ALAGAPPA UNIVERSITY

(A State University Established in 1985)

Karaikudi - 630003. Tamil Nadu, India

2017 Accredited with A+ Grade by NAAC (CGPA : 3.64)

2018 MHRD Govt. of India UGC Graded as Category - I & Granted Autonomy

2018 MHRD Swachh Campus Rank : 4

2021 nirf NATIONAL INSTITUTIONAL RANKING FRAMEWORK Rank : 33

2021 QS UNIVERSITY RANKINGS Asia Rank : 199

FACULTY OF SCIENCE

DEPARTMENT OF MICROBIOLOGY

M.Sc., MICROBIOLOGY

REGULATIONS AND SYLLABUS

(For the candidates admitted from the Academic Year 2022 - 2023)

DEPARTMENT OF MICROBIOLOGY
M.Sc., Microbiology

REGULATIONS AND SYLLABUS

[For the candidates admitted from the Academic Year 2022 – 2023 onwards]

ALAGAPPA UNIVERSITY
(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle andGraded as Category-I University by MHRD-UGC)
Karaikudi -630003, Tamil Nadu.

The panel of Members-Broad Based Board of Studies

Chairperson Name: Dr. A. Arun, **Designation:** Professor and Head, **Department:** Microbiology, University: Alagappa University, **Teaching Experience:** 20years, **Research Experience:** 20years, **Area of Research:** Bioenergy, Bioremediation and Bioplastics	
Foreign Expert (Industry) : Name Dr. Sudhakar Muniyasamy, **Designation:** Senior Scientist and Technical leader for Bioplastics and Biodegradable polymers, Department: Chemicals Cluster – Advanced Polymer Composite Ressearch, University- CSIR, South Africa, **Research Experience:**15 yeras, Area of Research: Bioplastics.	
Indian Expert: Name: Dr. R. Thirumurugan, Designation: Professor **Department:** Animal Science, University: Bharathidasan University, Trichy.	
Indian Expert: Name: Dr. V. Rajesh Kannan, Designation: Professor, **Department:** Microbiology, University: Bharathidasan University, Trichy.	
INDUSTRY EXPERT: NAME: D. Suresh Lingam, Designation: Managing Director, Yaazh Genomics, Madurai	
Member: Name: Dr. T. Kavitha, Designation: Assistant Professor **Department:** Microbiology, University: Alagappa University Teaching Experience: 15years, **Research Experience:** 7years, **Area of Research:** Agricultural Microbiology, Environmental Microbiology	

Member: Name: Dr. T. Sathiyamoorthi, Designation: Assistant Professor **Department:** Microbiology, University: Alagappa University, Teaching Experience: 7years, **Research Experience:** 7years, Area of Research: Medical Microbiology	
Member: Name: Dr. V.Balasubramaniyan, Designation: Assistant Professor, **Department:** Microbiology, University: Alagappa University, **Teaching Experience:** 6years, Research Experience: 13years	
Alumnus Name: P. Priyanka, Current position: Lab technician, Professional address: MSK computerized lab, Karaikudi	

ALAGAPPA UNIVERSITY

DEPARTMENT OF MICROBIOLOGY

Karaikudi -630003, Tamil Nadu.

REGULATIONS AND SYLLABUS- (CBCS-University Department)

[For the candidates admitted from the Academic Year 2022 – 2023 onwards**]**

Name of the Department **:** Microbiology

Name of the Programme **:** M.Sc., Microbiology

Duration of the Programme **:** Full Time (Two Years)

Choice-Based Credit System

A choice-Based Credit System is a flexible system of learning. This system allows students to gain knowledge at their own tempo. Students shall decide on electives from a wide range of elective courses offered by the University Departments in consultation with the Department committee. As a result, students undergo additional courses and acquire more than the required number of credits. They can also adopt an inter-disciplinary and intradisciplinary approach to learning and make the best use of available faculty expertise.

Programme

"Programme" means a course of study leading to the award of a degree in a discipline.

Courses

'Course' is a component (a paper) of a programme. A unique course code identifies each course offered by the Department. A course contains lectures/tutorials/laboratory/seminar/project / practical training/report writing /Viva-voce, etc., or acombination of these to effectively meet the teaching and learning needs.

Credits

The term "Credit" refers to the weightage given to a course, usually in relation to the instructional hours assigned to it. Normally in each of the courses, credits will be assigned on the basis of the number of lectures/tutorials/laboratory and other forms of learning required to complete the course contents in a 15-week schedule. One credit is equal to one hour of lecture per week. For laboratory/field work, one credit is equal to two hours.

Semesters

An Academic year is divided into two Semesters. Each semester, courses are offered in 15 teaching weeks, and the remaining 5 weeks are to be utilized for examination and evaluation purposes. Each week has 30 working hours spread over 5 days a week.

Medium of Instruction

All the courses will be instructed in English

Departmental committee

The Departmental Committee consists of the faculty of the Department. The Departmental Committee shall be responsible for admission to all the programs offered by the Department, including the conduct of entrance tests, verification of records, admission, and evaluation. The Departmental Committee determines the course deliberation and specifies the allocation of credits semester and course-wise. Each course will also identify the number of credits for lectures, tutorials, practical, seminars, etc. The courses (Core/Discipline Specific Elective/Non-Major Elective) are designed by teachers and approved by the Departmental Committees. The Board shall approve courses approved by the Departmental Committees of Studies/Broad-Based Board of Studies. A teacher offering a course will also be responsible for maintaining attendance and performance sheets (CIA -I, CIA-II, assignments, and seminar) of all the students registered for the course. The Non-major elective programme, MOOCs coordinator, and Internship Mentor are responsible for submitting the performance sheet to the Head of the department. The Head of the Department consolidates all such performance sheets of courses pertaining to the programmes offered by the department. Then forward the same to be Controller of Examinations.

Programme Objectives- (PO)

PO-1	To understand the morphology of microorganism
PO-2	To know the diversity and phylogenetic trelationship
PO-3	To analyse and understand the physiology of bacteria
PO-4	To impart the practical skills with advanced instruments
PO-5	To acquire fundamental knowledge on working principles of biological instruments
PO-6	To learn the various industrial application of microorganisms
PO-7	To understand the concepts of production of recombinant vaccines and other pharmaceutical products using microbes
PO-8	To inculcate the students about environmental cleanup by microbes

PO-9	To make the learner aspirant in research
PO-10	To understand the importance of indispensable living creature

Programme Specific Objectives-(PSO)

PSO-1	To acquire knowledge of principles of the microbial world
PSO-2	To make the students understand on fundamental interaction of the microbes with other biological and inanimate elements
PSO-3	To understand the rationale in the field of Applied Microbiology
PSO-4	To enable the students technically sound in the Microbial Techniques
PSO-5	To produce the student with more research knowledge on Recent Trends in Microbiology

Programme Outcomes

PO1	**Basic Science Knowledge:** Students will get basic knowledge on various domain of microbiology and depth insights in to the structure and their physiological functions.
PO2	**Problem analysis:** Explore the up-to-date knowledge on concepts of Microbiology to critically analyze the problems and find the novel solutions
PO3	**Solutions:** Understand and address the current issues through microbial products effectively by appling the knowledge acquired
PO4	**Investigate complex problems:** Ability to indentify the problem, critically thinking, forming hypothesis, collect the data, find the solution and interprete their results through the biological techniques learned
PO5	**Social Interaction** Appling practical skills to develop microbial products in order to meet the societal need of the hour.
PO6	**Environmental and Sustainability** Health issues and Environmental problems can be effectively addressed by advanced techniques learned
PO7	**Ethics** Understanding moral and ethical issues while handling hazardous microbes and following the biosafety guidelines and good laboratory practices.
PO8	**Individual and team work:** Become competent entrepreneurs by crittical thinking by individual, building a team and setting mission to resolve the problem which will facilitate start ups
PO9	**Effective communication** Able to effectively communicate their own ideas and explain the concepts of microbiology through Oral and written formate to other disciplines to improve their research collaboration
PO10	**Lifelong learning** Lifelong Learning to update scientific advancement by referring to books, journals, e-books, and other modern techniques (ICT) available to address the issues of the current scenario.

Programme Specific Outcomes

PSO1	**Knowledge :** Understand the concepts of microbiology with acquired knowledge of their structure and physiology and identify the issues in the current scenario to efficiently deal the problem.
PSO2	**Research Skill:** Become an expert in practical knowledge with relevance to microbial biochemistry, molecular biology, food, and dairy technology etc by following the (GLP)Good Laboratory Practices
PSO3	**Contribution to Society:** Application of microorganisms for human welfare through rDNA technology, Medical, Agri, and environmental microbiology to address the current issues
PSO4	**Employability Skill** :Develop skils to be placed in reputed institution and to pursue higher education.
PSO5	**Entrepreneurial Skill** : Becoming an effective entrepreneur with acquired knowledge, good leadership cabability in developing sustainable products from microbes routing for the startups

Eligibility for admission

A candidate who has passed Bachelor's Degree in Biological Sciences (Microbiology, Biochemistry, Biotechnology, Botany, Zoology, Bioinformatics, Agricultural / Veterinary / Fisheries Sciences / Pharmacy) degree with at least 50% of marks and 45% marks for SC/ST candidates as main course of study of any university accepted by the syndicate as equivalent thereto, subject to such condition as may be prescribed therefore shall be permitted to appear and qualify for the M.Sc. Degree in Microbiology of this University after a course of study of two academic years.

Minimum Duration of programme

The programme is for a period of two years. Each year shall consist of two semesters, viz. Odd and Even semesters. Odd semesters shall be from June / July to October / November, and even semesters shall be from November / December to April / May. Each semester there shall be 90 working days consisting of 6 teaching hours per working day (5 days/week).

Components

A PG programme consists of a number of courses. The term "course" is applied to indicate a logical part of the program's subject matter. It is invariably equivalent to a "paper" subject matter inthe conventional sense. The following are the various categories of the courses suggested for the PG programmes

A. Core courses (CC)- "Core Papers" means "the core courses" related to the programme concerned, including practicals and project work offered under the programme, and shall cover core competency, critical thinking, analytical reasoning, and research skill.

B. Discipline-Specific Electives (DSE) means the courses offered under the programme related to the major but are to be selected by the students shall cover additional academic knowledge, critical thinking, and analytical reasoning.

C. Non-Major Electives (NME)- Exposure beyond the discipline

- Students have to undergo a total of two Non- Major Elective courses with 2
- credits offered by other departments (one in II Semester and another in III Semester).
- A uniform time frame of 3 hours on a common day (Tuesday) shall be allocated for the Non-Major Electives.
- Non-Major Elective courses offered by the departments pertaining to a semester should be announced before the end of the previous semester.
- Registration process: Students must register for the Non-Major Elective course within 15 days from the commencement of the semester, either in the department or NME portal (University Website).

D. Self Learning Courses from MOOCs platforms.

- MOOCs shall be voluntary for the students.
- Students must undergo 2 Self Learning Courses (MOOCs), one in the 2nd semester and another in the 3rd semester.
- The actual credits earned through MOOCs shall be transferred to the credit
- plan of programs as extra credits. Otherwise 2 credits/course be given if the Self Learning Course (MOOCs) is without credit.
- While selecting the MOOCs, preference shall be given to the course related to employability skills.

Internship

The students have to go for an Internship. The student can undergo industrial training in reputed organizations to accrue industrial knowledge during the vacation period at the end of the second semester (Vacation period) for two weeks. The student has to find a suitable reputed industry related to their discipline (Public limited/Private Limited/ NGOs etc.) in consultation with the faculty in charge/Mentor and get approval from the head of the department and Departmental Committee before going for an internship. After the internship, the student can submit the report to the departmental committee for assessment and awarding the mark/credit for it.

Format to be followed for Internship report (Two Copies)

The format /certificate for internship report to be followed by the student are given Below

Title page -Format of the title page

Title of internship report

Internship report submitted in partial fulfilment of the
requirement for the Master ofScience in Microbiology to the
Alagappa University, Karaikudi -630003.

By

(Student Name)

(Register Number)

University Logo

Department of Microbiology

Alagappa University

(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle and Graded as Category-I University by MHRD-UGC, 2019: QS ASIA Rank- 216, QS BRICS Rank-104,QS India Rank-20)

Karaikudi - 630003

(Year)

Certificate-(Format of certificate – faculty in charge)

This is to certify that the report entitled " " submitted to Alagappa University, Karaikudi-630 003 in partial fulfilment for the Master of Science in Microbiology by Mr/Mis---------- (Reg No) under my supervision. This is based on the work carried out by him/her in the organization M/S --. This Internship report or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar record of any University or Institution.

Place: **Research Supervisor**

Date:

Certificate (HOD)

This is to certify that the Internship report entitled " " submitted by Mr/Mis.----------(Reg No) to the Alagappa University, in partial fulfilment for the award of the Master of Science in ------- is a bonafide record of Internship report done under the supervision of----------,Dr ,Professor / Associate Professor / Assistant Professor, Department of Microbiology , Alagappa University and the work carried out by him/her in the organization M/S --.

Place: Karaikudi

Date: _____

Head of the Department

Certificate-(Format of certificate – Company supervisor or Head of the Organization)

This is to certify that the Internship report entitled "----------" submitted to Alagappa University, Karaikudi-630 003 in partial fulfilment for the Master of Science in Microbiology by Mr/Mis---------- (Reg No:----------) under my supervision. This is based on the work carried out by him/her in our organization M/S ---------- for the period of three months or ------. This Internship report or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar record of any University or Institution.

Place: Karaikudi

Date: _____

Supervisor or in charge

Declaration (student)

I hereby declare that the Internship Report entitled " " submitted to the Alagappa University for the award of the Master of Science inMicrobiology has been carried out by me under the supervision of , Dr.----------, Professor / Associate Professor / Assistant Professor, Department of Microbiology, Alagappa University, Karaikudi – 630 003. This is my original and independent work carried out by me in the organization M/S ---------- for the period of three months or …….. and has not previously formed the basis of the award of any degree, diploma, associateship, fellowship, or any other similar title of any University orInstitution.

(……..)

Place: Karaikudi

Date: _____

Acknowledgment

Content as follows:

- **No. of copies of the dissertation in final semester**

The candidate should prepare three dissertation documents and submit the same for the examiners' evaluation. After evaluation, one copy will be retained in the department library, one copy will be retained by the guide, and the student shall hold one copy.

Projects / Dissertation (Maximum Marks: 200)

- **Plan of work**

Project/Dissertation

The candidate shall undergo Project/Dissertation Work during the final semester. The candidate should prepare a scheme of work with the expertized guide in the field for the dissertation/project work. After completing the dissertation /project work, the candidate shall be allowed to submit it to the university departments at the end of the final semester.

- **Format to be followed for dissertation**

The format /certificate for the thesis to be followed by the student are given below

- Title page
- Certificate
- Acknowledgment
- **Content as follows:**

Chapter No	Title	Page number
1	Introduction	
2	Aim and objectives	
3	Review of literature	
4	Materials and methods	
5	Result	
6	Discussion	
7	Summary and Conclusion	
8	References	

- **Format of the title page**

Title of Dissertation

Dissertation/Project submitted in partial fulfillment of the requirement for the degree of Master of Science to the Alagappa University, Karaikudi -630003.

By
(Student Name)
(Register Number)
University Logo

Department of Microbiology
Alagappa University

(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle and Graded as Category-I University by MHRD-UGC, 2019: QS ASIA Rank- 216, QS BRICS Rank-104,QS India Rank-20)

Karaikudi - 630003

(Year)

- **Format of certificates**

Certificate -Guide

This is to certify that the Dissertation/Project entitled "----------" submitted to Alagappa University, Karaikudi-630 003 in partial fulfilment for the degree of Master of Science in Microbiology by Mr/Mis ----------(Reg No) under my supervision. This is based on the results of studies carried out by him/her in the Department of----------, Alagappa University, Karaikudi-630 003. This dissertation/Project or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar titles or record of any University or Institution.

Place: Karaikudi

Date: _____

Research Supervisor

Certificate - (HOD)

This is to certify that the thesis entitled "…… " submitted by Mr/Mis ----------(Reg No: ----------) to the Alagappa University, in partial fulfilment for the award of the degree of Master of Science in Microbiology is a bonafide record of research work done under the supervision of Dr , Professor / Associate Professor / Assistant Professor, Department of Microbiology, Alagappa University.

Place: Karaikudi **Head of the Department**

Date:

Declaration (student)

I hereby declare that the dissertation entitled "…….. " submitted to the Alagappa University for the award of the degree of Master of Science in Microbiology has been carried out by meunder the guidance of Dr, Professor / Associate Professor / AssistantProfessor, Department of ,Alagappa University, Karaikudi – 630 003.This is my original and independent work and has not previously formed the basis of the award of any degree, diploma, associateship, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi (……)

Date:

Teaching methods

- Participation of students is essential; they are informed previously about the topic of the lecture.
- At the beginning of the lecture, the teacher inquiries about students' expectations and sets Objectives of the lecture.
- Some important points of the previous lecture are asked about.
- Students ask about non-clear points, and the teacher joins the previous with the new lecture
- Teacher proposes some simple problems to be solved by students currently during the lecture.
- At the end, a summary of the content is presented by 2 or 3 students, followed by an organized summary by the teacher.

Attendance

Students must have earned 75% of attendance in each course to appear for the examination. Students who have earned 74% to 70% of attendance need to apply for condonation in the prescribed form with the prescribed fee. Students who have earned 69% to 60% of attendance need to apply for condonation in the prescribed form with the prescribed fee along with the Medical Certificate. Students who have below 60% of attendance are not eligible to appear for the End Semester Examination (ESE). They shall re-do the semester(s) after completion of the programme.

Examination

The examinations shall be conducted separately for theory and practicals to assess (remembering, understanding, applying, analyzing, evaluating, and creating) the knowledge required during the study. There shall be two systems of examinations, internal and external. The internal examinations shall be conducted as Continuous Internal Assessment tests I and II (CIA Test I & II).

Internal Assessment

The internal assessment shall comprise a maximum of 25 marks for each subject. The following procedure shall be followed for awarding internal marks.

Theory -25 marks

Sr.No	Content	Marks
1.	Average marks of two CIA test	15
2.	Seminar/group discussion/quiz	5
3.	Assignment/field trip report/case study report	5
	Total	25

Practical -25 Marks

1	Major Experiment	10 marks
2	Minor Experiment	5 marks
3	Spotter (2x 5/ 4 x4) or any other mode	10 marks
	Total	25 Marks

Project/Dissertation -50 Marks (assess by Guide and HOD)

1	Two presentations (mid-term)	30 Marks
2	Progress report	20 Marks
	Total	50 Marks

External Examination

There shall be examinations at the end of each semester, for odd semesters in the month of October / November; for even semesters in April / May.

