | - | - | - | - | - | - | - | - | 3 |
| **CO2** | 2 | - | - | 2 | - | - | - | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO3** | 2 | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO4** | 1 | - | - | 2 | - | 2 | - | 3 | - | - | 3 | - | - | - | - | - | 3 |
| **CO5** | - | - | - | 2 | - | 2 | - | 3 | - | - | 2 | - | - | - | - | - | 3 |
| **Average** | **2** | **-** | **2** | **2** | **-** | **2** | **-** | **3** | **-** | **-** | **3** | **-** | **-** | **-** | **-** | **-** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester III**

**Journal Paper Analysis and Presentation 1H**

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

**Semester III**

**25MBPOE301 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

**PREREQUISITE**:

- Not required

**COURSE OBJECTIVES (CO):**

- To study the use of microorganisms in the manufacture of food or industrial products on the basis of employment.
- To gain knowledge on design of bioreactors, factors affecting growth and production, heat transfer and oxygen transfer
- To understand the rationale in medium formulation; design for microbial fermentation, andsterilization of medium and air.

**COURSE OUTCOMES (COs):**

Upon completion of this course students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Acquire knowledge in the production of industrial product, fermentation components and types | Understand |
| **CO2** | Isolate, preserve the microbes for fermentation upstream processes | Apply |
| **CO3** | Apply techniques for microbial production of various enzymes | Apply |
| **CO4** | Experiment with production of organic acids and beverages | Apply |
| **CO5** | Practice the techniques for the production of amino acids, vitamins and single cell proteins | Apply |

**Unit I Basics of fermentation processes 7 HOURS**

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

**Unit II Isolation and Preservation 7 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 7 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 7 HOURS**

Fermentation type reactions (Alcoholic, bacterial, mixed acid, propionic acid, butanediol and acetone-

butanol). Microbial production of enzymes (amylases, Proteases, cellulases) primary screening for producers, large scale production. Immobilization methods.

**Unit V Alcohols and Beverages** **8 HOURS**

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

**TOTAL: 36 HOURS**

**TEXT BOOKS:**


1. Sridhar, S. (2010). Industrial Microbiology, Dominant Publishers, New Delhi.
2. Tanuja. S and Purohit, S.S. (2008). *Fermentation Technology*, Agrobios Publication, Jodhpur, India.
3. Harider, S.I. and Ashok, A. (2009). *Biotechnology, A Comprehensive Training Guide for theBiotechnology Industry*, CRC Press, New York.


**REFERENCE BOOKS:**


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*, ElsevierAcademic Press, UK.
3. Glazer, A and Nikaido. (1995). *Microbial biotechnology fundamentals of applied microbiology*,W. H. Freeman 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.


**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | POS2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| **CO2** | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| **CO3** | 2 | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - | - | 3 |
| **CO4** | - | - | - | 2 | - | 2 | - | 3 | - | - | 2 | - | - | - | - | - | 3 |
| **CO5** | - | - | - | 2 | - | 2 | - | 3 | - | - | 2 | - | - | - | 2 | - | 3 |
| **Average** | **2.66** | **-** | **-** | **2** | **-** | **2** | **-** | **3** | **-** | **-** | **2** | **-** | **-** | **-** | **2** | **-** | **3** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester II**

| | | |
|---|---|---|
| **25MBP391** | **Internship** | **2C** |
| **Instruction Hours/week: L:0 T:0 P:0** | **Marks:** Internal**:100** External**: - T**otal**:100** | |

**Semester IV**

| **25MBP491** | **Project and Viva Voce** | **15C** |
|---|---|---|
| **Instruction Hours/week: L:0 T:0 P:0** | **Marks:** Internal**:80** External**: 120 T**otal**:200** | |

**Semester - III**

**25BTPOE301** **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

**PREREQUISITE:**

Student should know about basics of food, its nutrients and their relationship to health

**COURSE OBJECTIVES (CO)**

The main objectives of the course are

- To understand the fundamentals of food, nutrients and their relationship to health
- To develop knowledge on nutrition deficiency diseases and their consequences
- To know about food adulteration and prevention of food adulteration