A candidate who does not pass the examination in any course(s) may be permitted to appear in such failed course(s) in the subsequent examinations to be held in October / November or April / May. However, candidates who have arrears in Practical shall be permitted to take their Practical arrear examination only along with the Regular Practical examination in the respective semester.

A candidate should get registered for the first-semester examination. Suppose registration is not possible owing to a shortage of attendance beyond condonation limit/regulation prescribed OR belated joining OR on medical grounds. In that case, the candidates are permitted tomove to the next semester. Such candidates shall re-do the missed semester after completion of the programme.

For the Project Report/ Dissertation, the maximum marks will be 100 marks for project report evaluation, and for the Viva-Voce, it is 50 marks (if in some programmes, if the project is equivalent to more than one course, the project marks would be in proportion to the number of equivalent courses).

Viva-Voce: Each candidate shall be required to appear for the Viva-Voce Examination (in defense of the Dissertation).

Scheme of External Examination (Question Paper Pattern)

Theory - Maximum 75 Marks

Section A	10 questions. All questions carry equal marks. (Objective type questions)	10 x 1 = 10 Marks	10 questions – 2 each from every unit
Section B	5 questions Either / or type like 1.a (or) b. All questions carry equal marks	5 x 5 = 25	5 questions – 1 each from every unit
Section C	5 questions Either / or type like 1.a (or) b. All questions carry equal marks	5 x8 = 40	5 question –Should cover all units

Practical –Maximum 75 Marks

Section A	Major experiment	15 Marks
Section B	Minor experiment	10 Marks
Section C	Experimental setup	5 Marks
Section D	Spotters (5 x 5 marks)	25 Marks
Section E	Record note	10 Marks
Section F	Vivo voce	10 Marks

Dissertation - Scheme of evaluation

Dissertation /Project report/Internship report	100 Marks
Vivo voce	50 Marks

Results

The results of all the examinations will be published through the Department where thestudent underwent the course as well as through University Website

Passing minimum

- A candidate shall be declared to have passed in each course if he/she secures not less than 40% marks in the End Semester Examinations and 40% marks in the Internal Assessment and not less than 50% in the aggregate, taking Continuous assessment and End Semester Examinations marks together.
- The candidates who do not obtain 50% in the Internal Assessment are permitted to improve their Internal Assessment marks in the subsequent semesters (2 chances will be given)by writing the CIA tests and by submitting assignments.
- Candidates, who have secured the pass marks in the End-Semester Examination and in the CIA but failed to secure the aggregate minimum pass mark (E.S.E + C I.A), are permitted to improve their Internal Assessment mark in the following semester and/or in University examinations.
- A candidate shall be declared to have passed in the Project / Dissertation / Internship if he /she gets not less than 40% in each of the Project / Dissertation / Internship Report and Viva-Voce and not less than 50% in the aggregate of both the marks for Project Report and Viva-Voce.

- A candidate who gets less than 50% in the Project / Dissertation / Internship Report must resubmit the thesis. Such candidates need to take the Viva-Voce again on the resubmitted Project report.

Grading of the Courses

The following table gives the marks, Grade points, Letter Grades and classifications meant to indicate the overall academic performance of the candidate.

Conversion of Marks to Grade Points and Letter Grade (Performance in Paper / Course)

RANGE OF MARKS	GRADE POINTS	LETTER GRADE	DESCRIPTION
90 - 100	**9.0 – 10.0**	**O**	**Outstanding**
80 - 89	**8.0 – 8.9**	**D+**	**Excellent**
75 - 79	**7.5 – 7.9**	**D**	**Distinction**
70 - 74	**7.0 – 7.4**	**A+**	**Very Good**
60 - 69	**6.0 – 6.9**	**A**	**Good**
50 - 59	**5.0 – 5.9**	**B**	**Average**
00 - 49	**0.0**	**U**	**Re-appear**
ABSENT	**0.0**	**AAA**	**ABSENT**

a) Successful candidates passing the examinations and earning GPA between 9.0 and 10.0 and marks from 90– 100 shall be declared to have Outstanding (O).

b) Successful candidates passing the examinations and earning GPA between 8.0 and 8.9 and marks from 80- 89 shall be declared to have Excellent (D+).

c) Successful candidates passing the examinations and earning GPA between 7.5 – 7.9 and marks from 75 -79 shall be declared to have Distinction (D).

d) Successful candidates passing the examinations and earning GPA between 7.0 – 7.4 and marks from 70 -74 shall be declared to have Very Good (A+).

e) Successful candidates passing the examinations and earning GPA between 6.0 – 6.9 and marks from 60 -69 shall be declared to have Good (A).

f) Successful candidates passing the examinations and earning GPA between 5.0 – 5.9 and marks from 50 -59 shall be declared to have Average (B).

g) Candidates earning GPA between 0.0 and marks from 00 - 49 shall be declared to have Re-appear (U).

h) Absence from an examination shall not be taken as an attempt.

From the second semester onwards the total performance within a semester and continuous performance starting from the first semester are indicated respectively by **Grade Point**

Average (GPA) and Cumulative Grade Point Average (CGPA). These two are calculated by the following formulate

GRADE POINT AVERAGE (GPA) = □i Ci Gi / □i Ci

GPA = Sum of the multiplication of Grade Points by the credits of the courses Sum of the credits of the courses in a Semester

Classification of the final result

CGPA	Grade	Classification of Final Result
9.5 – 10.0	**O+**	First Class – Exemplary*
9.0 and above but below 9.5	**O**	
8.5 and above but below 9.0	**D++**	First Class with Distinction*
8.0 and above but below 8.5	**D+**	
7.5 and above but below 8.0	**D**	
7.0 and above but below 7.5	**A++**	First Class
6.5 and above but below 7.0	**A+**	
6.0 and above but below 6.5	**A**	
5.5 and above but below 6.0	**B+**	Second Class
5.0 and above but below 5.5	**B**	
0.0 and above but below 5.0	**U**	Re-appear

The final result of the candidate shall be based only on the CGPA earned by the candidate.

a)Successful candidates passing the examinations and earning CGPA between 9.5 and 10.0 shall be given Letter Grade (O+), those who earned CGPA between 9.0 and 9.4 shall be given Letter Grade (O) and declared to have First Class –Exemplary*.

b)Successful candidates passing the examinations and earning CGPA between 7.5 and 7.9 shall be given Letter Grade (D), those who earned CGPA between 8.0 and 8.4 shall be given Letter Grade (D+), those who earned CGPA between 8.5 and 8.9 shall be given Letter Grade (D++) and declared to have First Class with Distinction*.

c) Successful candidates passing the examinations and earning CGPA between 6.0 and 6.4 shall be given Letter Grade (A), those who earned CGPA between 6.5 and 6.9 shall be given Letter Grade (A+), those who earned CGPA between 7.0 and 7.4 shall be given Letter Grade (A++) and declared to have First Class.

d) Successful candidates passing the examinations and earning CGPA between 5.0 and 5.4 shall be given Letter Grade (B), those who earned CGPA between 5.5 and 5.9 shall be given Letter Grade (B+) and declared to have passed in Second Class.

i) Candidates those who earned CGPA between 0.0 and 4.9 shall be given Letter Grade (U) and declared to have Re-appear.

e) Absence from an examination shall not be taken as an attempt.

CUMULATIVE GRADE POINT AVERAGE (CGPA) = □n □i Cni Gni / □n □i Cni

CGPA = Sum of the multiplication of Grade Points by the credits of the entire Programme Sum of the credits of the courses for the entire Programme

Where 'Ci' is the Credit earned for Course i in any semester; 'Gi' is the Grade Point obtained by the student for Course i and 'n' refers to the semester in which such courses were credited.

CGPA (Cumulative Grade Point Average) = Average Grade Point of all the Courses passed starting from the first semester to the current semester.

Note: * The candidates who have passed in the first appearance and within the prescribed Semesters of the PG Programme are alone eligible for this classification.

Maximum duration of the completion of the programme

The maximum period for completion of an M.Sc., in Microbiology shall not exceed Four semesters continuing from the first semester.

Conferment of the Master's Degree

A candidate shall be eligible for the conferment of the Degree only after he/ she has earned the minimum required credits for the Programme prescribed therefor (i.e. 90 credits). Programme).

Village Extension Programme

The Sivaganga and Ramnad districts are very backward districts where most people live in poverty. The rural mass is economically and educationally backward. Thus the aimof the introduction of this Village Extension Programme is to extend out to reachenvironmental awareness, social activities, hygiene, and health to the rural people of this region. The students in their third semester must visit any of the adopted villages within the jurisdiction of Alagappa University. They can arrange various programs to educate the rural mass in the following areas for three days based on the theme.1. Environmental awareness 2. Hygiene and Health. A minimum of two faculty members can accompany the students and guide them.

M.Sc., MICROBIOLOGY-PROGRAMME STRUCTURE

S. No	Course Code	Title of the Course		T/P	Credits	Hours/ Week	Marks		
I Semester							**I**	**E**	**Total**
1	**530101**	Core1	General Microbiology	T	4	5	25	75	100
2	**530102**	Core2	Microbial Biochemistry	T	4	5	25	75	100
3	**530103**	Core3	Microbial Physiology	T	4	4	25	75	100
4	**530104**	Core4	Lab-I:Lab in General Microbiology	P	4	6	25	75	100
6	**530105**	Core5	Lab-II: Lab in Microbial Biochemistry and Microbial Physiology	P	4	6	25	75	100
7	**530501/ 530502**	DSE*-1	Biological techniques/ Microbial Diversity and Taxonomy	T	3	3	25	75	100
		Library/Yoga/counseling/Fieldtrip		-		1			
-				-	**23**	**30**	**150**	**450**	**600**
II Semester									
8	**530201**	Core6	Molecular Biology and Microbial Genetics	T	4	4	25	75	100
9	**530202**	Core7	r DNA Technology	T	4	4	25	75	100
10	**530203**	Core8	Food Microbiology	T	4	4	25	75	100
11	**530204**	Core9	LabIII: Lab in Molecular Biology and Microbial Genetics	P	4	6	25	75	100
12	**530205**	Core10	Lab-IV: Lab in rDNA Technology and Food Microbiology	P	4	6	25	75	100
13	**530503/ 530504**	DSE*2:	Agriculture and Environmental Microbiology/ Microbial Ecology	T	3	3	25	75	100
14		Non-Major Elective**		T	2	3	25	75	100
15		Self-learning course (SLC)–MOOCs***		T	Extra credit-(EC)				
16		****Internship Program During vacation at the end of the second semester(Two weeks)		-	3	-	25	75	100
-				-	**28**	**30**	**200**	**600**	**800**
III Semester									
15	**530301**	Core 11	Medical Microbiology	T	4	4	25	75	100
16	**530302**	Core 12	Immunobiology	T	4	4	25	75	100
17	**530303**	Core 13	Industrial Microbiology	T	4	4	25	75	100
18	**530304**	Core 14	LabV: Lab in Medical Microbiology	P	4	6	25	75	100
19	**530305**	Core 15	Lab-VI: Lab in Immunobiology and Industrial Microbiology	P	4	6	25	75	100
20	**530505/ 530506**	DSE*3: DSE*3:	Algal Biotechnology/ Applied Microbiology I	T	3	3	25	75	100
21		Non-Major Elective**		T	2	3	25	75	100
22		Self-learningcourse(SLC)–MOOCs***		T	T				
-				-	**25**	**30**	**175**	**525**	**700**

IV Semester									
23	**530401**	Core16	Applied MicrobiologyII	T	4	5	25	75	100
24	**530999**	Core17	*****Dissertation Work	P	10	25	50	150	200
				-	**14**	**30**	**75**	**225**	**300**
			Total		**90 +EC**		**600**	**1800**	**2400**

DSE – StudentChoiceand itmaybe conductedbyparallelsections.

** NME –Student havetoselect courses offered byother(Faculty)departments.

*** SLC- Voluntarybasis

****Internshipreport–Marks-
Internal(25)bytheinstitutionwherethestudentundergonetheinternship+ External – 75 (Report (35)+ Vivo-voce(40)= 75)

*****Dissertation report–Marks -Vivo-voce(50)+ thesis(100)+ internal(50)= 200

T-Theory,P-Practical

Non-Major Electives Course (NME) (For II Semester) - To be chosen by other PG degree Students

Subject	Contact Hrs/ Week	Credits	Total No of Hrs Allotted	Max Marks I	Max Marks E	Total
Molecular Biology	3	2	30	25	75	100
Agriculture and Environmental Microbiology	3	2	30	25	75	100

Non-Major Electives Course (NME) (For III Semester) - To be chosen by other PG degree students:

Subject	Contact Hrs / Week	Credits	Total No of Hrs Allotted	Max Marks I	Max Marks E	Total
Medical Microbiology	3	2	30	25	75	100
Food and industrial Microbiology	3	2	30	25	75	100

Semester –I					
Core	**Course code 530101**	**General Microbiology**	**T**	**Credits:4**	**Hours:5**

Unit–I		
Objective1	**Acquire knowledge on the history of microbiology and Classification of microorganisms**	
History and Scope of Microbiology –Spontaneous generation theory, and the germ theory of disease– Contribution of Leuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Joseph Lister, Winogradsky, Waksman and John Tyndall, Hargobind Khorana. **Classification of microorganisms** - Haeckel's three kingdom concept, Whittaker's five kingdom concept, Carl Woes' three-domain system, Principles and major characteristic physiological, morphological, and genetic characteristics used for microbial taxonomy. Bacterial classification (outline) according to Bergey's Manual of Systemic Bacteriology.		
Outcome1	**Recollect the history of microbiology and classify the microorganisms**	**K1**

Unit II		
Objective2	**Explain cell wall structures of bacteria and their functions**	
Ultrastructure of bacteria: Morphological types, Cell wall of Gram negative, Gram positive bacteria, and halophiles. Cell wall synthesis and functions of the cell wall. Capsule composition and function. Cell membranes in Eubacteria, archaebacteria and cyanobacteria, Cell membrane functions. Periplasmic space. Structure and function of flagella, cilia and pili, gas vesicles, chlorosomes, carboxysomes, magnetosomes and phycobilisomes. **Reserve food materials** – polyhydroxybutyrate, polyphosphates, cyanophycin and sulphur inclusions. **Bacterial endospores:** Structure, biochemistry and genetics of sporulation. General account on Mycoplasma and Actinobacteria.		
Outcome2	**Illustrate the cell wall of Eubacteria, Archaebacteria, and Cyanobacteria and understand the functions of various internal and external organs. Distinguish the bacteria based on chemical composition.**	**K2, K4**

Unit III		
Objective3	**Discuss the general characteristics, Classification and Structure of algae, Fungi, Lichen, and Protozoa**	
Algae, Fungi, Lichen, and Protozoa: General characteristics, Classification, Structure and Reproduction of **Algae:** Chlorophyta (Green algae), Diatoms, Rhodophyta (Red algae), **Fungi:** Cell wall – chemical composition and functions, membranes and their functions, nutritional strategies of fungi. Structure and life cycle of fungi Ascomycetes (Aspergillus), Zygomycetes (Mucor), Basidiomycetes (Agaricus). Diversity and importance of lichen. Morphology and classification of Protozoa		
Outcome 3	**Draw and classify the structure of different classes of algae and fungi. Elaborate the life cycle of various classes of algae and fungi. Differentiate the Algae from fungi, Understand the morphology of Protozoa**	**K2, K4, K6**

Unit IV		
Objective4	**Discuss about the viruses and bacteriophages**	
Viruses: Discovery, distinctive properties, morphology, and ultrastructure of Virus, Classification, Cultivation and Purification assay of the virus. **Bacteriophages -** structural organization and Classification, and life cycle - lytic, lysogenic. **Viral-related agents** - viroid and prion		
Outcome 4	**Recollecting the discovery of viruses, Classification of viruses, various Assay, summarizing the life cycle of viruses, differentiating virus-related agents**	**K1, K4**
Unit V		
Objective5	**Elucidate the types of media and culture preservation**	
Types of media and culture preservation: Types of growth media (natural, synthetic, complex, enriched and selective media). Anaerobic (thioglycolate, anaerobic chamber, Robertson's media, microaerophilic), liquid shake culture of aerobic bacteria Preservation and Maintenance of Microbial Cultures: Routine methods, liquid nitrogen preservation, freeze-drying (lyophilization), etc.		
Outcome5	**Formulate the different types of media for cultivation bacteria, identifying the growth characteristics on various culture media, Elaborate the methods of preservation**	**K3, K6**

Suggested Readings:

Atlas, R.A., & Bartha, R., (2000). Microbial Ecology, Fundamentals and Application. New York: Benjamin Cummings.

Aneja, K.R. (2008). A textbook of basic and applied microbiology. New Age International.

Baker. (2012). BIOS Instant Notes in Microbiology (4th ed). Taylor & Francis.

Heritage, (2012). Introductory Microbiology, Cambridge: Cambridge University Press

Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. (2000). Biology Microorganisms (12th ed). New Jerry: Prentice Hall

Pelczar, M.J., Schan, E.C. and Kreig, N.R. (2010). Microbiology: An Application Based Approach. Tata McGraw Hill Education Private Limited

Prescott, Joanne Willey, Linda Sherwood, & Christopher, J.W., (2017). Microbiology (10th ed). New York: McGraw Hill.

Stanier,R.Y., Ingraham, J. L., Wheelis, M,L., & Painter,R.R., (1986). General Microbiology (5th ed). London: Macmillan.

Stryer, L. (2019). Biochemistry (9th ed). New York: W.H. Freeman and Company

Tortora G.J., Funke, B.R.and Case, C.L. (2009). Microbiology (9th ed). Noida: Dorling Kindersley (India) Pvt. Ltd.

Online resources:

https://www.ncbi.nlm.gov/pmc/articles/PMC7176178/

http://owlcation.com/stem/types -of-culture-media/

https://microbeonline.com/maintenance-and-preservation-of-pure-cultures-of-bacteria/

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. T. Kavitha

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	-	-	-	-	M(2)	-	-	L(1)	M(2)
CO2	L(1)	M(2)	M(2)	L(1)	-	M(2)	-	L(1)	M(2)	M(2)
CO3	L(1)	S(3)	M(2)	M(2)	M(2)	L(1)	L(1)	M(2)	M(2)	M(2)
CO4	S(3)	L(1)	L(1)	-	M(2)	L(1)	M(2)	-	L(1)	S(3)
CO5	L(1)	M(2)	M(2)	L(1)	S(3)	S(3)	M(2)	S(3)	L(1)	S(3)
W.AV	**1.8**	**1.6**	**1.4**	**0.8**	**1.4**	**1.8**	**1.0**	**1.2**	**1.4**	**2.2**

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	-	M(2)	L(1)	-
CO2	L(1)	S(3)	S(3)	S(3)	S(3)
CO3	L(1)	S(3)	M(2)	S(3)	S(3)
CO4	M(2)	-	M(2)	L(1)	-
CO5	1(L)	S(3)	M(2)	M(2)	M(2)
W.AV	**1.4**	**1.8**	**2.2**	**2.0**	**1.6**

S–Strong(3),M-Medium(2),L-Low(1)

Semester – I					
Core	**Course code: 530102**	**Microbial biochemistry**	**T**	**Credits:4**	**Hours: 5**
Unit I					
Objective 1	**Learners can recall and acquire knowledge about the properties, structure and classifications of carbohydrates.**				
Carbohydrates: Classification, Structure and properties of monosaccharides and disaccharides. Polysaccharides - starch, cellulose, agar- agar and peptidoglycan. **Metabolism and it's regulation:** Gluconeogenesis, glycolysis, kreb's cycle, pentose phosphate pathway or hexose monophosphate shunt, glyoxylate cycle and Entner Doudroff pathway.					
Outcome 1	**Students can explains about the mechanisms and regulations of metabolic cycles.**				**K2**
Unit II					
Objective2	**Elaborate and relates clearly about the biosynthesis and biological importance of amino acids and proteins for students.**				
Amino acid and proteins: Classification based on structure, polarity, biological importance and reactivity. Physical properties and chemical reactions. Biosynthesis and degradation of amino acids– an overall view. **Protein:** Classification, physical and chemical properties. Structure – Primary (peptide conformation, N- and C- terminal, peptide cleavage), Secondary (α-helix, sheet, random coil, Ramachandran plot), Tertiary and Quaternary structures of proteins					
Outcome 2	**To educate and discuss about the properties, structure and classification of amino acids and proteins.**				**K6**
Unit III					
Objective3	**Develop knowledge about the classification, structure, properties and functions of lipids and fatty acids for learners.**				
Lipids and fatty acids: Classification, structure, properties and functions. Phospholipid and cholesterol synthesis in *E. coli*. Metabolism - α, β and γ oxidation of fatty acids and lipid peroxidation. **Nucleic acids:** Structure, synthesis (de novo and salvage) and degradation of purines and pyrimidines.					
Outcome 3	**Students examine the various steps in the synthesis and degradation of nucleic acids**.				**K4**
Unit IV					
Objective4	**To compare and classify the properties of enzymes and vitamins.**				
Enzymes and Vitamins: Classification, chemical nature and properties. Factors affecting enzyme activity, Active site, Enzyme inhibition- Reversible, irreversible, allosteric inhibition, enzyme specificity, co-enzymes, Mechanism of enzyme action- Lock and key model, induced fit theory. Isozyme, ribozyme and abzyme. **Vitamins** – Properties of Vitamins. Vitamins as Co – factors and Co – enzymes.					
Outcome 4	**Educate learners about the outline of various factors affecting enzyme activity.**				**K2**
Unit V					
Objective5	**Students can discuss the biosynthesis and mode of action of secondary metabolites.**				
Secondary Metabolites: Antibiotics – Classification based upon mode of action. Biosynthesis and regulation of penicillin and streptomycin. Microbial pigments – Biosynthesis of Chlorophyll. Microbial Toxins –classification, structure and mode of actions,- Salmonella toxin, Cholera toxin, Botulism toxin and Aflatoxin.					
Outcome 5	**Categorize and elaborate the importance of antibiotics, toxins and microbial pigments.**				**K4, K6**

Suggested Readings :-

Chen, C., Yaming XI. (2017). *Biochemistry,* Medtech Publisher.
Devlin, T.M. (1982). Devlin: *Textbook of Biochemistry – With Clinical Correlations*, John Wiley & Sons.
Donald Voet and Judith G. Voet, (2011). *Biochemistry* (3rd ed). John Wiley and Sons, Inc. New York.
Lehninger A.L. (2015). *Biochemistry*, Kalyani Publishers.
Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. (2000). *Biology Microorganisms* (12th ed). New Jerry: Prentice Hall.
Moat, A.G. and Foster, W. (2002). *Microbial Physiology* (4th ed). New York: John Wiley and Sons.
Satyanarayana, U. and Chakrapani, U. (2013). *Biochemistry* (4th ed). Kolkata: Book and Allied Pvt. Ltd.
Sriharsha, S.N. (2018). *Industrial Biochemistry*, Akshaya Publication.
Stryer, L. (2010). *Biochemistry* (7th ed). New York: W.H. Freeman and Company.
Veer Bala Rastogi, K.R. Aneja, (2017). *Principles of Biochemistry* (5th ed). Bengaluru: Medtech.

Online resources

https://www.microbes.info/
https://www.asmscience.org/VisualLibrary
https://microbe.net/resources/microbiology-web-resources/
https://www.microbiologyresearch.org/resources
https://libguides.wccnet.edu/oer-subjects/microbiology

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. T. Sathiamoorthi

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	L(1)	M(2)	L(1)	S(3)	L(1)	-	L(1)	M(2)	M(2)
CO2	S(3)	L(1)	-	-	M(2)	-	-	L(1)	L(1)	L(1)
CO3	S(3)	L(1)	M(2)	L(1)	M(2)	L(1)	L(1)	L(1)	M(2)	M(2)
CO4	S(3)	M(2)	L(1)	L(1)	S(3)	S(3)	-	L(1)	M(2)	S(3)
CO5	S(3)		M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)
W.AV	**3**	**1.6**	**1.4**	**1**	**2.4**	**1.4**	**-**	**1.4**	**2**	**2**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome vs Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M(2)	M(2)	-	L(1)
CO2	S(3)	M(2)	M(2)	L(1)	L(1)
CO3	S(3)	M(2)	S(3)	L(1)	L(1)
CO4	M(2)	S(3)	S(3)	M(2)	M(2)
CO5	S(3)	S(3)	S(3)	S(3)	L(1)
W.AV	**3.4**	**2.4**	**2.6**	**1.4**	**1.2**

S –Strong (3), M-Medium (2), L- Low (1)

Semester – I					
Core	**Course code: 530103**	**Microbial Physiology**	**T**	**Credits:4**	**Hours: 4**

Unit I		
Objective 1	**Acquire knowledge about the growth and survival requirements of Microorganisms for students.**	
Growth of Bacteria: Phases of growth. Growth kinetics - batch culture, continuous culture and synchronous culture - induction of synchrony. Factors affecting growth -nutrition, aeration, temperature and pH. Physiological adaptation to extreme environmental conditions. Nutritional types and metabolic diversity - types based on carbon, energy and electron sources.		
Outcome 1	**Understand the nutritional requirements and Metabolic diversity of bacteria.**	**K2**
Unit II		
Objective2	**Illustrate clearly about the types and mechanisms of microbial photosynthesis.**	
Bacterial Photosynthesis: Historical background. General types of microbial photosynthesis - oxygenic and anoxygenic. Structure of photosynthetic pigments –chlorophylls, bacteriochlorophyll, carotenoids and phycobilins. Photosynthetic bacteria - green sulfur and purple. Mechanism of photosynthesis - non-cyclic and cyclic electron transport. Photo phosphorylation. Carbon assimilation - Calvin, reverse citric acid cycle and hydroxyl propionate cycle.		
Outcome 2	**Distinguish the photosynthesis in bacteria and plants. Compare the photosynthetic pigments present in bacteria and plants.**	**K4**
Unit III		
Objective3	**Explain the concepts of Nitrogen Metabolism in bacteria.**	
Nitrogen metabolism: Nitrogen cycle - ammonification, nitrification, denitrification and nitrogen fixation. Nitrogenase enzyme, physiology of nitrogen fixation in symbiotic and free-living bacteria. Genetics of nitrogen fixation, acetylene reduction assay. Transamination and deamination.		
Outcome 3	**Examine the various steps in nitrogen cycle.**	**K4**
Unit IV		
Objective4	**Elaborate the factors of microbial stress responses.**	
Microbial stress responses - osmotic stress and osmoregulation; aerobic to anaerobic transitions; oxidative stress; pH stress; acid tolerance; thermal stress, heat shock response; nutrient stress and starvation stress. Fermentative pathways in specific groups of microbes: alcoholic, lactic acid, formic, mixed, propionic, butyric, butanol, and butanediol fermentation. Anaerobic respiration.		
Outcome 4	**Categories the fermentative pathways of microbes for the production of specific product.**	**K4**
Unit V		
Objective5	**Discuss the significance of bioenergetics.**	
Bioenergetics: Principles and laws of thermodynamics. Coupling of chemical reactions - TCA cycle, electron transport chain, and chemiosmotic theory of Mitchell. Bio membranes: Fluid mosaic model, transport across membrane - diffusion, osmosis, active transport and group translocation.		
Outcome 5	**Create and evaluate various protocols on energy production in the microbial cell.**	**K5, K6**

Suggested Readings:

Atlas, R.M. (1995). *Principles of Microbiology*. New York: Macmillan Publish Company.
Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. (2000). *Biology Microorganisms* (12th ed). New Jerry: Prentice Hall.

Moat, A.G. and Foster, W.(2002). *Microbial Physiology* (4th ed). New York: John Wiley and Sons.
Postgate, J. (1998). *Nitrogen Fixation* (3rd ed). Cambridge: Cambridge University Press.
Prescott, Joanne Willey, Linda Sherwood, Christopher J. and Woolverton. (2017). *Microbiology* (10th ed). New York: McGraw Hill.
Rustogi, M. (2016). *Bacterial Metabolism,* Bengaluru: Medtec Publisher
Satyanarayana, U. and Chakrapani, U. (2013). *Biochemistry* (4th ed). Kolkata: Book and Allied Pvt. Ltd.
Srivastava, M.L. (2008). *Microbial Biochemistry*. New Delhi: Narosa Publishing House.
Stryer, L. (2019). *Biochemistry* (9th ed). New York: W.H. Freeman and Company.
Subbarao, N.S. (2017). *Soil Microbiology*. Bengaluru: Medtec Publisher.

Online resources

https://www.microbes.info/
https://www.asmscience.org/VisualLibrary
https://microbe.net/resources/microbiology-web-resources/
https://www.microbiologyresearch.org/resources
https://www.asmscience.org/VisualLibrary

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. A. Arun

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	M(2)	L(1)	S(3)	L(1)	M(2)	L(1)	M(2)	L(1)
CO2	S(3)	L(1)	-	-	M(2)	M(2)	-	-	-	L(1)
CO3	S(3)	L(1)	M(2)	L(1)	S(3)	S(3)	L(1)	-	M(2)	M(2)
CO4	S(3)	L(1)	L(1)	L(1)	S(3)	S(3)	L(1)	M(2)	L(1)	L(1)
CO5	M(2)	S(3)	L(1)	M(2)	M(2)	M(2)	L(1)	S(3)	S(3)	M(2)
W.AV	**2.8**	**1.6**	**1.2**	**1**	**2.6**	**2.2**	**1**	**1.2**	**1.6**	**1.4**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome vs Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	M(2)	-	L(1)
CO2	S(3)	S(3)	M(2)	-	L(1)
CO3	S(3)	M(2)	S(3)	-	L(1)
CO4	M(2)	S(3)	S(3)	M(2)	M(2)
CO5	L(1)	S(3)	S(3)	S(3)	L(1)
W.AV	**2.4**	**2.8**	**2.6**	**1**	**1.2**

S –Strong (3), M-Medium (2), L- Low (1)

Semester –I					
Core	**Course Code 530104**	**Lab-I: Lab in General Microbiology**	**P**	**Credits:4**	**Hours:6**

Unit–I		
Objective1	**Gain knowledge on the fundamentals, handling and applications of microscopy, sterilization methods.**	
1. Principles and methods of sterilization 2. Preparation of media: nutrient broth, nutrient agar plate, soft agar.		
Outcome1	**Remembering the principles and methods of Sterilization. Demonstrate the various types of media preparation.**	**K1, K2**
UnitII		
Objective2	**Prepare media for bacterial growth. Discuss about plating and growth measurement techniques**	
3. Pure culture techniques: streak plate, spread plate and pour plate.		
Outcome2	**Isolate and Identifying the pure colonies by applying different plating methods**	**K3**
UnitIII		
Objective3	**Identify the microbes by different staining methods**	
4. Motility determination – Hanging drop method and soft agar method 5. Isolation and enumeration of bacteria from different environmental samples.		
Outcome 3	**Determine the motility of bacteria, Apply the differential staining procedure to differentiate bacteria based on gram staining.**	**K5**
UnitIV		
Objective4	**Discuss the plate count and heamocytometric count method**	
6. Enumeration of bacteria - viable count (plate count) and total count (Haemocytometer count). 7. Direct microscopic observation of fungal spores and mycelium 8. Staining method: simple, negative, Gram's staining and spore staining.		
Outcome 4	**Distinguish the viable and total count of cells by plate count and heamocytometric count method**	**K4, K5**
UnitV		
Objective5	**Acquire knowledge on growth curve and generation time of microbes**	
9. Determination of microbial size by micrometry 10. Fungal slide culture KOH mount preparation 11. Measurement of growth rate and generation time by turbidometry method.		
Outcome5	**Determine the microbial size by micrometry. Apply the staining methods to observe the fungal spore .Measure the growth rate and construct the growth curve.**	**K3, K5, K6**

Suggested Readings :-

Aneja, K.R. (2003). Experiments in Microbiology: Plant Pathology and Tissue Culture, New Delhi: WishwaPrakashan.

Aneja, K.N. (2018). Lab Manual of Microbiology and Biotechnology, Medtec Publisher

Cappuccino, J.H. and Sherman, N. (2014). Microbiology – A Lab Manual (10th ed). Singapore: The Benjamin Publishing Company.

David, T. Plummer, (1992). An introduction to practical Biochemistry (3rd ed). New Delhi: Tata McGraw Hill publishing Com. Ltd.
Gunasekaran, P. (1995). Laboratory Manual in Microbiology. New Delhi: New Age International (P) Ltd. Publishers.
Gold man, E and Green, H.(2008) . Practical handbook of microbiology. CRC press Jayaraman, J. (1981). Laboratory Manual in Biochemistry. New Delhi: New Age International (Pvt.) Ltd. Publishers.
Palanivel, P. (2009). Laboratory Manual for Analytical Biochemistry & Separation Techniques. (4th ed). School of Biotechnology, Madurai Kamaraj University, Madurai.
Reddy, C. A., Beveridge, T. J., Breznak, J. A., Marzluf, G. A., Schmidt, T. M., & Snyder L. R. (2007). Methods for General and Molecular Microbiology (3rd ed). Washington: American Society for Microbiology.
Trivedi, R. (2016). Practical Mannual in Microbial Physiology and Industrial Microbiology. New Delhi: SSDN Publishers

Onlineresources:
https://microbiologynote.com/hanging-drop-method/https://bio.libretexts.org/Courses/North_Carolina_State_University/MB352_General_Microbiology_Laboratory_2021_(Lee)/05%3A_Enumeration_of_Bacteria/5.01%3A_Introduction_to_Enumeration_of_Bacteria

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by:Dr. T. Kavitha

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	-	-	-	-	-	M(2)	-	L(1)	L(1)
CO2	M(2)	-	-	-	M(2)	-	M(2)	L(1)	M(2)	M(2)
CO3	S(3)	L(1)	-	-	-	-	M(2)	L(1)	M(2)	M(2)
CO4	S(3)	M(2)	-	-	-	-	-	L(1)	M(2)	M(2)
CO5	M(2)	L(1)	-	-	M(2)	-	L(1)	L(1)	M(2)	M(2)
W.AV	**2.4**	**0.8**	**-**	**-**	**0.8**	**-**	**1.4**	**0.8**	**1.8**	**1.8**

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L(1)	M(2)	L(1)	M(2)	M(2)
CO2	S(3)	M(2)	L(1)	M(2)	M(2)
CO3	L(1)	M(2)	L(1)	S(3)	S(3)
CO4	M(2)	M(2)	L(1)	S(3)	S(3)
CO5	M(2)	M(2)	L(1)	S(3)	S(3)
W.AV	**1.8**	**2.0**	**1.0**	**2.6**	**2.6**

S–Strong(3),M-Medium(2),L-Low(1)

I–Semester					
Core	**Course Code 530105**	**Lab-II: Lab in Microbial Biochemistry and Microbial Physiology**	**P**	**Credits:4**	**Hours: 6**

Unit–I		
Objective1	**To gain knowledge about the analytical instruments and study the chromatographic techniques**	
PHmetry- Preparation of buffer **Spectrophotometer:** UV visible spectrophotometer-Wave lengths can **Chromatography:** - Paper chromatography – circular. - Thin layer chromatography - separation of amino acid.		
Outcome1	Demonstrate about the basic instrumentation about pH meter and preparation of buffer and adjustment of acidic and alkaline conditions using pH meter and discuss about the principles, absorbance and emittance of light using UV-Visible spectrophotometer and to separate, identify and purify the components of a mixture using chromatographic techniques.	**K2, K3**
Unit II		
Objective2	**To understand about the biochemical methods**	
Carbohydrates: Quantitative estimation of glucose and glycogen from bacterial and yeast cells. **Protein:** Quantitative estimation of protein from bacterial yeast cells. **Enzyme:** Estimation of alkaline phosphatase activity.		
Outcome2	Formulate the measurement of carbohydrate content by hydrolyzing the polysaccharides into simple sugars and discuss about the protein estimation by Lowrys method and examine the quantitative estimation of isoenzymes.	**K3, K4**
Unit III		
Objective3	**To study the effect of environmental factors on bacterial growth**	
Environmental factor: - Effect of temperature on bacterial growth. - Effect of pH on bacterial growth.		
Outcome3	Compare the different environmental conditions such as temperature and pH on the bacterial growth.	**K2**
Unit IV		
Objective4	**Acquire knowledge on grouping of bacteria based on physiological conditions**	
Physiological groupings of bacteria. - Isolation of saccharophilic microorganisms (starch hydrolysis). - Proteolytic activity of microorganisms (casein and gelatin hydrolysis). - Lipolytic activity of microorganisms.		
Outcome4	Discuss about various methods on grouping of bacteria based on physiological characteristics such as saccharolytic, proteolytic and lipolytic activity using starch, casein, gelatin hydrolysis.	**K4**

Unit V		
Objective5	**To familiarize about degradation studies, bioenergetics**	
Utilization of Unusual compounds - Microbial degradation of azodyes **Bioenergetics.** - Cytochrome oxidase assay. -Catalase assay. **Nitrogen metabolism.** - Nitrate reduction test.		
Outcome5	Identify the role of azoreductase in decolorization by breaking down the azo bonds and perform the catalase activity that breakdown the harmful substance hydrogen peroxidase and determine the ability of organism to reduce nitrate.	**K3, K5**

Suggested Readings:

Aneja, K.R. (2003). Experiments in Microbiology: Plant Pathology and Tissue Culture, New Delhi: Wishwa Prakashan.