**COURSE OUTCOMES (COs)**

On completion of the course, students are able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Name the fundamentals of nutrition and their relationship to health | Remember |
| **CO2** | Learn to derive maximum benefits from available food resources | Understand |
| **CO3** | Identify the consequences of vitamin and mineral deficiency/excess of vitamin | Apply |
| **CO4** | Analyze the importance of nutrition in adult age | Analyze |
| **CO5** | Assess about nutrition deficiency diseases and their consequences | Evaluate |

**UNIT I BASIC CONCEPTS IN FOOD AND NUTRITION** **5 HOURS**

Understanding relationship between food, nutrition and health, Functions of food-Physiological, psychological and social. Dietary guidelines for Indians and food pyramid

**UNIT II NUTRIENTS** **5 HOURS**

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 NUTRITION DURING THE ADULT YEARS** **10 HOURS**

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, Breast feeding, Assessment and management of moderate and severe malnutrition among children, Child health and morbidity, neonatal, infant and child mortality

**UNIT IV INTRODUCTION TO NUTRITIONAL DEFICIENCY DISEASES** **6 HOURS**

Causes, symptoms, treatment, prevention of the following: Protein Energy Malnutrition (PEM), Vitamin A Deficiency (VAD), Iron Deficiency Anemia (IDA), Iodine Deficiency Disorders (IDD), Zinc Deficiency, Flurosis Nutritional needs during pregnancy, common disorders of pregnancy (Anemia, 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 DIETETICS** **10 HOURS**

Dietary and stress management. Dietary recommendations of WHO. Diet for diabetes mellitus-Nutrition recommendations for patient with diabetes, Meal planning, Diet for Cardiovascular Diseases -Dietary management and general guidelines for coronary heart disease, Diet for cancers at various sites in the human body, diet therapy, managing eating problems during treatment. Hormonal imbalance - Poly cystic ovarian syndrome, causes of hormonal imbalance. Diet management.

**Total : 36 Hours**

**TEXT BOOKS:**


1. Srilakshmi.B. (2015) Food Science:. New Age International (P) Ltd. Publishers. 6nd Edition., New Delhi
2. Swaminathan.M. (2008). Essential of Food and Nutrition Vol II The Bangalore Printing and Publishing Co. Ltd., Bangalore.


**REFERENCE BOOKS:**


1. Garrow,J.S., and James, W.P.T.,(2000). *Human Nutrition & Dietetics*, Longman Group, UK.
2. Gordon M, Wardlaw and Paul M. (2012). *Perspectives in Nutrition*: U.S.A. McGraw Hill Publishers. 9rd Edition. New Delhi
3. Sharma, R (2004). *Diet Management*,3rdEdition, Reed Elsevier India Private Limited, Chennai.
4. Srilakshmi.B. (2014). Nutrition Science, 4th Edition, New Age International (P) Ltd. Publishers. New Delhi.


**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | - | - | - | - | - | - | 2 | 2 | - | 2 | 2 | 2 | - | 2 | 2 | 2 |
| CO2 | 3 | - | - | - | - | - | - | 2 | 2 | - | 2 | 2 | 2 | - | 2 | 2 | 2 |
| CO3 | 3 | - | - | - | - | - | - | 2 | 2 | - | 2 | 2 | 2 | - | 2 | 2 | 2 |
| CO4 | 3 | - | - | - | - | - | - | 2 | 2 | - | 2 | 2 | 2 | - | 2 | 2 | 2 |
| CO5 | 3 | - | - | - | - | - | - | 2 | 2 | - | 2 | 2 | 2 | - | 2 | 2 | 2 |
| Avg | 3 | - | - | - | - | - | - | 2 | 2 | - | 2 | 2 | 2 | - | 2 | 2 | 2 |

**1-Low; 2-Medium; 3-Strong; '-' No correlation**

**Semester III**

**25CAPOE301** **Robotics Process Automation** **3H - 2C**

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

**End Semester Exam:** 3 Hours

**PREREQUISITE:**

Not Required

**COURSE OBJECTIVES (CO):**

- To enable the understanding of RPA and the types of variables.
- To create expertism in handling the User Events and various types of Exceptions and strategies.
- To demonstrate the Deployment of the Robot and to maintain the connection.