Aneja, K.N. (2018). Lab Manual of Microbiology and Biotechnology, Medtec Publisher Cappuccino, J.H. and

Sherman, N. (2014). Microbiology – A Lab Manual (10th ed). Singapore: The Benjamin Publishing Company.

David, T. Plummer, (1992). An introduction to practical Biochemistry (3rd ed). New Delhi: Tata McGraw Hill publishing Com. Ltd.

Gunasekaran, P. (1995). Laboratory Manual in Microbiology. New Delhi: New Age International (P) Ltd. Publishers.

Gold man, E and Green, H.(2008) . Practical handbook of microbiology. CRC press

Jayaraman, J. (1981). Laboratory Manual in Biochemistry. New Delhi: New Age International (Pvt.) Ltd. Publishers.

Palanivel, P. (2009). Laboratory Manual for Analytical Biochemistry & Separation Techniques. (4th ed). School of Biotechnology, Madurai Kamaraj University, Madurai.

Reddy, C. A., Beveridge, T. J., Breznak, J. A., Marzluf, G. A., Schmidt, T. M., & Snyder L. R. (2007). Methods for General and Molecular Microbiology (3rd ed). Washington: American Society for Microbiology.

Trivedi, R. (2016). Practical Mannual in Microbial Physiology and Industrial Microbiology. New Delhi: SSDN Publishers.

Online resources

https:// skyfox.co-Practical-Manual-of-Biochemistry.pdf

https://www.ugc.gov.in-5495549_B.Sc.-Hons-Microbiology.p

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. T.Sathiamoorthi

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L(1)	S(3)	M(2)	S(3)	M(2)	M(2)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	M(2)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)
CO3	S(3)	M(2)	S(3)	M(2)	S(3)	L(1)	S(3)	S(3)	M(2)	M(2)
CO4	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)	S(3)	M(2)	M(2)	M(2)
CO5	S(3)	S(3)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)
W.AV	**2.8**	**2.4**	**2.6**	**2.2**	**2.6**	**2**	**2.8**	**2.6**	**2.6**	**2.4**

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M(2)	M(2)	M(2)	S(3)
CO2	S(3)	M(2)	M(2)	M(2)	M(2)
CO3	S(3)	S(3)	S(3)	M(2)	M(2)
CO4	S(3)	S(3)	S(3)	S(3)	M(2)
CO5	S(3)	S(3)	S(3)	M(2)	M(2)
W.AV	**3**	**2.6**	**2.6**	**2.2**	**2.2**

S–Strong(3),M-Medium(2),L-Low(1)

Semester – I					
DSE-1	**Course code 530501**	**Biological Techniques**	**T**	**Credits: 3**	**Hours: 3**
UNIT–I					
Objective 1	To provide overview in principles, types and applications of various microscopes.				
Microscopy and preparation techniques- Principles and applications, simple, compound, dark, bright field, phase-contrast and fluorescent microscopes. Confocal laser scanning microscopy. Electron microscopy: SEM and TEM, Mechanism of image formation and contrast generation in SEM, Sample preparation methods for TEM					
Outcome 1	Learners can understand recent developments in microscopical specimen preparation techniques and their image formation mechanism.				**K2**
UNIT–II					
Objective2	To educate the basic principles and techniques of spectroscopy.				
Spectroscopy - Electromagnetic spectrum, Beer Lambert's Law. UV/VIS Spectrophotometry, single beam, dual beam, Infrared spectroscopy, FTIR, Atomic absorption spectroscopy, Electron Spin Resonance Spectroscopy techniques, Spin label and H and C NMR spectroscopy. X-ray diffraction, Fluorescent spectroscopy, Quenching, principle, instrumentation of Mass spectrometry- MALDI-ToF MS, ESI-MS, ICP-MS.					
Outcome 2	Students can understand about the analysis, chemistry and applications of spectroscopic techniques.				**K2, K4**
UNIT–III					
Objective3	To learn the role of laboratory centrifuges in diverse fields.				
Centrifugation Techniques: Principles, Swedberg unit, sedimentation coefficient, factors affecting sedimentation rate, clearing factor, rotors, their types and maintenance, determination of molecular weight by centrifugation, types of centrifuges, density gradient centrifugation, ultracentrifuges.					
Outcome 3	Students can analyze significance, principles, objectives and methodology of different types of centrifuges.				**K4**
UNIT–IV					
Objective4	To acquire quick knowledge on chromatographic and electrophoretic methods.				
Chromatography and Electrophoresis - Introduction and types of chromatography, paper, thin layer, gas and liquid, Rf value, Qualitative and preparative techniques, Gel permeation, ion exchange, HP-TLC, FPLC and affinity chromatography and instrumentation. Applications of Chromatographic Techniques in Microbiology. Electrophoresis - basic principles, PAGE - Native-PAGE, SDS-PAGE, Isoelectric focussing and 2- Dimensional gels. Capillary electrophoresis. Principle and application of Agarose gel electrophoresis, DGGE, PFGE, Mobility shift electrophoresis					
Outcome 4	Learners can understand the overall analytical potential of chromatographic and electrophoretic methods.				**K2**

UNIT–V		
Objective 5	To provide a forum on bioethics, genetic engineering and Intellectual Property Rights.	
Bioethics and IPR: Definition of bioethics and ethical issues in biosciences, Ethical committee, Guidelines for research that involve animals, humans, microorganisms, Genetic engineering, Gene therapy, organ transplantation & Stem cells. Intellectual Property Rights (IPR): Tools of IPR – Patenting; Trademark; Trade secret; Copyrights; Geographical Indications; National and International Agencies (WTO, WIPO) involved in IPR and Patenting. Patenting of biological products.		
Outcome 5	Students can discuss about ethical issues in biosciences, applications of gene therapy and patentability of microorganisms.	**K6**

Suggested Readings:

Boyer R. F., 2012 Biochemistry laboratory: modern theory and techniques (Prentice Hall, Boston, 2nd ed.,).

Campbell I. D., , 1984 Biological spectroscopy (Benjamin/Cummings Pub. Co, Menlo Park, Calif), Biophysical techniques series.

Freifelder D. M. (1982) Physical Biochemistry- Application to Biochemistry and Molecular Biology, 2nd edition., W.H. Freeman, U.S.A.

Katoch R., 2011 Analytical techniques in biochemistry and molecular biology (Springer, New York).

Pradbury, S. 1991. Basic measurement techniques for light microscopy, Oxford University Press, Royal Microscopical Society.

Sambrook, J., Russell, D.W. 2013. Molecular Cloning – A Laboratory Manual (4th eidition, Vol. 1,2,3) Cold Spring Laboratory Press, New York. Indian edition: Viva Books Private Limited, India.

Slater, R. J. (2002) Radioisotopes in Biology: A Practical Approach. Oxford University Press, UK.

Spector, D.L., Goldman, R.D. 2006. Basic methods in microscopy: Protocols and concepts from cells: A laboratory manual, 1st edition, Cold Spring Harbor Laboratory Press, New York.

Webster, J.G. 2008. Bioinstrumentation, University of Wisconsin, John Wiley & Sons, Inc. Wilson K. & Walker. J. (2010). Principles and Techniques in Practical Biochemistry. 7th ed. Cambridge Univ. Press, UK

Online resources

https://microbiologynotes.org/microscopy-overview-principles-and-its-types/
https://microbiologynotes.org/spectroscopy-introduction-principles-types-and-applications/
https://www.vedantu.com/chemistry/applications-of-centrifugation
https://collegedunia.com/exams/chromatography-chemistry-articleid-4111
https://www.iatp.org/sites/default/files/Biotechnology_Patents_and_Bioethics.htm

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. A. Arun

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	L (1)	L (1)	S (3)	M (2)	M (2)	L (1)	M (2)	S (3)	M (2)
CO2	S (3)	L (1)	L (1)	S (3)	M (2)	M (2)	L (1)	M (2)	S (3)	M (2)
CO3	S (3)	L (1)	L (1)	S (3)	M (2)	M (2)	L (1)	M (2)	S (3)	M (2)
CO4	S (3)	L (1)	L (1)	S (3)	M (2)	M (2)	L (1)	M (2)	S (3)	M (2)
CO5	M (2)	S (3)	L (1)	L (1)	L (1)	S (3)	S (3)	L (1)	M (2)	S (3)
W.AV	**2.8**	**1.4**	**1.0**	**2.6**	**1.8**	**2.2**	**1.4**	**1.8**	**2.8**	**2.2**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	S (3)	L (1)	S (3)	M (2)
CO2	S (3)	S (3)	L (1)	S (3)	M (2)
CO3	S (3)	S (3)	L (1)	S (3)	M (2)
CO4	S (3)	S (3)	L (1)	S (3)	M (2)
CO5	M (2)	M (2)	M (2)	M (2)	L (1)
W.AV	**2.8**	**2.8**	**1.2**	**2.8**	**1.8**

S –Strong (3), M-Medium (2), L- Low (1)

Semester –I					
DSE-1	**Course Code 530502**	**Microbial Diversity and Taxonomy**	**T**	**Credits:3**	**Hours:3**
Unit–I					
Objective1	**Acquire knowledge on microbial biodiversity, physiology of halophilic and thermophilic microorganisms**				
Discovery of microbial world: History, scope and relevance of microbiology. Current thoughts on microbial evolution, including the origin of life. **Introduction to microbial biodiversity** – distribution, abundance, ecological niche of bacterial, archaeal and Eukaryal. **Prokaryotic diversity:** The archaea – phylogenetic overview. **Euryarcheota** – extremely halophilicarchaea, taxonomy and physiology of halophilicarchaea. **Methane producing archaea:** methanogens – diversity and physiology. Thermo plasmatales–thermo plasma. **Hyper thermophilic euryarchaeota:** Thermo coccales and Methanopyrus.					
Outcome1	**Able to understand the ubiquitous nature of microbes and to give basic knowledge on extremophiles.**				**K1, K2**
Unit II					
Objective2	**Explain adaptability of microorganisms under extreme environment condition**				
Crenarcheota: Habitat and energy metabolism, cold dwelling microbes (artic and antartic regions), **hyperthermophiles** – terrestrial, volcanic habitats –sulfolobales and thermo proteales. **Evolution and life at high temperature** – heat stability of biomolecules, DNA stability, lipid stability. Limits to microbial existence.					
Outcome2	**Understand the adaptability and differentiate the extremophiles**				**K2, K4**
Unit III					
Objective3	**Discuss the diversity, characteristic features of various bacteria**				
Systematics, occurrence, diversity, characteristic features and significance: Spirochaetes - aerobic/microaerophilic motile, helical / vibriod - non-motile gram negative curved bacteria - gram negative aerobic rod and cocci - facultative anaerobic gram negative rod - anaerobic gram negative straight, curved & helical rods - sulfur reducing bacteria - anaerobic gram negative cocci - rickettsias and chlamydias – mycoplasmas - endosymbionts.					
Outcome 3	**Relate the various groups of bacteria and differentiate the non culturable bacteria.**				**K2, K4**
Unit IV					
Objective4	**Illustrate major Characteristics of different types of bacteria**				
Diversity- characteristic features and significance: Major Characteristics used in taxonomy. Gram positive cocci - endospore-forming; Gram positive rod and cocci regular; non-sporing; gram positive rod – Irregular, non-sporing– Mycobacteria – Nocardioformis. Anoxygenic phototrophic bacteria, oxygenic photosynthetic bacteria, Nitrogen fixers, Nitrifying / Denitrifying bacteria. **Aerobic chemo lithotrophic bacteria** – budding and appendaged bacteria, sheathed bacteria, **non-photosynthetic bacteria** - Myxobacteria – Archea bacteria.					
Outcome 4	**Differentiate the various groups of bacteria with their cultural characteristics. Elaborate the nitrifying and denitrifing groups of microbes.**				**K4, K6**

Unit V		
Objective5	**Elucidate the characteristic features of actinomycetes, Fungi and acquire knowledge on applications of bioinformatics tools**	
Diversity, characteristic features and significance: Nocardioformactinomycetes – actinomycetes with multilocular sporangia – actino planets – Streptomyces and related genera – Maduromycetes – Micromonospora - Thermonospora and related genera – Thermoactinomycetes – other genera. Fungi (general structure, nutrition and reproduction); Evolutionary analysis: distances, Cladistic and Phenetic methods. Sequence comparison, alignment and database searching – ClustalW, FASTA & BLAST. DNA barcoding.		
Outcome5	**Explore the diversity of actinobacteria, Bioinformatic tools applications in the taxonomy and analyse the evolutionary relationship.**	**K3, K4, K5**

Suggested Readings :-

Atlas, R.M. (2000). Microbiology Fundamentals and Application, New York: Macmillan Publish Company.

Booth, S.J. (2009). Microbiology: Pearls of Wisdom, Jones and Bartlett Publishers.

Dubey, R.C. and Maheswari, D.K. (2013). A text book of Microbiology (Revised). NewDelhi: S. Chand and Company Ltd.

Kreig, N.R. (1984). Bergeys Manual of Systematic Bacteriology Vol I: Sneath, P.H.A., Ed 1986, Vol II: Staley, J.T. Ed., 1989. Vol III, William, S.T., Ed., 1989, Vol IV. Baltimore: William and William.

Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. (2000). Biology Microorganisms (12th ed). New Jerry: Prentice Hall.

Nina Parker, Mark Schneegurt, Anh-Hue ThiTu, Brian M. Forster, Philip Lister. (2016). Microbiology. Washington: American Society for Microbiology.

Pelczar, M.J., Schan, E.C. and Kreig, N.R. (2010). Microbiology – An application based approach (5th ed). New Delhi: Tata McGraw Hill Publishing Company Limited.

Prescott, Joanne Willey, Linda Sherwood, Christopher J. Woolverton. (2017). Microbiology (10thed). New York: McGraw Hill.

Schlegal, H.G. (1995). General Microbiology (7th ed). Cambridge: Cambridge Univeristy Press.

Tortora G.J., Funke, B.R.and Case, C.L. (2010). Microbiology, (10th ed). Noida: San Francisco, CAPearson Benjamin Cummings, Dorling Kindersely (India) Pvt. Ltd.

Onlineresources:

https://academic.oup.com/femsle/article/330/1/1/468173

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1664684/

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by:Dr. T. Kavitha

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	L(1)	L(1)	-	-	M(2)	-	-	M(2)	M(2)
CO2	-	S(3)	M(2)	M(2)	M(2)	L(1)	L(1)	-	-	-
CO3	L(1)	M(2)	M(2)	M(2)	L(1)	-	-	1(L)	M(2)	1(L)
CO4	M(2)	L(1)	M(2)	S(3)	M(2)	M(2)	L(1)	L(1)	L(1)	L(1)
CO5	M(2)	S(3)	L(1)	L(1)	L(1)	-	-	M(2)	1(L)	-
W.AV	**1.6**	**2.0**	**1.6**	**1.6**	**1.2**	**1.0**	**0.4**	**0.8**	**1.2**	**0.8**

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	-	S(3)	-	L(1)
CO2	L(1)	-	M(2)	-	L(1)
CO3	L(1)	L(1)	M(2)	L(1)	L(1)
CO4	L(1)	L(1)	L(1)	-	-
CO5	M(2)	L(1)	M(2)	S(3)	M(2)
W.AV	**1.6**	**0.6**	**1.8**	**0.8**	**1.0**

S–Strong(3),M-Medium(2),L-Low(1)

Semester – II					
Core	**Course code: 530201**	**Molecular Biology and Microbial Genetics**	**T**	**Credits:4**	**Hours: 4**

Unit I		
Objective 1	**Classify and compare the structure and functions of genetic materials.**	
Discovery of DNA, Structure of DNA – A, B, and Z form. Forms of DNA – DNA heteroduplex, circular, super helical DNA, twisted circle. Properties of DNA -denaturation, renaturation, melting curve, hyperchromicity. Structure and types of RNA. Structure of ribosomes. Plasmids: Types and Properties of plasmids – sex factors, drug resistant, colicinogenic, Agrobacterium Ti and broad host range plasmid. Copy number, replication-circular and theta. amplification and incompatibility.		
Outcome 1	Generate elaborate knowledge on nucleic acids and plasmids.	**K4, K6**

Unit II		
Objective2	**Inculcate knowledge to relate the molecular basis of mutation and DNA repair mechanisms at the microbial level.**	
Origin of mutation. Biochemical basis of mutation: Spontaneous mutation – random and non–adaptive mutation. Mutation rates. Origin of spontaneous mutation –isolation of mutants. Selection of bacterial variation: Direct - fluctuation test, indirect- replica plating. Mutagenesis and mutagenic agents. Detection of mutagen – Ames test, in vitro mutagenesis. Molecular basis of mutation. DNA damage: DNA damages, hit theory, UV radiation. DNA repair: post-irradiation effects on survival levels - photo reactivation, liquid holding recovery. Biochemical repair mechanism: excision, recombination and SOS repair.		
Outcome 2	**Discuss and Classify the origin of mutation and mutagenic agents with their detection methods.**	**K4, K6**

Unit III		
Objective3	**Interpret genome organization, transcription and translation process in prokaryotes.**	
Replication of DNA - semi-conservative model, Meselson - Stahl experiment. Enzymology of DNA replication - DNA polymerase I, II and III; topoisomerase I and II; helicase; primase and gyrase. Molecular mechanism of DNA replication. Replication fork, origin and Okazaki fragments. Transcription process in Prokaryotes: Initiation - promotors, upstream and downstream sequences, transcription factors; Elongation - RNA polymerase, subunits; Termination – Rho dependent and Rho-independent; nus A protein and antitermination. Posttranscriptional processes: RNA processing, rRNA and tRNA processing, RNA Editing: Post-transcriptional gene regulation.		
Outcome 3	**Compile DNA replication process. Compare the transcription process in prokaryotes and eukaryotes.**	**K2, K4**

Unit IV		
Objective4	**Elaborate the gene regulation and expression mechanisms.**	
Genetic code: Elucidation of triplet code, code characteristics and codon dictionary. Reading frames, sense and nonsense code. Degeneracy - wobble hypothesis, the universality of genetic code. Process of translation in prokaryotes: Initiation and Termination. Role of rRNA in protein synthesis. Post-translational modifications - Protein modification, folding, chaperones, transportation; signal hypothesis, protein degradation. Gene concept - regulation of bacterial gene expression. Lactose system - coordinate regulation, Lac components, positive and negative regulation, catabolite repression. Tryptophan operon – regulation and attenuation. Arabinose operon and regulation.		
Outcome 4	**Examine the process of translation and Post-translational modifications.**	**K4**

Unit V		
Objective5	**Justify and construct the techniques used in gene transfer and gene recombination methods.**	
Gene transfer and recombination: Transformation. Conjugation. Transduction: DNA generalized and specialized transduction, Recombination: Types – homologous or general, site specific and random recombination, general recombination between homologous DNA-Holliday model, double strand model of general recombination, enzymes involved in recombination rec - proteins.		
Outcome 5	**Develop knowledge about genetic recombination techniques.**	**K6**

Suggested Readings :-

Benjamin Lewin. (2007). *Genes XI*. New York: Oxford University Press.