**COURSE OUTCOMES (COs):**

Upon completion of this course, the student will be able to:

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Explain the RPA and the ability to differentiate it from other types of automation. | Understand |
| **CO2** | Analyze the different types of variables, Control Flow and data manipulation techniques. | Analyze |
| **CO3** | Summarize Image, Text and Data Tables Automation. | Understand |
| **CO4** | Evaluate the User Events and its types of Exceptions and strategies. | Evaluate |
| **CO5** | Illustrate the deployment of the robot and to maintain the connection. | Apply |

**UNIT I INTRODUCTION TO ROBOTIC PROCESS AUTOMATION 8 HOURS**

Scope and techniques of automation, Robotic process automation - What can RPA do?, Benefits of RPA, Components of RPA, RPA platforms, The future of automation.

RPA Basics: History of Automation - What is RPA - RPA vs Automation - Processes & Flowcharts - Programming Constructs in RPA - What Processes can be Automated - Types of Bots - Workloads which can be automated - RPA Advanced Concepts - Standardization of processes - RPA Development methodologies - Difference from SDLC - Robotic control flow architecture - RPA business case - RPA Team - Process Design Document/Solution Design Document – Industries best suited for RPA - Risks & Challenges with RPA - RPA and emerging ecosystem.

**UNIT II RPA TOOL INTRODUCTION AND BASICS 7 HOURS**

Introduction -The User Interface - Variables - Managing Variables - Naming Best Practices - The Variables Panel - Generic Value Variables - Text Variables True or False Variables - Number Variables - Array Variables - Date and Time Variables Data Table Variables - Managing Arguments - Naming Best Practices - The Arguments Panel - Using Arguments - About Imported Namespaces - Importing New Namespaces- Control Flow - Control Flow Introduction - If Else Statements - Loops - Advanced Control Flow - Sequences - Flowcharts - About Control Flow - Control Flow Activities - The Assign Activity - The Delay Activity - The Do While Activity - The If Activity - The Switch Activity - The While Activity - The For Each Activity - The Break Activity - Data Manipulation- Data Manipulation Introduction -

Scalar variables, collections and Tables -Text Manipulation - Data Manipulation - Gathering and Assembling Data

**UNIT III ADVANCED AUTOMATION CONCEPTS & TECHNIQUES 7 HOURS**

Recording Introduction - Basic and Desktop Recording - Web Recording - Input/Output Methods - Screen Scraping - Data Scraping - Scraping advanced techniques - Selectors - Defining and Assessing Selectors - Customization - Debugging - Dynamic Selectors - Partial Selectors - RPA Challenge - Image, Text & Advanced Citrix Automation - Introduction to Image & Text Automation - Image based automation - Keyboard based automation - Information Retrieval - Advanced Citrix Automation challenges - Best Practices - Using tab for Images - Starting Apps - Excel DataTables & PDF - Data Tables in RPA - Excel and Data Table basics - Data Manipulation in excel – Extracting Data from PDF - Extracting a single piece of data - Anchors - Using anchors in PDF.

**UNIT IV HANDLING USER EVENTS & ASSISTANT BOTS, EXCEPTION HANDLING 7 HOURS**

What are assistant bots? - Monitoring system event triggers - Hotkey trigger - Mouse trigger - System trigger - Monitoring image and element triggers - An example of monitoring email - Example of monitoring a copying event and blocking it - Launching an assistant bot on a keyboard event. Exception Handling -Debugging and Exception Handling - Debugging Tools - Strategies for solving issues - Catching errors.

**UNIT V DEPLOYING AND MAINTAINING THE BOT 7 HOURS**

Publishing using publish utility - Creation of Server - Using Server to control the bots - Creating a provision Robotfrom the Server - Connecting a Robot to Server - Deploy the Robot to Server - Publishing and managing updates - Managing packages - Uploading packages - Deleting packages.

**TOTAL: 36 HOURS**

**TEXT BOOKS:**


1. Alok Mani Tripathi. (2018). *Learning Robotic Process Automation*, Packt Publishing.
2. Frank Casale , Rebecca Dilla, Heidi Jaynes , Lauren Livingston.(2015). *Introduction to Robotic Process Automation:a Primer*, Institute of Robotic Process Automation,1st Edition.
3. Richard Murdoch. (2018). *Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant*, Independently Published, 1st Edition.


**REFERENCE BOOKS:**


1. Srikanth Merinda. (2018). *Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation*, Consulting Opportunity Holdings LLC, 1st Edition.
2. Lim Mei Ying. (2018). *Robotic Process Automation with Blue Prism Quick Start Guide: Create software robots andautomate business processes*, Packt Publishing, 1st Edition.


**WEBSITE LINKS:**

1. https://www.uipath.com/rpa/robotic-process-automation
2. https://www.academy.uipath.com

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | - | - | - | - | 2 | - | - | 2 | 2 | - | - | - | - | - | - | - |
| CO2 | - | - | - | - | - | 3 | - | - | 3 | 3 | - | - | - | - | - | - | - |
| CO3 | - | - | - | 3 | - | - | 2 | - | 3 | 3 | - | - | - | - | - | - | - |
| CO4 | 2 | 2 | - | - | - | - | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - |
| CO5 | - | 2 | 1 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Avg | 2.5 | 2 | 1 | 2.5 | - | 2.5 | 2 | 1 | 2.5 | 2.5 | - | - | - | - | - | - | - |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**Semester III**

**25CHPOE301 Industrial Chemistry 3H-2C**

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

**External Semester Exam: 3 Hours**

**PREREQUISITE:**

- Not Required

**COURSE OBJECTIVES:**

- To gain the comprehensive process of cane sugar and paint production.
- To understand the physical and chemical properties, characteristics, and the manufacturing processes of glass and cement.
- To acquire the knowledge of rubber fabrication.

**COURSE OUTCOMES (CO's):**

Upon completion of this course, the student will be able to:

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Illustrate comprehensive process of cane sugar production. | Understand |
| **CO2** | Apply the knowledge of paint classification, constituents and diverse applications. | Apply |
| **CO3** | Examine the physical and chemical properties of glass. | Analyze |
| **CO4** | Analyze the manufacturing processes of cement, including the wet and dry processes, | Analyze |
| **CO5** | Explain the rubber fabrication, including refining processes, fabrication methods, and vulcanization techniques. | Evaluate |

**UNIT I SUGAR 8 HOURS**

Introduction, Manufacture of Cane Sugar - Extraction of juice, Purification of Juice, Defecation, Sulphitation, Carbonation, Concentration or Evaporation. Crystallization -Separation of crystals, drying, refining, recovery of sugar from Molasses, Bagasse. Manufacture of sucrose from beet root. Estimation of sugar, double sulphitation process, double carbonation.

**UNIT II PAINTS 8 HOURS**

Classification, constituents, setting of paints, requirements of a good paint. Emulsion, Latex, Luminescent, Fire retardant and Heat resistant paints. Methods of applying paints. Special applications and failures of paint. Varnishes - Introduction – Raw materials – Manufacture of varnishes.

**UNIT III GLASS 8 HOURS**

Introduction, Physical/Chemical properties, Characteristics of glass. Raw materials, methods of manufacture - formation of batch material, melting, shaping, annealing and finishing of glass.

**UNIT IV CEMENT 6 HOURS**

Introduction, raw materials, manufacture – Wet process, Dry process, reactions in kiln, setting of cement, properties and uses of cement. Plaster of Paris, Gypsum, Lime.

**UNIT V RUBBER 6 HOURS**

Introduction, Importance, types and properties of rubber. Refining of crude rubber, drawbacks of raw

rubber. Rubber fabrication, vulcanization techniques.

**TOTAL: 36 HOURS**

**TEXT BOOKS:**

1. Sharma, B.K. (2014). *Industrial Chemistry* ,14th Edition, Meerut: Goel Publishing House.
2. Vermani, O.P and Narula, A.K. (2016). *Industrial Chemistry*. Delhi:Galgotia Publications Pvt Ltd.

**REFERENCE BOOK:**

1. Jain, P.C. and Monika Jain. (2016). *Engineering Chemistry* ,16th Edition, New Delhi: Dhanpat Rai Publishing Co. (Pvt) Ltd.