Cummings, M.R., Klug, W.S. (1995). *Essentials of Genetics* (9th ed). Pearson Publisher. David Freifelder. D. (2008). *Microbial Genetics* (18th ed). New Delhi: Narosa Publishing House. Freifelder, D. (2000). *Molecular Biology* (2nd ed). New Delhi: Narosa Publishing house.

Glick, B.K. and Pasternak, J.J. (2010). *Molecular Biotechnology: Principles and Applications of Recombinant DNA* (4th ed) Washington: ASM Press.

Sambamurty, A. V. S. S. (2007). *Molecular Genetics*. Narosa Publication.

Sanders, M.F. and Bowman, J.L. (2018). *Genetic Analysis: An Integrated Approach*. Pearson Publisher.

Stanley R. Maloy, John E.C. and Freifelder, D. (2008). *Microbial Genetics*. New Delhi: Narosa Publishing House.

Stryer, L. (2019). *Biochemistry* (9th ed). New York: W.H. Freeman and Company.

Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A. M. (2013). *Molecular Biology of the Gene* (17th ed). Tokyo: The Benjamin Cummings Publishing Company Inc.

Online resources

https://microbenotes.com/gene-cloning-requirements-principle-steps-applications/
https://geneticeducation.co.in/what-is-transcriptomics
https://www.molbiotools.com/usefullinks.html
https://geneticeducation.co.in/what-is-transcriptomics
https://courses.lumenlearning.com/boundless-biology/chapter/dna-replication/

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. A. Arun

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	L(1)	L(1)	-	M(2)	L(1)	L(1)	-	L(1)	M(2)
CO2	S(3)	S(3)	M(2)	M(2)	S(3)	S(3)	S(3)	-	M(2)	L(1)
CO3	S(3)	L(1)	L(1)	M(2)	S(3)	M(2)	L(1)	L(1)	M(2)	S(3)
CO4	M(2)	L(1)	M(2)	L(1)	M(2)	M(2)	M(2)	L(1)	M(2)	M(2)
CO5	S(3)	M(2)	M(2)	L(1)	M(2)	S(3)	M(2)	-	-	M(2)
W.AV	**2.8**	**1.6**	**1.6**	**1.2**	**2.4**	**2.2**	**1.6**	**-**	**1.4**	**2**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	M(2)	L(1)	M(2)
CO2	S(3)	M(2)	S(3)	L(1)	M(2)
CO3	M(2)	S(3)	L(1)	L(1)	L(1)
CO4	S(3)	M(2)	S(3)	L(1)	L(1)
CO5	S(3)	S(3)	M(2)	L(1)	L(1)
W.AV	**2.8**	**2.6**	**2.2**	**1**	**1.4**

S –Strong (3), M-Medium (2), L- Low (1)

Semester –II					
Core	**Course Code 530202**	**r DNA technology**	**T**	**Credits:4**	**Hours:4**
Unit–I					
Objective1	**Discuss about the DNA modifying enzymes and plasmid vectors**				
DNA modifying enzymes: Polymerases, restriction endonucleases, polynucleotide kinase, terminal deoxynucleotidyl transferase, DNase, Methylase, phosphatases, ligases. **Cloning vectors** – plasmids, cosmids, phasmids, phagemids, expression vectors, **plasmid vectors** – pBR322 and pUC18, **integrating shuttle vector** –YAC vectors, **viral vector** – SV 40 and adenovirus. **Lac Z promoter** – expression system – Lambda, PL /PR Promoter, T7 promoter, Sp6 promoter, SV – 40 promoter, CaMV 35s promoter.					
Outcome1	**Define the functions DNA modifying enzymes. Understand and compare the DNA modifying enzymes and Draw the structure of various types of plasmids. Students come out with basic ideas on cloning vehicle. To choose the suitable type of vector.**				**K1, K2, K3**
Unit II					
Objective2	**Explain the Cloning methodologies and human genome project**				
Cloning methodologies: α complementation, sticky and blunt-end cloning. Cloning from mRNA – synthesis of cDNA, cloning cDNA– cDNA library. **Cloning from genomic DNA** – genomic library. Shotgun cloning. **Screening of recombinant** – phenotypic expression of characters – Blotting techniques – western, northern and southern. **Mapping of human genes** – Human genome project					
Outcome2	**Understand the cloning strategy, to describe the construction, to compare and differentiate the blotting techniques.**				**K2, K4**
Unit III					
Objective3	**Gain knowledge on DNA sequencing and gene amplification**				
PCR: gene amplification, primer designing, optimization, variation in the PCR (RAPD, RFLP, RACE, RT-PCR) DNA sequencing – Sanger – Coulsen's method, Maxam Gilbert's method automated sequencing and microarray					
Outcome3	**Design the primer, Differentiate RAPD and RFLP. Illustrate the sequencing method.**				**K2, K6**
Unit IV					
Objective4	**Aquire knowledge on Production of biopolymers and recombinant products**				
Cloning: human insulin, interferon in E.coli. **Recombinant vaccine development** – HBs Ag in yeast. Cloning for commercial production of antibiotics (Penicillin). Bio steroid transformation. **Production of biopolymers** – Xanthumgum. Melanin biosynthesis in E.coli, adhesive biopolymer in yeast.					
Outcome 4	**Design the vector to synthesis the recombinant products**				**K6**

Unit V		
Objective5	**Elucidate the Gene silencing and gene therapy**	
Gene silencing and antisense technology: Types and mechanism of gene silencing. Genetic factors of silencing, formation of antisense mRNA, inhibition of gene expression by antisense RNA. **Gene silencing in crop plants:** tomato. Si RNA and disease control. **Plant genetic engineering:** Ti plasmid, CaMV vector, **Direct DNA delivery methods** – microprojectile bombardment, microinjection, electroporation. Liposome-mediated gene transfer and DNA/calcium phosphate co-precipitate method. Gene therapy.		
Outcome5	**Apply the molecular method for gene cloning and Explain the gene transfer methods, interpret the advantage of each methods**	**K3, K5**

Suggested Readings:

Brown, T.A. (2006). Gene Cloning and DNA Analysis: An Introduction (5th ed). Oxford: Blackwell Publishing.

Glick, B.K. and Pasternak, J.J. (2010). Molecular Biotechnology: Principles and Applications of Recombinat DNA (4th ed). Washington: ASM Press.

Hammong, J., Mc Garvey, P. and Springer, V.Y. (2000). Plant Biotechnology. Lewin, B. (2000). Genes VII, UK: Oxford University Press.

Primrose, S.B. and Twyman, R.M. (2016). Principles of Gene manipulation and Genomics (18th ed). UK: Blackwell publishing.

Stryer, L. (2019). Biochemistry (9th ed). New York: W.H. Freeman and Company.

Susan, R.B.(2008). Biotechnology, New Delhi: Cengage Learning Pvt. Ltd.

Thieman, W.J. and Palladino, M.A. (2009). Introduction to Biotechnology, Noida: Dorling Kindersley India Pvt. Ltd.

Veer BalaRastogi, (2016). Principles of molecular biology. Medtech Publishers

Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A. M. (2013). Molecular Biology of the Gene (7th ed). Tokyo: The Benjamin Cummings Publishing Company Inc.

Onlineresources:

https://pubmed.ncbi.nlm.nih.gov/9829916/

https://www.cdc.gov/mmwr/preview/mmwrhtml/00019181.htm

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by:Dr. T. Kavitha

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	M(2)	M(2)	M(2)	L(1)	L(1)	-	-	L(1)	L(1)
CO2	L(1)	M(2)	M(2)	L(1)	M(2)	M(2)	-	-	L(1)	L(1)
CO3	L(1)	L(1)	M(2)	L(1)	L(1)	L(1)	L(1)	M(2)	L(1)	L(1)
CO4	-	M(2)	M(2)	M(2)	M(2)	M(2)	L(1)	M(2)	L(1)	L(1)
CO5	L(1)	L(1)	L(1)	L(1)	-	-	-	-	L(1)	L(1)
W.AV	**1.0**	**1.6**	**1.8**	**1.4**	**1.2**	**1.6**	**0.4**	**0.8**	**1.0**	**1.0**

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	-	M(2)	-	L(1)
CO2	M(2)	M(2)	S(3)	L(1)	L(1)
CO3	L(1)	M(2)	M(2)	M(2)	S(3)
CO4	L(1)	S(3)	S(3)	M(2)	M(2)
CO5	-	S(3)	S(3)	-	-
W.AV	**1.2**	**2.0**	**2.6**	**1.0**	**1.4**

S–Strong(3),M-Medium(2),L-Low(1)

Semester – II					
Core	**Course code: 530203**	**Food Microbiology**	**T**	**Credits: 4**	**Hours: 4**
UNIT–I					
Objective 1	To acquire fundamental knowledge about developments of food microbiology and diverse habitats of microorganisms.				
History and development of Food microbiology: Role and Significance of Microorganisms in Foods, Outline of food spoilage and preservation, **Food safety and microbiological Quality Assurance.** Micro-organisms and Food Materials-Diversity of Habitat, **Micro-organisms in the Atmosphere**–Airborne Bacteria, Airborne Fungi, Micro-organisms of Soil, **Micro-organisms of Water,** Micro-organisms of Plants, Micro-organisms of Animal Origin.					
Outcome 1	Students remember origin, evolution and scope of food microbiology and exploration of food microbial diversity.				**K1**
UNIT–II					
Objective2	To illustrate different growth factors affecting the food microbial incidence and to elucidate the importance of biopreservatives.				
Factors Affecting the Growth and Survival of Micro-organisms in Foods: Microbial Growth, Intrinsic Factors-Nutrient Content, pH and Buffering Capacity, Redox Potential, Antimicrobial Barriers and Constituents, **Water Activity and Extrinsic Factors**-Relative Humidity, Temperature and Gaseous Atmosphere.					
Outcome 2	Learners understand about the intrinsic and extrinsic factors that influencing the growth and survival of food microbes.				**K2**
UNIT–III					
Objective3	To construct knowledge on Food safety practices and to create awareness about the impact of food preservation methods.				
Microbiology of Food Preservation: Heat Processing, Irradiation, High-pressure Processing–Pascalization, Low-temperature Storage and Chemical Preservatives. Aseptic Packaging, Mano-thermo-sonication, Microbiological quality standards of food, FDA, HACCP, ISI, AGMARK.					
Outcome 3	Students can distinguish the significance of various food preservation techniques and familiarize about the food safety management system.				**K4**
UNIT–IV					
Objective4	To characterize and classify the complex microbiota of raw milk and to know the principles of fermented dairy products.				
Fermented dairy products: Microbes associated with raw milk: Significance of specific groups of microorganisms in milk-psychrotrophic, mesophilic, thermoduric and thermophilic bacteria–their morphological and biochemical characteristics and classification. Microbial contaminations in raw milk, and their sources during various stages of production–milking, chilling, storage and transportation with special reference to psychrotrophic microorganisms. Fermented dairy products–microbes fermentation of butter milk, cream, yogurt, kafir, kumiss, acidophilous milk and cheese production and its types.					
Outcome 4	Learners can critically evaluate the microbiota associated with raw milk and their sources, and gain knowledge on microbial fermentation of dairy products and their potential nutrition benefits.				**K5**

UNIT–V		
Objective5	To educate about food spoilage and food borne illness in order to protect public health.	
Food spoilage, preservation and food borne diseases: organism involved in spoilage of fruits and vegetables, cereal and cereal products, meat and meat products. Food borne diseases-Bacterial food borne diseases-(*Staphylococcal* intoxication, Botulism, Salmonellosis, Shigellosis, EPEC Diarrhoea; Food-borne fungi- Mycotoxins- Aflatoxicosis, Deoxynivalenol, Mycotoxicosis, Ergotism. Food Borne Viral Pathogens- (Norwalk virus, Reovirus, Rotavirus, Adenovirus, Parvovirus, Hepatitis A Virus)		
Outcome 5	Students can discuss about food deterioration and various food borne diseases-Causes, symptoms and treatment	**K6**

Suggested Readings :-

Adams,M.R.andMoss,M.O.(2008).*FoodMicrobiology*.UK:RSCPublishing,Cambridge

Aneja, K.N.(2018).*Modern Food Microbiology*, Medtec Publisher.

Bhatnagar,R.(2017).*FoodMicrobiology*,CrescentPublishingCorporation.

BlackburnC.deW.(2006),*Foodspoilagemicroorganisms*.UK:WoodheadPublishing,Cambridge.

Cruger,W.and Crueger, A. 1995,Biotechnology. BlackWell Scientific Publications, Oxford.

Deak, T. and Beuchat, L.R. (1996). *Hand Book of Food Spoilage yeasts*, CRC.

DickM,(2017).*FoodMicrobiologyAnIntroduction*(2nd ed).Bengaluru:Medtech.

Frazier WC and Westhoff DC. (2014) Food microbiology, TATA McGraw Hill Publishing CompanyLtd.5thedition,NewDelhi.

JayJ.M.(2000).*ModernFoodMicrobiology*(6th ed).NewYork:Chapman&Hall.

FosterW.M.*FoodMicrobiology*,CBSPublication

Prescott,L.M.,Harley,J.P.andHelin,D.A.(2008).*Microbiology*(5th ed).NewYork: McGrawHill.

Online resources

https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/food-spoilage

https://www.sciencedirect.com/topics/food-science/food-preservation

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by : Dr.T. Sathiamoorthi

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	M (2)	M (2)	M (2)	L (1)	S (3)	S (3)	L (1)	M (2)	M (2)
CO2	S (3)	M (2)	L (1)	M (2)	L (1)	S (3)	L (1)	L (1)	L (1)	M (2)
CO3	M (2)	S (3)	M (2)	S (3)	M (2)	M (2)	S (3)	M (2)	M (2)	S (3)
CO4	S (3)	-	L (1)	S (3)	S (3)	M (2)	M (2)	M (2)	M (2)	M (2)
CO5	M (2)	L (1)	S (3)	M (2)	M (2)	S (3)	S (3)	L (1)	M (2)	M (2)
W.AV	**2.6**	**1.6**	**1.8**	**2.4**	**1.8**	**2.6**	**2.4**	**1.4**	**1.8**	**2.2**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	L (1)	M (2)	M (2)	M (2)
CO2	S (3)	L (1)	L (1)	M (2)	M (2)
CO3	M (2)	S (3)	L (1)	S (3)	S (3)
CO4	M (2)	S (3)	S (3)	S (3)	S (3)
CO5	M (2)	M (2)	M (2)	M (2)	S (3)
W.AV	**2.4**	**2.0**	**1.8**	**2.4**	**2.6**

S –Strong (3), M-Medium (2), L- Low (1)

Semester –II					
Core	**Course code: 530204**	**Lab-III: Lab in Molecular Biology and Microbial Genetics**	**P**	**Credits:4**	**Hours:6**

Unit–I		
Objective1	**Gain knowledge on the Isolate the genomic and plasmid DNA from bacteria and yeast**	
1. Isolation of genomic DNA from bacteria. 2. Isolation of genomic DNA from yeast. 3. Isolation of plasmid DNA from bacteria.		
Outcome1	**Isolate and identify the genomic, plasmid DNA from bacteria and yeast.**	**K1, K2**
Unit II		
Objective2	**Discuss estimation of nucleic acids by various methods**	
4. Extraction of total RNA from bacteria and yeast 5. Estimation of nucleic acids a) UV - VIS spectrophotometer analysis. b) Analysis of nucleic acids by agarose gel electrophoresis.		
Outcome2	**Apply the knowledge of molecular biology skills in clinical diagnosis.**	**K2, K6**
Unit III		
Objective3	**Illustrate extraction of total RNA from bacteria and yeast**	
6. Detection of proteins by SDS-PAGE.		
Outcome 3	**Evaluate the presence of different molecular proteins**	**K6**
Unit IV		
Objective4	**Explain the percentage of the killing of bacterial cells by UV rays.**	
7. Determination of percentage of the killing of bacterial cells by UV rays. 8. Plotting of UV survival curve.		
Outcome 4	**Determination of percentage of killing by UV. Analysis the survival time by UV exposure**	**K4, K5**
Unit V		
Objective5	**Acquire knowledge on mutation and reversion**	
9. Reversion of auxotrophy		
Outcome5	**Apply the concept of mutation and reversion**	**K3**

Suggested Readings :-

Aneja, K.R. (2003). Experiments in Microbiology: Plant Pathology and Tissue Culture. New Delhi: WishwaPrakashan.

Ausubel, F.M., Roger, B., Robert E. Kingston, David A. Moore, Seidman J.G., John A. Smith. and Kelvin, S. (1992). Short Protocols in Molecular Biology (3rd ed). New York: Jolm Wiley &Sons Inc.

Berger, S.L. and Kimmel, R. (1987). Guide to Molecular Cloning Techniques. New York: Academic Press, Inc.

Brown, T.A. (1998). Molecular Biology Lab Fax 11 Gene Analysis. London: Academic Press.

Cappuccino, J.H. and Sherman, N. (2007). Microbiology – A Lab Manual (7th ed). Singapore: The Benjamin Publishing Company.

Malov, S.R. (1990). Experimental Techniques in Bacterial Genetics. Boston: Jones and Bartlett

Publishers.
Miller, J.H. (1992). A Short Course in Bacterial Genetics: A Lab Manual &Hand Book for E. coli and related Bacteria. Cold Spring Harbour: Cold spring Harbor Lab press.
Palanivel, P. (2000). Laboratory Manual for Analytical Biochemistry & Separation Techniques. School of Biotechnology, Madurai Kamaraj University, Madurai.
Sambrook, I., Fritsch, E.F. and Maniatis, T. (2001). Molecular Cloning 1, 2, 3 - A Laboratory Manual (3rd ed). USA: Cold Spring Laboratory Press.
Verma, A.S., Surajit, D and Anchal, S. (2014). Laboratory Manual for Biotechnology. New Delhi: S. Chand and Company Ltd.