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | - | - | 2 | - | - | - | - | 2 | - | 1 | - | - | 2 | - | 2 | - |
| CO2 | 3 | - | - | 2 | - | - | - | - | 2 | - | 1 | - | - | - | - | 2 | - |
| CO3 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 | - |
| CO4 | - | - | - | 2 | - | - | - | - | 2 | - | 1 | - | - | 1 | - | 3 | - |
| CO5 | 2 | - | - | 2 | - | - | - | - | 2 | - | 1 | - | - | 1 | - | 2 | - |
| Avg | 2.5 | - | - | 2 | - | - | - | - | 2 | - | 1 | - | - | 1.3 | - | 2.4 | - |

**1-Low, 2-Medium, 3-High, '-' - No Correlation**

Semester III

**25CMPOE301** **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:** 3Hours

**PREREQUISITE:**

- Basic understanding of financial management principles.

**COURSE OBJECTIVES(CO):**

- To familiarize students with the concept of Investment Planning and its methods.
- To examine the scope and methods of Personal Tax Planning.
- To analyze Insurance Planning and its relevance.

**COURSE OUTCOMES(COs):**

**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 |

**UNIT I INTRODUCTION TO FINANCIAL PLANNING 7 HOURS**

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 7 HOURS**

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 7 HOURS**

Tax Structure in India for personal taxation, Scope of Personal tax planning, Exemptions and deductions available to individuals under different heads ofincome 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 7 HOURS**

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 8 HOURS**

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.

**TOTAL: 36 HOURS**

**TEXT BOOKS:**

1. Indian Institute of Banking & Finance. (2017). *Introduction to Financial Planning*, Taxmann Publication., New Delhi.
2. Pandit, A. (2014). *The Only Financial Planning Book that You Will Ever Need*, Network Publications Ltd., Mumbai.

**REFERENCE BOOKS:**

1. Sinha, M. (2008). *Financial Planning: A Ready Reckoner*, McGraw HillEducation, New York.
2. Halan, M. (2018). *Let's Talk Money: You've Worked Hard for It, Now Make It Workfor You*, Harper Collins Publishers, New York.
3. Tripathi, V. (2017). *Fundamentals of Investment*, Taxmann Publication, New Delhi.

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | P011 | P012 | P013 | P014 | P015 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | - | - | - | 3 | - | - | - | - | - | 3 | - | - | - | 3 | 3 | 3 |
| **CO2** | 3 | - | - | - | 3 | - | - | - | - | - | 3 | - | - | - | 3 | - | - |
| **CO3** | 3 | - | - | - | 3 | - | - | - | 2 | - | 3 | - | - | - | 3 | 3 | 3 |
| **CO4** | 3 | - | - | - | 3 | - | - | - | 2 | - | 3 | - | - | - | 3 | 3 | 3 |
| **CO5** | 3 | - | 1 | - |  | - | - | - | 2 | - | 3 | - | - | - | 3 | - | - |
| **Average** | 3 | - | 1 | - | 3 | - | - | - | 2 | - | 3 | - | - | - | 3 | 3 | 3 |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**25CSPOE301** **Cyber Forensics** **3H – 2C**

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

**End Semester Exam:** 3 Hours

**PREREQUISITE:**

- Basics of Cyber Security.

**COURSE OBJECTIVES (CO):**

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

**COURSE OUTCOMES (COs):**

Upon the completion of this course, the students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Explain various investigation procedures and summarize duplication of digital evidence. | Evaluate |
| **CO2** | Apply the knowledge of digital evidences. | Apply |
| **CO3** | Design and develop various forensics tools and analyse the network forensics. | Analyze |
| **CO4** | Determine the systematic study of high-tech forensics | Evaluate |
| **CO5** | Analyze and validate digital evidence data | Analyze |

**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.

**TOTAL:36 HOURS**

**TEXT BOOKS:**


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*, 1st Edition, Academic Press.
3. John R Vacca, (2016). *Computer Forensics*, 2nd Edition, Cengage Learning.


**REFERENCE BOOKS:**


1. John R. Vacca, (2005), *Computer Forensics: Computer Crime Scene Investigation*, 2nd Edition Cengage Learning.
2. Marjie T Britz, (2008), *Computer Forensics and Cyber Crime: An Introduction*, 2nd Edition, Pearson Education.
3. Mari E-Helen Maras, (2014). *Computer Forensics: Cybercriminals, Laws, and Evidence*, 2nd Edition Jones & Bartlett Learning.


**WEBSITES:**

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.

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | 3 | - | - | - | - | - | - | - | 2 | - | - | - | - | 2 | - |
| **CO2** | - | - | 3 | - | 1 | - | - | - | - | - | - | - | - | - | - | - | 2 |
| **CO3** | 3 | - | - | - | - | 1 | 2 | - | - | - | - | - | - | - | - | - | - |
| **CO4** | - | - | - | - | - | | 2 | - | - | - | - | - | - | - | - | - | - |
| **CO5** | 3 | - | 3 | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - |
| **Average** | **3** | **-** | **3** | **-** | **1** | **1** | **2** | **-** | **-** | **-** | **2** | **-** | **-** | **-** | **-** | **2** | **2** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**25EGPOE301** **English for Competitive Examinations** **3H-2C**

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

**End Semester Exam:**3Hours

**PREREQUISITE**

**Course Objectives (CO):**

•To train learners to crack 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 (COs):**

Upon the completion of this course, students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | execute the grammatical elements in competitive exams | Apply |
| **CO2** | identify the various skills to build a strong outer relationship | Understand |
| **CO3** | analyse logical reasoning questions | Analyse |
| **CO4** | execute the process of sharing the general knowledge with use of proper communication | Apply |
| **CO5** | translate the correct structure of sentence from one language to other | Understand |

**UNIT I Grammar** **8 HOURS**

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

**UNIT II Word Power** **7 HOURS**

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

**UNIT III Paragraph** **7 HOURS**

Expansion of an idea

**UNIT IV Writing** **7 HOURS**

Essay- Letters-Memos-Agenda-Resume writing

**UNIT V Speaking** **7 HOURS**

Public Speaking-Group Discussion-Interview-Spoken English

**TOTAL:36 HOURS**

**TEXT BOOK**

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

**WEBSITES**

1.https://www.ef.com/wwen/english-resources/english-idioms/

2. https://www.talkenglish.com/speaking/listbasics.aspx

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO 9 | PO 10 | PO 11 | PO 12 | PO 13 | PO 14 | PO 15 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | 3 | - | - | 3 | - | - | - | - | - | - | - | - | - | - | - |
| **CO2** | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - | - | - |
| **CO3** | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO4** | - | - | - | 3 | 3 | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO5** | - | 3 | - | - | - | - | - | | - | - | - | - | - | - | - | - | - |
| **Average** | | **2.5** | **3** | **3** | **3** | **3** | **-** | **3** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |

**3-Strong; 2-Medium; 1-Low '-' – No Corrections**

**Semester III**

**25MBAPOE301 Organizational Behavior 3H-2C**

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

**End Semester Exam:** 3 Hours

**PREREQUISITE:**

- Not Required

**COURSE OBJECTIVES (CO):**

- 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 evaluate how to perform in group and team and how to manage the power, politics and conflict.
- To recognize the importance of organizational culture and organizational change, group and team work to managing the conflict between members of the organization

**COURSE OUTCOMES (COs):**

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

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Connect organizational behavior issues in the context of the organizational behavior theories and concepts. | Understand |
| **CO2** | Assess the behavior of the individuals and groups in organization and manage the stress. | Apply |
| **CO3** | Categorize team, power, politics and conflict arising between the members. | Analyze |
| **CO4** | Explain how organizational change and culture affect the working relationship within organizations. | Evaluate |
| **CO5** | Plan and exhibit the communications kills to convey the thoughts and ideas of case analysis to the individuals and group. | Analyze |

**UNIT I ORGANIZATION BEHAVIOR : INTRODUCTION 7 HOURS**

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

**UNIT II BEHAVIOUR AND PERSONALITY 7 HOURS**

Attitudes – Sources - Types - Functions of Attitudes – Attitude and Job satisfaction, Emotions and Moods – Emotional Intelligence – Organization Behavior Applications of Emotions and Moods, Learning – Theories of Learning. Personality – Determinants of personality- Theories of Personality - psycho-analytical, social learning, job-fit, and trait theories.