Onlineresources:

https://www.iitg.ac.in/biotech/MTechLabProtocols/SDS%20PAGE.pdf

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1203408/pdf/ge1192237.pdf

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by:Dr. T. Kavitha

Course Outcome VS Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	L(1)	L(1)	L(1)	M(2)	L(1)	L(1)	L(1)	M(2)	-
CO2	L(1)	L(1)	M(2)	M(2)	L(1)	L(1)	M(2)	M(2)	M(2)	L(1)
CO3	M(2)	M(2)	-	-	-	M(2)	L(1)	L(1)	L(1)	-
CO4	L(1)	L(1)	L(1)	-	-	-	L(1)	L(1)	L(1)	L(1)
CO5	L(1)	L(1)	L(1)	-	L(1)	M(2)	-	L(1)	L(1)	L(1)
W.AV	**1.4**	**1.2**	**1.0**	**0.6**	**0.8**	**1.2**	**1.0**	**1.2**	**1.4**	**0.6**

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	M(2)	M(2)	M(2)	M(2)
CO2	M(2)	M(2)	M(2)	M(2)	M(2)
CO3	M(2)	M(2)	L(1)	L(1)	L(1)
CO4	L(1)	L(1)	L(1)	L(1)	L(1)
CO5	M(2)	M(2)	M(2)	L(1)	L(1)
W.AV	**1.8**	**1.8**	**1.6**	**1.4**	**1.4**

S–Strong(3),M-Medium(2),L-Low(1)

Semester –II					
Core	**Course Code 530205**	**Lab-IV: Lab in r DNA Technology and Food Microbiology**	**P**	**Credits:4**	**Hours:6**

Unit I		
Objective1	**Gain knowledge on identify the antibiotic resistant mutants by various techniques**	
1. Isolation of streptomycin-resistant mutants using gradient plate technique. 2. AMES test.		
Outcome1	**Identify the streptomycin resistant mutant, Demonstrate the AIMS test**	**K3, K2**
Unit II		
Objective2	**Discuss isolation of phage from waste water sample**	
3. Isolation of auxotrophic mutant. 4. Uninterrupted bacterial conjugation. 5. Isolation of phage from the septic tank.		
Outcome2	**Identify auxotrophic mutant, Show the conjugation between bacteria, Indentify the Phage infected colony**	**K2, K3**
Unit III		
Objective3	**Illustrate molecular techniques in biological applications**	
6. P1 Transduction. 7. Isolation of pBR322/ p blue script by alkaline detergent method - A miniprep procedure 8. Recovery of DNA from gels. 9. Acrylamide gel electrophoresis and silver staining of the digested plasmid. 10. Cloning of DNA fragment in pBR322/pbluescript – insertion inactivation/ blue white selection.		
Outcome 3	**Demonstrate the P1 page transduction, identify the pBR322, Prove the Plasmid DNA presence by silver staining method. Differentiate the cloned colony by blue white selection**	**K2, K4, K6**
Unit IV		
Objective4	**Explain the Cloning techniques**	
11. Viable count of bacteria in milk. 12. Methylene Blue Dye reduction test. 13. Resazurin dye reduction test. 14. Phosphatase test. 15. Litmus milk reaction		
Outcome 4	**Enumerate the number of colony present in the milk sample, Determination of milk quality by various methods**	**K4, K5**
Unit V		
Objective5	**Acquire knowledge on assessment of milk quality and water quality by various methods**	
16. Portability analysis of drinking water.		
Outcome5	**Analysis the portability of water**	**K4**

Suggested Readings :-

Aneja, K.R. (2003). Experiments in Microbiology: Plant Pathology and Tissue Culture. New Delhi: WishwaPrakashan.

Ausubel, F.M., Roger, B., Robert E. Kingston, David A. Moore, Seidman J.G., John A. Smith. andKelvin, S. (1992). Short Protocols in Molecular Biology (3rd ed). New York: Jolm Wiley &Sons Inc.

Berger, S.L. and Kimmel, R. (1987). Guide to Molecular Cloning Techniques. New York: Academic

Press, Inc.
Brown, T.A. (1998). Molecular Biology Lab Fax 11 Gene Analysis. London: Academic Press.
Cappuccino, J.H. and Sherman, N. (2007). Microbiology – A Lab Manual (7th ed). Singapore: The Benjamin Publishing Company.
Malov, S.R. (1990). Experimental Techniques in Bacterial Genetics. Boston: Jones and Bartlett Publishers.
Miller, J.H. (1992). A Short Course in Bacterial Genetics: A Lab Manual &Hand Book for E. coli and related Bacteria. Cold Spring Harbour: Cold spring Harbor Lab press.
Palanivel, P. (2000). Laboratory Manual for Analytical Biochemistry & Separation Techniques. School of Biotechnology, Madurai Kamaraj University, Madurai.
Sambrook, I., Fritsch, E.F. and Maniatis, T. (2001). Molecular Cloning 1, 2, 3 - A Laboratory Manual (3rd ed). USA: Cold Spring Laboratory Press.
Verma, A.S., Surajit, D and Anchal, S. (2014). Laboratory Manual for Biotechnology. New Delhi: S. Chand and Company Ltd.

Onlineresources:

https://microbeonline.com/litmus-milk-test-principle-procedure-and-results/
https://redrecombineering.ncifcrf.gov/protocols/thomason-2007-p1-prot.pdf

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by:Dr. T. Kavitha

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	L(1)	L(1)	L(1)	M(2)	-	L(1)	L(1)	L(1)	L(1)
CO2	S(3)	M(2)	M(2)	M(2)	M(2)	L(1)	L(1)	L(1)	L(1)	L(1)
CO3	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	L(1)	M(2)	M(2)	M(2)
CO4	S(3)	S(3)	S(3)	-	-	-	M(2)	L(1)	L(1)	L(1)
CO5	S(3)	S(3)	M(2)	M(2)	-	-	-	-	L(1)	L(1)
W.AV	**2.6**	**2.2**	**2.0**	**1.4**	**1.2**	**0.6**	**1.0**	**1.0**	**1.2**	**1.2**

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M(2)	-	M(2)	M(2)
CO2	M(2)	M(2)	-	M(2)	M(2)
CO3	M(2)	M(2)	M(2)	M(2)	M(2)
CO4	M(2)	L(1)	M(2)	M(2)	M(2)
CO5	M(2)	M(2)	M(2)	M(2)	M(2)
W.AV	**2.2**	**1.8**	**1.2**	**2.0**	**2.0**

S–Strong(3),M-Medium(2),L-Low(1)

Semester – II					
DSE -2	**Course code:530503**	**Agriculture and Environmental Microbiology**	**T**	**Credits:3**	**Hours: 3**
Unit I					
Objective 1	**Students acquire basic knowledge about the role of microorganisms in soil fertility.**				
Diversity and distribution of microorganisms in soil: Soil microflora- Bacteria, Fungi and Actinomycetes. Classification, physical, chemical properties and structure of soil. **Microbial interactions** - mutualism, synergism, commensalism, amensalism, parasitism, predation and competition. **Microbial interactions with plants** – phyllosphere, mycorrhizae, rhizosphere and symbiotic association in root nodules. **Biofertilizer** – VAM, *Rhizobium, Frankia*, *Azospirillum, Azotobacter*, Cyanobacteria, Phosphobacteria and *Azolla.*					
Outcome 1	**Generate elaborate knowledge on diversity and distribution of soil microorganisms with their interaction with plants.**				**K4, K6**
Unit II					
Objective2	**Inculcate knowledge to relate the bacterial diseases and plant protection of agricultural crops for students.**				
Bacterial diseases of agricultural crops - pathogens, symptoms, control measures with reference to paddy, cotton, maize, tomato, citrus, mango and potato. **Plant protection** – Phenolics – phytoalexins and related compounds. Bioinsecticides – viral (Baculovirus, NPV)-bacterial (*Bacillus thuringiensis*) and fungal (*Trichoderma*) - a brief note.					
Outcome 2	**Explain and examine the various bacterial diseases and their control measures of agricultural crops.**				**K4, K5**
Unit III					
Objective3	**Learners can analyse and compare the role and importance of biogeochemical cycles in soil.**				
Bio-geo chemical cycles in soil – Carbon cycle, Nitrogen cycle – Nitrogen fixation, nitrification, denitrification, sulfur, iron and phosphorus cycles. **Aerobiology** – a brief introduction - droplet nuclei – aerosols - air-borne transmission of microbes and diseases and assessment of air quality.					
Outcome 3	**Compile the biogeochemical cycles in soil. Explain about the air borne transmission of microbes and diseases.**				**K5, K6**
Unit IV					
Objective4	**Elaborate the role of microorganisms in aquatic and marine habitats for students.**				
Aquatic microbiology - factors affecting microbial growth – temperature – pressure – light – salinity - turbidity – pH -inorganic and organic constituents. **Aquatic habitats** - freshwater - lakes, ponds and streams; **Marine habitats** - estuaries, deep sea, hydrothermal vents, saltpans, coral reefs and mangroves and their microbial communities; **zonation** – food chain and food web.					
Outcome 4	**Examine the factors affecting microbial growth in aquatic and marine environment.**				**K4**

Unit V		
Objective5	**Learners acquire deep knowledge of solid and liquid wastes.**	
Types of wastes - solid and liquid wastes. Treatment of solid wastes - Thermal Treatment: Incineration, Gasification, Pyrolysis and Open Burning- **Dumps and Landfills**: Sanitary landfills, Controlled dumps, Bioreactor Landfills-**Biological Waste Treatment**: Composting, Vermicomposting and termi composting. **Treatment of liquid wastes** –primary, secondary, tertiary treatment; anaerobic (methanogenesis), aerobic, Trickling, activated sludge, oxidation pond. Production of biogas from waste.		
Outcome 5	**Develop knowledge about various biological waste treatment methods for learners.**	**K6**

Suggested Readings:

Alexander M. (1997). *Introduction to soil microbiology*, New York: John Wiley & Sons, Inc.

EcEldowney S., Hardman, D.J. and Waite, S. (1993). *Pollution Ecology and Biotreatment.* Longman Scientific Technical.

Grant, W.D. and Long, P.L. (1981). *Environmental Microbiology*. Blalckie Glasgow and London.

Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. (2000). Twelfth Edition, *Biology Microorganisms*, New Jerry: Prentice Hall.

Mark Wheelis, (2010). *Principles of Modern Microbiology*, New Delhi: Jones & Bartlett India Pvt. Ltd.

Mehrotra, R.S. (1983). *Plant Pathology*, New Delhi: Tata McGraw Hill Publishing Company Ltd.

Pandy, B.P. (1997). *Plant Pathology (Pathogen & Plant Disease),* New Delhi: S. Chand& Company Ltd.

Ray Chadhuri, S.P. (1977). *A Manual of Virus Diseases of Tropical Plants*, New Delhi: MacMillan Company of India Ltd.

Rengaswami, G. and Rajagopalan, S. (1973). *Bacterial Plant Pathology*. Coimbatore: Tamil Nadu Agriculture University.

SubbaRao, N.S. (1995). *Soil Microorganisms and Plant Growth (3rd ed).* New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.

Online resources

https://openstax.org/details/books/microbiology
https://www.scienceprofonline.com/instructors-corner/instructors-corner-vmc.html
www.environmentshumail.blogspot.in/
https://www.frontiersin.org/articles/10.3389/fpls.2017.01617/full
https://serc.carleton.edu/microbelife/index.html

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr.G.Dhanam Jayam

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	M(2)	M(2)	S(3)	S(3)	L(1)	L(1)	M(2)	M(2)
CO2	M(2)	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	L(1)	S(3)	S(3)
CO3	S(3)	M(2)	M(2)	M(2)	S(3)	S(3)	L(1)	-	L(1)	L(1)
CO4	S(3)	S(3)	L(1)	L(1)	S(3)	S(3)	L(1)	-	L(1)	-
CO5	M(2)	S(3)	M(2)	M(2)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)
W.AV	**2.6**	**2.6**	**2.0**	**2.0**	**3.0**	**3.0**	**1.4**	**1.0**	**2.0**	**1.6**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	M(2)	M(2)	-
CO2	S(3)	S(3)	S(3)	-	L(1)
CO3	S(3)	S(3)	M(2)	-	-
CO4	M(2)	M(2)	S(3)	L(1)	M(2)
CO5	S(3)	S(3)	S(3)	S(3)	S(3)
W.AV	**2.8**	**2.8**	**2.6**	**1.2**	**1.2**

S –Strong (3), M-Medium (2), L- Low (1)

II-Semester					
DSE-2	**Course Code: 530504**	**Microbial Ecology**	**T**	**Credits:3**	**Hours: 3**
Unit -1					
Objective 1:	**To create awareness on the evolutionary relationship of ecosystem**				
Introduction microbial ecology:- overview, history and scope of microbial ecology. Population ecology: properties of population–density, natality and fecundity, mortality,longevity and senescence, immigration and emigration. Microbial population ecology –population growth, density dependence and independence, r and k selection. Species concept – universal, biological, phenetical, evolutionary and phylogenetic. Speciation – bacterial, mismatch repair as a speciation mechanism, rapid speciation, operons, genome economization and speciation, hypermutation, genome reduction.					
Outcome 1	Recall microbial ecology, history, scope, and its significance, properties of microbial populations. Define population concept and analyse species in microbial ecology and evaluate bacterial speciation.				**K1, K4, K5**
Unit -2					
Objective 2:	**To understand the concepts of microbial ecology**				
Concepts of microbial ecology:- definition and terminology, Ecology of individuals- the study of individual microorganisms, genetic individuals, ramets. ecological individual, niche. Abiotic constraints (temperature, pH, nutrient source, electron acceptor, redox, pressure, and light), metapopulation, dispersal, modularity, source and sinks, and population ecology of genes. Source of phenotypic and genotypic variation, gene ecology.					
Outcome 2	Define the terminology and concepts in microbial ecology. Discuss the ecology of individual microorganisms, niches, and genetic variation and identify abiotic factors and their impact on microbial populations. Apply the principles of population dynamics, in microbial ecology.				**K1, K3, K4**
Unit -3					
Objective 3:	**To gain knowledge about the population study and sensing**				
Population and spatial stability:- Uniformity of populations, adaptation, the population in time. Bacterial communication: Quorum sensing – the evolutionary implication of quorum sensing, cell-cell communication in bacteria, quorum sensing and evolution, disruption or manipulation of quorum sensing response, oligotrophic state of nature, starvation survival, aging, senescence, death, dormancy or resting state and miniaturization.					
Outcome 3	Examine the uniformity, adaptation, and temporal aspects of microbial populations. Describe bacterial communication through quorum sensing, Explain their role and effects on evolution and response. Explore and evaluate survival strategies, such as starvation, aging, dormancy, and miniaturization.				**K2, K4, K5**
Unit -4					
Objective 4:	**To learn about the individual ecosystem and its interactions.**				
Microbial Interactions:- with their physical and chemical environment, Species interaction and processes: Species interaction, proliferation hypothesis. Interactions with the biotic environment: symbiosis, competition, parasitism, predation, Negative relationship – parasitism, predation, bacterial and viral interaction, microbial loop and bacteria as predators. Neutral relationship: positive relationship - metabiosis and symbiosis.					
Outcome 4	Define and explain the concepts of various microbial interactions with their physical and chemical environment and analysetheir impact on microbial communities and ecosystem.				**K1,K2, K4**

Unit -5		
Objective 5:	**To understand the concepts of community ecology.**	
Community ecology:-Water communities - hydrosphere ecology of fresh water,composition and activity of freshwater microbial communities, physical and chemicalfactors, estuaries and marine water environment; characteristics and stratification of the ocean, composition and activity of marine microbial communities, the role of microbes in the aquatic environment and lithosphere. Soil communities - introduction to soil formation, rock and minerals, soil horizon, soil texture, organic matter, chemical properties of soil, and soil microbial communities. Biofilm communities, phylogenetics, and community ecology.		
Outcome 5	Define ecology of aquatic ecosystems. Analyse the ecology of microbial community's composition, and explain the role of microbes in aquatic and soil ecosystem. Apply the knowledge of microbial role in soil formation and evaluate the principles of community ecology.	**K1,K2, K4, K5**

Suggested Readings :-

Atlas, R.A. and Bartha, R. (2000). Microbial Ecology, Fundamentals and Application. New York: Benjamin Cummings.

Dubey, R.C. and Maheswari, D.K. (2013). A text book of Microbiology (Revised). New Delhi: S. Chand and Company Ltd.

Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. (2000). Biology Microorganisms (12th ed)., New Jerry: Prentice Hall.

Pelczar, M.J., Schan, E.C. and Kreig, N.R. (2010). Microbiology – An application based approach (5th ed). New Delhi: Tata McGraw Hill Publishing Company Limited.

Prescott, L.M., Harley, J.P. and Helin, D.A. (2008). Microbiology (9thed). New York: McGraw Hill.

Saha, T.K. (2010). Ecology and Environmental Biology. Kolkata: Books and Allied Pvt. Ltd. Schlegal, H.G. (1995). General Microbiology (7thed). Cambridge: Cambridge Univeristy Press.

Stanier, R., Lingraham, Y., Wheelis, M.L. and Painter, R.P. (1986). General Microbiology (5thed). London: Macmillan.

Tortora G.J., Funke, B.R. and Case, C.L. (2009). Microbiology (9thed). Noida: Dorling Kindersely (India) Pvt. Ltd.