**UNIT III PERCEPTION 7 HOURS**

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 7 HOURS**

Foundation of Group Behavior - Concept of Group - 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 AND STRESS MANAGEMENT 8 HOURS**

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

**TOTAL: 36 HOURS**

**TEXT BOOKS:**


1. 1. Fred Luthans. (2017). *Organizational Behavior: An Evidence - Based Approach,* 12th Edition, Mcgraw Hill Education, New Delhi.
2. Steven Mcshane and Mary Ann Von Glinow (2017), *Organizational Behavior,* 6th Edition, McGraw Hill Education, New Delhi
3. 3. Robbins,S.P, and Judge,T.A.(2016). *Organizational Behaviour,* 16th edition, Prentice Hall of India, New Delhi


**REFERENCE BOOKS:**


1. Laurie J. Mullins (2016). *Management and Organisational behaviour,* 10th Edition, Pearson Education, New Delhi
2. Robbins,S. P, and Judge,T.A.(2016). *Essentials of Organizational Behavior*,13th Edition, Pearson Education


**WEB SITES:**

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

## CO, PO, PSO Mapping

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO 9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CO2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 | |
| CO3 | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - |
| CO4 | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - | - | - | - |
| CO5 | - | - | - | 3 | - | - | - | - | - | - | - | - | - | - | - | 2 | - |
| Average | - | - | 2 | 3 | 2 | | 3 | - | - | - | - | - | - | - | - | 3 | - |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**25MMPOE301** **Coding Theory** **3H - 2C**

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

**End Semester Exam:** 3 Hours

**PREREQUISITE:**

- Algebra, Probability and Statistics, Digital Communication, Programming Skills.

**COURSE OBJECTIVES (CO):**

- To understand the communication channels and the importance of error correction.
- To explore the linear codes, self-orthogonal codes, and self-dual codes.
- To learn about the cyclic codes, their properties, and decoding methods.

**COURSE OUTCOMES (COs):**

Upon completion of this course, the student will be able to:

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Understand the fundamental concepts of error detection, correction, and decoding in communication channels. | Understand |
| **CO2** | Apply the concepts of generator matrix and parity check matrix in encoding and decoding linear codes. | Apply |
| **CO3** | Analyze different types of codes, including Binary and q-ary Hamming codes, Golay codes, and MDS codes, for their error-correcting capabilities. | Analyze |
| **CO4** | Understand the definitions and properties of cyclic codes. | Understand |
| **CO5** | Apply BCH codes and Reed Solomon codes to various coding problems. | Apply |

**UNIT I ERROR DETECTION, CORRECTION AND DECODING** **7 HOURS**

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

**UNIT II LINEAR CODES** **7 HOURS**

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

**UNIT III BOUNDS IN CODING THEORY** **8 HOURS**

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** **7 HOURS**

Definitions – Generator polynomials – Generator matrix and parity check matrix – Decoding of Cyclic codes.

**UNIT V SPECIAL CYCLIC CODES** **7 HOURS**

BCH codes – Parameters of BCH codes – Decoding of BCH codes – Reed Solomon codes.

**TOTAL: 36 HOURS**

**TEXT BOOKS:**


1. Hill, H. (1986). *A first course in Coding theory*, OUP.
2. San Ling and Chaping Xing, (2004). *Coding Theory: A first course*, Cambridge University Press.


**REFERENCE BOOKS:**


1. Berlekamp, E.R. (1968). *Algebraic Coding Theory*, Mc Graw – Hill.
2. Lin, S. and Costello, D. J. (1983). *Error control Coding: Fundamentals and Applications*, Prentice – Hall, Inc., New Jersey.
3. Vera Pless, (1982). *Introduction to the Theory of Error Correcting Codes*, Wiley, New York.


**WEBSITES:**

1. https://nptel.ac.in/courses/108104092
2. https://nptel.ac.in/courses/117106031

**CO, PO, PSO Mapping**

| CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PO 13 | PO 14 | PO 15 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | 1 |
| **CO2** | 3 | 2 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| **CO3** | 2 | 1 | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | 1 |
| **CO4** | 2 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| **CO5** | 3 | 2 | 1 | - | - | - | 1 | - | - | - | - | - | - | - | - | - | 1 |
| **Average** | **2.4** | **1.4** | **1** | **-** | **-** | **-** | **1** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **1** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**

**25PHPOE301 Electrical Appliances and Servicing 3H – 2C**

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

**End Semester Exam:** 3 Hours

**PREREQUISITE:**

- Not Required

**COURSE OBJECTIVES (CO):**

- To create awareness about types and handling of domestic appliances
- To acquire knowledge about principle of operation, working and application of various domestic appliances.
- To gain the skills in assembly, repair, installation, testing and maintenance of domestic appliances.
- To acquire skills in entrepreneurship