Online resources

https://byjus.com/biology/an-overview-of-community-ecology/https://en.wikipedia.org/wiki/Quorum_sensing

https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMB2101.pdf

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr.G.Dhanam Jayam

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	L(1)	L(1)	-	M(2)	M(2)	L(1)	S(3)	M(2)
CO2	S(3)	M(2)	M(2)	S(3)	M(2)	S(3)	L(1)	L(1)	S(3)	S(3)
C03	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)
CO4	S(3)	M(2)	L(1)	S(3)	M(2)	S(3)	M(2)	L(1)	S(3)	M(2)
C05	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)	M(2)
W.AV	**3**	**2**	**2**	**2.4**	**1.8**	**2.8**	**1.8**	**1.4**	**2.6**	**2.4**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M(2)	M(2)	M(2)	M(2)
CO2	S(3)	M(2)	M(2)	S(3)	M(2)
CO3	S(3)	S(3)	S(3)	M(2)	M(2)
CO4	S(3)	S(3)	M(2)	L(1)	L(1)
CO5	S(3)	S(3)	S(3)	M(2)	M(2)
W.AV	**3**	**2.6**	**2.4**	**2**	**1.8**

S –Strong (3), M-Medium (2), L- Low (1)

Semester III					
Core	**Course Code: 530301**	**Medical Microbiology**	**T**	**Credits:4**	**Hours:4**

Unit I

Objective1	**Acquire Knowledge on collection, transportation and processing of various kinds of clinical specimens**	
Laboratory management – Safety in containment laboratory. Rules and regulationsto be followed in a microbiology laboratory. Collection, transport of clinical samplesand laboratory waste disposal system. Microbiological examination of urine, blood,feces, cerebrospinal fluid, throat swabs, sputum, pus and wound exudates. **Normalfloraofhumansystems**– skin,respiratorytract,gastrointestinaltractandgenitourinarytract.Nosocomialinfections. Storage method of clinical samples in laboratory		
Outcome1	List the rules and regulations in microbiology laboratory and identify the flora of human systems. Enumerate the steps involved in collection, transport of clinical specimens. Anlayse the disease associated with noscominal infections and storage method of clinical samples.	**K1, K4**

Unit II

Objective2	**Explain morphology, characteristics and pathogenesis of bacteria**	
Morphology,classification,culturalcharacteristics,pathogenicity,laboratorydiagnosis and prevention of infections caused by the following organisms: **Grampositivecocci**– *Staphylococci,Streptococci.***Gramnegativecocci**–*Gonococci.***Gram positive non-spore-forming bacilli**: aerobic – *Corynebacteria* and anaerobic-*Actinomyces*.**Grampositivesporeformingbacilli**:aerobic-*Bacillusanthracis* and anaerobic *Clostridia. Corynebacterium diptheriae*		
Outcome2	Analyze the various types of bacterial infections and its pathogenesis, diagnosis and preventive measures and classify the bacterial morphological, cultural characteristics.	**K2, K4**

Unit III

Objective3	**To gain knowledge about the various types of bacterial diseases and its control measures.**	
Generalcharacters, pathogenesis, laboratory diagnosis and control measures of: **Gramnegativenon-spore-formingbacilli**:Aerobic-*Bordetella*.Smallgramnegativefacultative anaerobic bacteria – *Yersinia*. **Enteric gram negative bacilli** – *Vibrio*,*E.coli* and *Salmonella.* **Acid fast bacteria** – *M. tuberculosis, M.* leprae.Cell wall lessbacteria–*Mycoplasma*.**Spirochaetes**– Leptospirosis.Sexuallytransmitteddiseases		
Outcome3	Discuss about the characters, pathogenesis and laboratory diagnosis of diseases caused by bacterial species and identify its preventive measures.	**K3, K4**

Unit IV

Objective4	**Acquire knowledge on yeast & fungi and their importance**	
General characteristics, pathogenesis and laboratory diagnosis and control measuresof**Yeast**– *Cryptococcusneoformans.***Yeast-likefungus**–*Candidaspp*.**Filamentousfungi** – *Aspergillus* and *Penicillium.* Dimorphic fungi, yeast morphology, generalcharacteristics and reproduction. – *Blastomyces dermatitis.* Classification, structure and reproduction of fungi, general characteristics ofIntracellularparasites–*Cryptosporidium* and *Plasmodium.* Intralumenparasites– *Entameobahistolytica* and *Ascarislumbricoides.*Parasiticzoonosis–*Toxoplasma*and*Taenia.*		
Outcome4	Employ various methods to detect fungi & yeast in clinical samples and apply knowledge on antifungal agents. Discuss about the fungi classification, its structure and reproduction. Explore about the disease caused by intralumen parasites and parasitic zoonosis.	**K4, K5**

Unit V		
Objective5	**To understand about the viral related diseases, emerging and reemerging disease**	
Morphology, pathogenesis and laboratory diagnosis and control measures of: **DNA viruses** – Hepatitis B virus. **RNA viruses** – Flavi virus (dengue), Retrovirus – HIV.**Viral zoonosis** -rabies. **Classification of antibiotics based on the mode of action**: anti bacterial(Penicillin),antiviral(Amantadine),antifungal(Amphotericin),antiparasitic drugs (Quinine and Metronidazole). Infectious diseases- Definition of emerging& re-emerging diseases. Factors contributing to emergence. Examples (Chickungunya, Zikavirus, H1N1and Ebola).Nationalprogramsin the preventionof infectiousdiseases. Papilomaviridae- Human papilloma viruses and Rhabdoviridae		
Outcome5	Apply various diagnostic methods to detect virus infections. Interpret the mode of action of antibiotics and outline the national programs in prevention of infectious diseases and factors contributing to emergence.	**K3, K5, K2**

Suggested Readings :-

AnathanarayanRandJeyaramPanikersC.K.(2013).*TextBookofMicrobiology*(9th ed).NewDelhi:Jainbookdepot.

AroraD.R.,BrijBalaArora.(2015).*TextbookofMicrobiology*.Chennai:CBS.

AwetzMelnickandAdelberg's.(2010).*MedicalMicrobiology,21st Century.*Appleton&Lange.BhattacharjeeR.N.(2015).*IntroductiontoMicrobiology*(1st ed).NewDelhi:KalyaniPublishers.ConnieRMahon.(2010).*TextbookofDiagnosticMicrobiology*(3rd ed).Pearson.

DavidGreenwood, RichardSlack, JohnPeutherer.(2012).*MedicalMicrobiology* ChurchillLivingstone.

JesseRussell,RonaldCohn.(2012).*MedicalMicrobiology.*BookonDemandLtd.MyraWilkinson.(2011). *MedicalMicrobiology.*ScionPublishingLtd

PatrickR.Murray.(2015).*MedicalMicrobiology.*Elsevier

Patrick Murray & Ken Rosenthal & Michael Pfalle. (2015). *Medical Microbiology* (8th ed).NewYork

Online resources

https://www.acs.org/careers/chemical-sciences/fields/laboratory-management.html

https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/dna-virus

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. T.Sathiamoorthi

Course OutcomeVS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L(1)	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)	L(1)
CO2	M(2)	M(2)	L(1)	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)	S(3)
CO3	S(3)	M(2)	L(1)	M(2)	S(3)	L(1)	L(1)	L(1)	M(2)	M(2)
CO4	M(2)	M(2)	M(2)	L(1)	L(1)	S(3)	S(3)	-	M(2)	L(1)
CO5	L(1)	S(3)	S(3)	M(2)	L(1)	M(2)	M(2)	M(2)	L(1)	L(1)
W.AV	**1.8**	**2.4**	**1.8**	**2**	**2**	**2.2**	**2.2**	**2.2**	**2.2**	**1.6**

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	S(3)	S(3)	M(2)	S(3)
CO2	L(1)	M(2)	L(1)	M(2)	L(1)
CO3	S(3)	L(1)	M(2)	L(1)	M(2)
CO4	M(2)	L(1)	M(2)	S(3)	M(2)
CO5	L(1)	M(2)	S(3)	M(2)	L(1)
W.AV	**1.8**	**1.8**	**2.2**	**2**	**1.8**

S–Strong(3),M-Medium(2),L-Low(1)

Semester -III					
Core	**Course Code 530302**	**Immunobiology**	**T**	**Credits:4**	**Hours:4**

Unit–I

Objective1	**Discuss types of immunity, Indentify organs and cells involved in immunity**	
History and scope of immunology: Types of immunity: innate-components-physical, physiological defenses: complement, acute phase proteins and adaptive immunity, **Acquired immunity:** (specific) natural, artificial, active and passive immunity. **Inflammatory response;** Phagocytic system-mononuclear phagocytes, macrophages, neutrophils, Natural killer cells, mast cells, basophils, and eosinophils. **Physiology of immune response** – humoral and cell-mediated immunity. **Lymphoid organs** – primary and secondary. **Barriers of the immune system**- Haematopoietic stem cells. Transfusion, rh incompatibility.		
Outcome1	**Define the Immunity, Differentiate various types of Immunity, Recal the role of immune cells. Classify the types of immune cells and organs. Understand the principles of heamatopoies.**	**K1, K2, K4**

Unit II

Objective2	**Compare the types of antigens and their properties**	
Antigens: characteristics, types, cross-reactivity, hapten, adjuvant, immunogenicity and antigenicity. **Immunoglobulin** – types structure and functions. Engineered antibodies. Antigen- Antibody interactions. **Immuno technology** – hybridoma and monoclonal antibodies. Super antigen, antigen processing and presentation to T-lymphocytes.		
Outcome2	**Distinguish various types of antigen and antibodies. Explain the antigen antibody interaction. Elaborate the hybridoma technology.**	**K3, K4, K6**

Unit III

Objective3	**Elucidate the mechanisms of different hypersensitivity reactions**	
Immune effector mechanisms: Cytokines – properties and functions. **Complement components** – classical and alternate pathways, complement activation, and complement deficiencies. **Hypersensitivity** – anaphylaxis, cytotoxic, immune complex deposition and cell- mediated. **Autoimmunity** – idiotype, network and autoimmune diseases. Mechanism of immune regulation – tolerance. DTH response		
Outcome3	**Describe the complement fixation pathways and List the complement proteins. Summarise the hypersensitivity reaction and Autoimmune diseases.**	**K1, K2, K4**

Unit IV

Objective4	**List out the infectious diseases, discuss about vaccines and their development.**	
Immunity to infectious diseases: bacterial (Mycobacterium tuberculosis), viral (HIV), protozoan (Leishmania). **Vaccines:** Types – inactivated, subunit, synthetic, DNA and live attenuated vaccines-Immunoinformation, immunomodulation in infection		
Outcome4	**Demonstrate the role of various types of vaccines. Determine the disease based on immunological symptoms.**	**K3, K5**

Unit V		
Objective5	**Aquire knowledge on Transplantation studies and learn the principles of immunological techniques.**	
Transplantation immunology: Graft versus host reactions. Structure, functions of class I and class II MHC molecules, HLA typing. **Principles of tumor immunology**: Immunodiagnosis based on **antigen and antibody interaction** - precipitation, agglutination, EIA, RIA, Immunodiffusion, Immunoelectrophoresis, Immunofluorescence, Immunoprecipitation, flow cytometry and immunofluorescence, ELI spot techniques, cancer immunology.		
Outcome5	**Classify the MHC molecules, Apply the immunological techniques to test the samples.**	**K2, K3**

Suggested Readings :-

Abul, K. Abbas Andrew H. H. Lichtman& Shiv Pillai. (2015). Basic Immunology, Functions and Disorders of the Immune System (5th ed). Elsevier.

Abul K. Abbas & Andrew H. Lichtman& Shiv Pillai. (2014). Cellular and Molecular Immunology(8th ed). Elsevier.

Barbara, J. A., Regan, F. A., & Contreras, M. (Eds.). (2008). Transfusion microbiology. Cambridge University Press.

Coico, R., & Sunshine, G. (2015). Immunology: a short course. John Wiley & Sons. Day, M. J., & Schultz, R. D. (2014). Veterinary immunology: principles and practice. CRC Press.

Geha, R., &Notarangelo, L. (2012). Case studies in immunology: a clinical companion. GarlandScience.

Jenni Punt; Sharon A Stranford; Patricia P Jones; Janis Kuby. (2013). Kuby immunology. New York: W.H. Freeman.

Joseph, A. Bellanti. (2016). Immunology IV: Clinical Applications in Health and Disease. Washington, DC: Georgetown University School of Medicine.

Murphy, K., & Weaver, C. (2016). Janeway'simmunobiology (9th ed). Garland Science. Rao, C. V. (2013). Immunology (2nd ed). New Delhi: Narosa Publishing House.

Onlineresources:

https://www.khanacademy.org/science/how-does-the-human-body-work-class-12/x7babbc170453fdb8:human-health-and-disease/x7babbc170453fdb8:types-of-immunity-and-the-immune-system/a/lymphoid-organs-review

https://www.medicalnewstoday.com/articles/hypersensitivity-reactions

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by:Dr. T. Kavitha

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	M(2)	L(1)	L(1)	L(1)	--	-	-	M(2)
CO2	L(1)	-	-	-	-	M(2)	-	-	-	-
CO3	M(2)	-	-	-	-	L(1)	-	-	L(1)	L(1)
CO4	M(2)	M(2)	M(2)	L(1)	S(3)	S(3)	M(2)	L(1)	L(1)	L(1)
CO5	L(1)	-	-	-	M(2)	L(1)	L(1)	L(1)	-	-
W.AV	**1.8**	**0.8**	**0.4**	**0.4**	**1.2**	**1.6**	**0.6**	**0.4**	**0.4**	**0.8**

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	S(3)	L(1)	M(2)	M(2)
CO2	L(1)	M(2)	M(2)	L(1)	L(1)
CO3	M(2)	L(1)	L(1)	L(1)	L(1)
CO4	S(3)	S(3)	S(3)	S(3)	S(3)
CO5	L(1)	M(2)	M(2)	M(2)	M(2)
W.AV	**1.8**	**2.2**	**1.8**	**1.8**	**1.8**

S–Strong(3),M-Medium(2),L-Low(1)

Semester -III					
Core	**Course code: 530 303**	**Industrial Microbiology**	**T**	**Credits:4**	**Hours: 4**

Unit -1		
Objective 1	**To know basic about the fermentation process and strain improvement methods**	
An introduction to fermentation process:- Screening of industrial microbes – Detection and assay of fermentation products. Classification of fermentation types. Genetic control of fermentation. Strain selection and improvement, mutation - protoplast fusion, parasexual reproduction and recombinant DNA technique for strain development. Preservation methods of cultures.		
Outcome 1	Recall the concept of fermentation process and screening methods of industrial microbes and fermentation types. Explain the methods of strain selection and improvement and genetic control mechanisms of fermentation processes and preservation of microbial cultures. Analyse the advantages and disadvantages of various strain improvement methods and impact of strain selection on fermentation products.	**K1, K2, K4**

Unit -2		
Objective2	**To learn about the types and applications of bioreactors**	
Types and design of bioreactors:- Packed/fluidized, fed, transport phenomena – mass transfer, Newtonian and non – Newtonian behavior of fluid – mass transfer coefficient, oxygen, viscosity, heat transfer and scale up. Mode of operation. Instrumentation and computer application in fermentation		
Outcome 2	Describe the bioreactors types and their design principles. Explain and apply the role of instrumentation and computers in fermentation processes. Analyse the bioreactor design for scale up process.	**K2,K3, K4**

Unit -3		
Objective 3	**To gain knowledge about the fermentation kinetics**	
Fermentation kinetics: Yield factors - growth rate parameters- kinetics of growth and product formation in batch, chemostat and fed-batch culture. Inoculum development, media formulation, optimization methods, media sterilization, statistical design for media formulation, optimization, and contour Plot. Immobilization of cells and enzymes - methods and applications.		
Outcome 3	Describe the principles of media formulation and optimization methods. Identify and Analyze the growth rate parameters and kinetics of growth and product formation in batch, chemostat, and fed-batch cultures.Apply the immobilization methods in fermentation.	**K2,K3, K4**

Unit -4		
Objective 4	**To study other microbial fermentation and its products**	
Fermentation of microbial products:– Single Cell Protein (SCP).Anaerobic fermentation (beer and wine). Aerobic fermentation (vinegar and citric acid. Antibiotic fermentation (penicillin and streptomycin). Vitamins (B12, riboflavin), Hormone (gibberellic acid, IAA). Enzyme (amylase, protease). Biogas production.		
Outcome 4	Identify and explain the fermentation processes of various microbial products and explain their fermentation principle, methods and key steps. Analyse the factors involved in the quality of fermentation.	**K1, K2, K4**

Unit -5		
Objective 5	**To understand about the downstream fermentation process**	
Downstream processing:-Cell disruption – physical and chemical methods. Precipitation. Filtration-batch and continuous filters. Centrifugation - types, liquid liquid extraction, chromatography, membrane process, drying, crystallization. Quality control and evaluation of industrial products a nd packaging. Fermentation economics - market potential, process cost, recovery cost		
Outcome 5	Mention and explain different methods of downstream processing for the purification, extraction, and recovery of microbial products and Explore and analyze the quality control methods.	**K1, K2, K4, K5**

Suggested Readings :-

Casida, L.E.J.R. (2019). Industrial Microbiology (2nd ed). New Delhi: New Age International (P) Ltd., Publishers.

Crueger, W. (2017). Biotechnology: A Test Book of Industrial Microbiology (3rd ed), MEDTECH Publishers.

El-Mansi, E. M. T., Bryce, C. F. A., Arnold L. Demain and Allman, A.R. (2012). Fermentation Microbiology and Biotechnology, CRC Press.

Glick, B.R., and Patten, C.L. (2010). Molecular Biotechnology Principles and Applications of Recombinant DNA (4th ed). ASM Publishers.

Joshi, R.D. (2017). Text Book of Industrial Microbiology, Oxford.

Patel A.H. (2016). Industrial Microbiology. (2nd ed). New Delhi: Laxmi Publications (P) Ltd. Peppler, H. and Pearman, D. (1979). Microbial Technology, Vol.I, New York: Academic Press. Prescott, L.M., Harley, J.P. and Helin, D.A. (2015). Microbiology (5th ed). New Delhi: McGraw Hill.

Stanbury, P.F, Whitaker, A. and Hall, S.J. (2016). Principles of Fermentation Technology (3rd ed). New Delhi: Aditya Book (P) Ltd.

Waites, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. (2001). Industrial Microbiology: An Introduction. London: Blackwell Science.