**COURSE OUTCOMES (COs):**

Upon the completion of this course, the students will be able to

| COs | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Repair maintenance of the basic electrical and electronics appliances | Apply |
| **CO2** | Identification to protective devices | Understand |
| **CO3** | Repair and maintenance of the split Vacuum Cleaner and washing machine | Analysis |
| **CO4** | Repair and maintenance of the electric fan & hair drier | Apply |
| **CO5** | Acquire knowledge about tools, equipment and Instruments | Understand |

**UNIT I INSTRUMENTS AND TESTING 8 HOURS**

Introduction – voltage tester screwdriver – continuing test – insulation test – measurement of power for dc & ac circuits. **Electrical Cooking Appliances** introduction – types – construction – electric toaster – types – automatic and non-automatic. **Electric Iron Box** types – non-automatic – automatic – construction and working – comparison – trouble shooting – Steam iron box.

**UNIT II WATER HEATERS & COFFEE MAKERS 7 HOURS**

Water heater – function – types – electric kettle – immersion water heater – construction and working – storage water heaters – non pressure type – pressure type – construction and working – repairs & remedies – coffee maker – types – construction and working of percolator type.

**UNIT III ELECTRIC MIXER & EGG BEATERS 7 HOURS**

Electric maker – function and its construction – general operating instruction – caution – cleaning – repairs and remedies – egg beaters – hand operated crank type – electric type and its construction.

**UNIT IV VACUUM CLEANER AND WASHING MACHINE 7 HOURS**

Vacuum cleaner – function – principle – main components – features – types - working – accessories - filters – repairing. washing machine – function – types – semi and fully automatic – top and front loading – washing technique – working cycle – construction and working of washing machine – comparison of top and front-loading machines – problems and

remedies.

**UNIT V ELECTRIC FAN & HAIR DRIER** **7 HOURS**

Fan – function – terminology – construction and working of ceiling & table fans –exhaust fan – general fault and remedy. hair drier – function – types – construction and working – safety features – repairs & remedies.

**TOTAL: 36 HOURS**

**TEXT BOOKS:**

1. *Electrical Practical, Directorate General of employment & training (DGET),*(2018) .Arihant Publisher.
2. *Handbook of Repair and Maintenance of Domestic Electronics Appliances handbook* By Shashi Bhushan Sinha, BPB Publications.

**REFERENCE BOOKS:**

1. Dixon and Graham, *Electrical Appliance Manual–Hardcover,* ISBN 13: 9781859608005.
2. Graham and Dixon, (1995). *Electrical Appliances: The Complete Guide to the Maintenance and Repair of Domestic Electrical Appliances* (Haynes for Home DIY S.).
3. Shashi Bhushan Sinha, *Handbook of Repair and Maintenance of Domestic Electronics Appliances.*

**WEBSITES:**

1. https://alison.com/courses?query=Electrical%20Appliance%20and%20Servicings#
2. https://www.scribd.com/document/269725441/Electrical-Appliances-PDF.
3. https://www.unitec.ac.nz/career-and-study-options/electrical-and-electronics-engineering/electrical-appliance-serviceperson-eas.

**CO, PO, PSO Mapping**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PO13 | PO14 | PO15 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | 3 | - | - | - | - | - | 1 | - | 2 | - | 2 | - | - | 2 | - |
| **CO2** | - | - | 3 | - | 1 | - | - | - | 1 | - | - | - | - | - | - | - | - |
| **CO3** | 3 | - | - | - | - | 1 | 2 | - | - | - | - | - | - | - | - | - | - |
| **CO4** | - | - | - | - | - | | 2 | - | - | - | - | - | 2 | - | - | - | 2 |
| **CO5** | 3 | - | 3 | - | - | - | - | - | - | - | 2 | - | - | - | - | - | - |
| **Average** | **3** | **-** | **3** | **-** | **1** | **1** | **2** | **-** | **1** | **-** | **2** | **-** | **2** | **-** | **-** | **2** | **2** |

**1 - Low, 2 - Medium, 3 - High, '-' - No Correlation**