Online resources

https://en.wikipedia.org/wiki/Industrial_fermentation
https://atlas-scientific.com/blog/types-of-bioreactors
http://www.eolss.net/sample-chapters/c06/e6-34-09-09.pdf

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by:Dr. T. Sathiamoorthi

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)	L(1)	M(2)	L(1)
CO2	M(2)	L(1)	L(1)	S(3)	M(2)	-	M(2)	L(1)	L(1)	L(1)
C03	S(3)	M(2)	S(3)	S(3)	L(1)	-	S(3)	M(2)	S(3)	S(3)
CO4	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)	M(2)	M(2)
C05	M(2)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)
W.AV	**2.4**	**1.8**	**2.2**	**2.6**	**2**	**1.6**	**2.4**	**2**	**2**	**1.8**

Strong (3), M-Medium (2), L- Low (1)

Course OutcomeVS ProgrammeSpecificOutcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M(2)	M(2)	L(1)	L(1)
CO2	M(2)	M(2)	S(3)	S(3)	S(3)
CO3	S(3)	S(3)	M(2)	M(2)	M(2)
CO4	M(2)	S(3)	S(3)	S(3)	S(3)
CO5	L(1)	M(2)	S(3)	S(3)	S(3)
W.AV	**2.2**	**2.4**	**2.6**	**2.4**	**2.4**

S –Strong (3), M-Medium (2), L- Low (1)

Semester – III					
Core	**Course Code: 530304**	**Lab V: Lab in Medical Microbiology**	**P**	**Credits:4**	**Hours: 6**

Unit I		
Objective 1	**Learners understand the techniques for identification of the pathogens through various staining methods.**	
Staining methods for the morphological feature of pathogenic bacteria. A. Differential stains – Gram stain, Ziehl Neelsen's stain for AFB B. Cytological stains – i) Endospore stain – *Bacillus, Clostridium* ii) Capsule stain – positive stain C. Stain for Amoeba / Intestinal protozoa / Malarial parasites – Iron haematoxylin stain, Leishman's stain, Giemsa stain.		
Outcome 1	**Compare and distinguish the morphological features of pathogenic bacteria using different staining methods.**	**K4, K5**
Unit II		
Objective2	**Describe clearly about isolation and identification of clinical samples diagnosis.**	
Diagnostic Bacteriology: Laboratory diagnosis (isolation & identification) i) Pyogenic infection- *Streptococci* ii) UTI infection – *E. coli, Proteus, Pseudomonas* and *Salmonella.*		
Outcome 2	**Summarizes clearly about the laboratory diagnosis of bacterial pathogens causing pyogenic and UTI infection.**	**K2**
Unit III		
Objective3	**Modify and develop various assays for the detection of antimicrobial susceptibility testing.**	
i) Kirby – Bauer disc diffusion technique. ii) Antimicrobial susceptibility testing by MIC and MBC.		
Outcome 3	**Evaluate and explain the various assays for antimicrobial susceptibility testing.**	**K2, K5**
Unit IV		
Objective4	**Discuss various electrophoretic separation of proteins for students.**	
i) Electrophoretic separation of serum proteins. ii) Screening of antibiotic-producing microbes**.**		
Outcome 4	**Classify and compare the methods of screening of antibiotic-producing microbes.**	**K4**
Unit V		
Objective5	**Learners acquire knowledge about Isolation, biochemical characterization and identification of the clinical pathogens.**	
i) Identification of dermatophytes from clinical samples. ii) Isolation, biochemical characterization and identification of the clinical pathogen from urine, pus, throat swab and sputum.		
Outcome 5	**Examine and evaluate the detection methods of dermatophytes from clinical samples.**	**K4, K5**

Suggested Readings :-

Bailey and Scott's Diagnostic Microbiology, (2006). London: Mosby.
Carpenter D.L.(1975). *Immunology and Serology* (3rd ed). London: W.B. Saunders Company.
Collins and Lyne's Microbiological methods, (2001). New York: Arnold publishers.
Demain, A.L, and Davis, J.E. (1999). *Manual of Industrial Microbiology and Biotechnology* (2nd ed). Washington: American Society for Microbiology.

Hudson, L. and Hay, F.C. (1989*), Practical Immunology* (3rd ed). Oxford: Blackwell

Scientific Publications.
Lippincott Williams and Wilkins. Philadelphia, Baltimore (2006). *Koneman's Color Atlas and Text book of Diagnostic Microbiology*.
Noel R. Rose, Herman Friedman, John L. Fahey. (1986). *Manual of Clinical Laboratory Immunology*, American Society for Microbiology.
Patrick R. Murray, Ellen Jo Baron, James Jorgensen, Michael Pfaller, Marie Louise Landry. (2007). *Manual of Clinical Microbiology*: 2 Volume Set (9th Revised ed). American Society for Microbiology.
Rastogi S.C. (1996). *Immunodiagnostics Principles and Practice*. New Delhi: New Age International (P) Ltd.
Talwar, G.P. (1983). *A Handbook of Practical Immunology*. New Delhi: Vikas Publishing House Pvt. Ltd.

Online resources

https://www.escmid.org/escmid_publications/manual_of_microbiology
https://microbiologyinfo.com/
https://www.futurelearn.com/courses/basic-concepts-in-microbiology-and-clinical-pharmacology-of-antimicrobials
https://www.escmid.org/escmid_publications/manual_of_microbiology
https://libguides.msjc.edu/c.php?g=791138&p=5683424

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. T. Sathiamoorthi

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	L(1)	-	L(1)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	M(2)	-	S(3)	-	M(2)	S(3)	S(3)	S(3)	S(3)
CO3	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)
CO4	M(2)	-	L(1)	M(2)	M(2)	L(1)	L(1)	M(2)	M(2)	M(2)
CO5	M(2)	M(2)	L(1)	S(3)	S(3)	L(1)	L(1)	S(3)	M(2)	S(3)
W.AV	**2.6**	**1.4**	**1**	**2.4**	**2.2**	**1.6**	**2.2**	**2.8**	**2.6**	**2.8**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	L(1)	S(3)	S(3)
CO2	S(3)	S(3)	L(1)	M(2)	M(2)
CO3	S(3)	S(3)	M(2)	L(1)	M(2)
CO4	S(3)	M(2)	S(3)	L(1)	M(2)
CO5	S(3)	M(2)	S(3)	S(3)	S(3)
W.AV	**3**	**2.4**	**2.6**	**2.2**	**2.6**

S –Strong (3), M-Medium (2), L- Low (1)

Semester –III					
Core	**Course Code 530305**	**Lab-VI: Lab in Immunobiology and Industrial Microbiology**	**P**	**Credits:4**	**Hours:6**

Unit–I		
Objective1	**Acquire adequate skills to perform blood grouping and serological reactions**	
1.Widal slide and tube agglutination test 2. Latex agglutination test- RA- test, CRP- test, ASO- test		
Outcome1	**Identification of the typhoid pathogen infection by widal test, Analyse blood for the presence of various pathogen related proteins.**	**K2, K4**
UnitII		
Objective2	**Discuss differential leukocyte count**	
3. Direct agglutination to determine ABO blood grouping. 4. Determination of differential leukocyte count.		
Outcome2	**Determine the blood group of individual sample, and differentiate the various types of WBC cells.**	**K2, K4**
UnitIII		
Objective3	**Illustrate the isolation of RBC from blood**	
5. Isolation and enumeration of RBC from human blood.		
Outcome 3	**Enumerate the RBC in the patient blood**	**K5**
UnitIV		
Objective4	**Explain the fermentation process and production of various enzymes**	
6. Demonstration of fermentation using Kuhn's fermentation vessel. 7. Assay of amylase from microbes 8. Assay of protease from microbes. 9. Assay of cellulase from microbes.		
Outcome 4	**Demonstrate the fermentation, analysis the production of various industrially important enzymes**	**K2,K3**
UnitV		
Objective5	**Acquire knowledge on enzyme and cell Immobilization techniques**	
10. Enzyme Immobilization in sodium alginate gel. 11. Cell immobilization in calcium alginate gel		
Outcome5	**Design the immobilization for the enzymes which is industrially more important.**	**K6**

Suggested Readings :-

Baily and Scott's Diagnostic Microbiology, (2006). London: Mosby.

Carpenter D.L.(1975). Immunology and Serology (3rd ed). London: W.B. Saunders Company.

Collins and Lyne's Microbiological methods, (2001). New York: Arnold publishers.

Demain, A.L, and Davis, J.E. (1999). Manual of Industrial Microbiology and Biotechnology (2nded). Washington: American Society for Microbiology.

Hudson, L. and Hay, F.C. (1989), Practical Immunology (3rd ed). Oxford: Blackwell scientific Publications.

Lippincott Williams and Wilkins. Philadelphia, Baltimore (2006). Koneman'sColor Atlas and Text book of Diagnostic Microbiology.

Noel R. Rose, Herman Friedman, John L. Fahey. (1986). Manual of Clinical Laboratory Immunology, American Society for Microbiology.

Patrick R. Murray, Ellen Jo Baron, James Jorgensen, Michael Pfaller, Marie Louise Landry. (2007). Manual of Clinical Microbiology: 2 Volume Set (9th Revised ed). American Society for Microbiology.

Rastogi S.C. (1996). Immunodiagnostics Principles and Practice. New Delhi: New Age International (P) Ltd.
Talwar, G.P. (1983). A Hand Book of Practical Immunology. New Delhi: Vikas Publishing House Pvt. Ltd.

Onlineresources:
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3695878/
https://medlineplus.gov/ency/article/003334.htm

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. T. Kavitha

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	M(2)	-	-	-	-	-	-	1 (L)	1 (L)
CO2	M(2)	1 (L)	-	-	-	-	-	-	1 (L)	1 (L)
CO3	M(2)	M(2)	M(2)	-	-	-	-	-	1 (L)	M(2)
CO4	1 (L)	1 (L)	M(2)	-	-	M(2)	1 (L)	M(2)	M(2)	M(2)
CO5	M(2)	1 (L)	1 (L)	1 (L)	M(2)	1 (L)	M(2)	1 (L)	1 (L)	1 (L)
W.AV	**1.8**	**1.4**	**1.0**	**0.2**	**0.4**	**0.6**	**0.6**	**0.6**	**1.2**	**1.4**

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	1 (L)	M(2)	M(2)	M(2)
CO2	M(2)	1 (L)	M(2)	3 (S)	3 (S)
CO3	M(2)	1 (L)	1 (L)	3 (S)	3 (S)
CO4	M(2)	3 (S)	1 (L)	M(2)	M(2)
CO5	1 (L)	3 (S)	3 (S)	M(2)	1 (L)
W.AV	**1.8**	**1.8**	**1.8**	**2.4**	**2.2**

S–Strong(3),M-Medium(2),L-Low(1)

Semester- III					
DSE-3	**Course Code 530505**	**Algal Biotechnology**	**T**	**Credits:3**	**Hours: 3**

Unit -1

Objective 1	**To familiarize basic information about algal biotechnology**	
General overview, occurrence, and distribution of algae:-General overview, occurrence, and distribution of algae:- Fundamentals of algal cultivation. Culture methods - batch cultures, continuous cultures, semi-continuous cultures, commercial-scale cultures, outdoor ponds, photobioreactors and culture of sessile microalgae. Quantitative determinations of algal density and growth, Growth rate and generation time determinations. Cultivation of economically important Fresh water and marine algae. Algae as a source of food and fodder		
Outcome 1	Recall the fundamental concepts of algal classification, occurrence, and distribution, cultivation methods, growth measurement, cultivation of economically important algae for food and feed. Apply the quantification methods and cultivation methods.	**K1, K3**

Unit -2

Objective 2	**To learn about the techniques and applications of algae in various fields**	
Algal Biotechnology:- Application of cell fusion, tissue culture and hybridization techniques in algae. Algaegenomics. Genetic engineering of algae: construction of transformation and expression vectors, methods of gene introduction. Metabolic engineering in lipid metabolism. Phycoremediation. Role of algae in the biogeochemical cycle. Microalgal biotechnological applications in nutrition, health and environment.		
Outcome 2	Explain molecular techniques for strain improvement and algal genetics and genomic data analysis and outline the lipid metabolism, assess phycoremediation and their role in biogeochemical cycle.Discuss the various applications of algae in nutrition, health, and environmental science fields.	**K2, K4**

Unit- 3

Objective 3	**To study the production process and algal cultivation methods**	
Biofuels and Biofertilizer:- Biogas, Ethanol, Diesel, and Hydrogen production by algae. Seaweed fertilizer and algae as Biofertilizer.		
Outcome 3	Explain the production of various biogas, biofuels from algae and mass cultivation. Evaluate the use of seaweeds, algae as biofertilizers.	**K2, K5**

Unit- 4

Objective 4	**To classify the algae and its role in medicine**	
Food and nutraceuticals of Algae:- Cyanophyta, Rhodophyta, Heterokontophyta, Chlorophyta. Polysaccharides (Agar Agar, Carrageenan and Alginic acid), Algae in pharmaceutical industries, Animal feed, Therapeutic supplements and toxins.		
Outcome 4	Describe the food and nutraceutical role of algae.Define and classify different types of algae,andpolysaccharides derived from algae and their properties. Explore as animal feed, therapeutic supplements, and toxin production.	**K1, K2, K5**
Objective 5	**To make aware of algae and pollution**	
Algae and Pollution:-Eutrophication, Algae as an indicator of pollution, atmospheric algae. Harmful algae blooms (HABS). Impacts of HABs on Aquaculture- Shellfish, Finfish, Impacts of Coastal HABs on Tourism.		
Outcome 5	Explain the process of eutrophication and role of algae as indicators of pollution and effect of harmful algal blooms (HABs) in aquaculture, and tourism and apply their mitigation and management strategies.	**K2, K3**

Suggested Readings:

Chapman, F.G. and Chapman, D.J. (1973). The Algae. McMillan & Co.

Faizal Bux , Yusuf Chisti (eds). (2016). Algae Biotechnology- Products and Processes. Springer International Publishing Switzerland.

Faizal Bux, Yusuf Chisti (eds.). (2018). Algae Biotechnology_ Products and Processes- (Green Energy and Technology) -Springer International Publishing.

Melanie N. Johansen. (2011). Microalgae_ Biotechnology, Microbiology and Energy (Marine Biology) -

-Nova Science Pub Inc.
Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl, Thomas Brock. (2015). Brock biology of microorganisms-Benjamin Cummings.
Se-Kwon Kim. (2015). Handbook of Marine Microalgae_ Biotechnology Advances. Academic Press.
Tridevi, P. C. (2001). Algal Biotechnology. Jaipur: Point Publisher.
VandenHoek, C., Mann, D.G., and Jahns, H.M. (2009). Algae- An introduction to Phycology.
Vashishta, B.R., Sinha, A.k., and Singh V.P. (2010). Algae (Revised) New Delhi: S.Chand & Company Ltd. Williams, K.L. (2007).Endotoxins – Pyrogens, LAL Testing and Depyrogenation (3rd ed). INFORMA Publishers

Online resources

https://www.ddugpgcsitapur.com/study-material/Classification_of_algae.pdf
https://www.bbc.com/future/article/20230110-the-pollution-causing-harmful-algal-blooms
https://microbiologynotes.org/algae-occurence-classification-and-economic-importance

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr.G. Dhanam Jayam

CourseOutcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	M(2)	M(2)	M(2)	-	M(2)	-	S(3)	M(2)
CO2	-	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)	L(1)	S(3)	S(3)
C03	L(1)	S(3)	M(2)	S(3)	S(3)	S(3)	M(2)	-	M(2)	M(2)
CO4	M(2)	M(2)	S(3)	L(1)	S(3)	S(3)	L(1)	M(2)	S(3)	S(3)
C05	M(2)	M(2)	-	2 (M)	L(1)	L(1)	S(3)	-	L(1)	M(2)
W.AV	**1.6**	**2.4**	**1.4**	**2**	**2.4**	**2**	**2**	**0.6**	**2.4**	**2.4**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	L(1)	L(1)	M(2)	L(1)
CO2	M(2)	M(2)	S(3)	S(3)	M(2)
CO3	M(2)	S(3)	S(3)	S(3)	S(3)
CO4	M(2)	M(2)	S(3)	M(2)	M(2)
CO5	M(2)	-	S(3)	L(1)	-
W.AV	**2.2**	**1.6**	**2.6**	**2.2**	**1.6**

S –Strong (3), M-Medium (2), L- Low (1)

Semester –III					
DSE - 3	**CourseCode 530506**	**Applied Microbiology -I**	**T**	**Credits:3**	**Hours:3**
Unit–I					
Objective1	**Gain knowledge on the International Standard on Medical Devices**				
Microbiological standards I: General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025). International Standard on Medical Devices - Quality Management Systems - Requirements for Regulatory Purposes (ISO 13485).					
Outcome1	**Recollecting the international stands methods, quality assessment**				**K1**
UnitII					
Objective2	**Discuss Sterilization of medical devices**				
Microbiological standards II: Sterilization of health care products - Microbiological methods (BS EN ISO 11737-1:2018). **Sterilization of medical devices** - Microbiological Methods (BS EN ISO 11737-2:2009). **Biological evaluation of medical devices** - Tests for in vitro cytotoxicity- ISO 10993-5.					
Outcome2	**Understand the microbiological standards and sterilization methods**				**K2**
UnitIII					
Objective3	**Elaborate the risk assessment and Biosafety concepts of Microbiology of Food technology**				
Microbiology of Food technology: Microbiological Risk Analysis Concepts: Risk assessment, risk management and risk communication; risk profiling of products. Biosafety concepts in the handling of dairy/ food pathogens and setting up microbiological / pathogen lab in a dairy/food plant. **Rapid Enumeration Techniques:** Enumeration principles and procedure for rapid detection of predominant hygiene indicator organisms and pathogens like *E. coli, Salmonella, Shigella, Staphylococcus aureus. Bacillus cereus* and *Listeria monocytogenes*					
Outcome3	**Analysis and assess the various levels of risk in food industry, Determine the indicator organism to maintain the hygienic condition.**				**K3, K5**
UnitIV					
Objective4	**Explain the percentage of the killing of bacterial cells by UV rays.**				
Pharmaceutical Microbiology: The role of the Qualified Person in microbiological quality assurance, safety in Rapid microbiology enumeration and identification methods– selection and use of cleaning and disinfection agents in pharmaceutical manufacturing measurement of biocide effectiveness, International disinfectant testing protocols. The personal Qualification procedure for clean area entry –clean-in-Place, sterilization in place, Clean room design, operation, and regulatory standards					
Outcome 4	**Applying various disinfectants, testing of international disinfection protocol.**				**K3, K6**

UnitV		
Objective5	**Aquire knowledge on nanotechnology and their applications, working mechanism of biosensor.**	
Microbial nanotechnology: Definition and terminologies- microbial nanotechnology, nanomedicine, nanowires, quantum Dots, nanocomposite, nanoparticles Synthesis of nanomaterial using microbes. **Properties and characterization-** imaging and Size and composition. Nanomaterials in diagnostics drug delivery and therapeutics. **Nanomaterials** – cytotoxicity and genotoxicity –in vivo test and assay. **Microbial biosensor:** Working mechanism and applications, advantages and limitations.		
Outcome 5	**Define the important terminology in nanotechnology. Summarize the applications of nanotechnology. Elaborate the working mechanism of biosensor**	**K2, K4, K6**

Suggested Readings :-

Ashutosh, K. (2008). Pharmaceutical Microbiology. New Delhi: New Age International Publishers. Charalampopoulos, Dimitris, Rastall and Robert (2009), Prebiotics and Probiotics Science and Technology, Springer Publication

Doyle M. P. and Beuchat L. R. (2007). Food Microbiology- Fundamentals and Frontiers, ASM Press. Kenji Sonomoto and Atsushi Yokota (2011), Lactic acid bacteria and Bifidobacteria, Caister Academic Press Publisher.

Kevin, W. (2007). Endotoxins – Pyrogens, LAL Testing and Depyrogenation (3rd ed). Informa Press. Manivasakam, N. (2001). Chemical and Microbial analysis of mineral and packaged drinking waters. Coimbatore: Sakthi Book Service.

Peppler, H.J. and Pearlman, 2004. Microbial Technology, Vol – I, and Academic press, New Delhi. Stanbury, P.F., Whitaker, A and Hall, S.A. 2000. Principles of Fermentation Technology, Second edition, Pergaman Press – Oxford.

Trivedy, R.K., Goel, P.K. and Trishal, C.L. (1987). Practical methods in Ecology and Environmental science. Environmental publishers. Rajendran, P and P. Gunasekaran. (2007). Microbial Bioremediation. MJP. Publishers

Onlineresources:

https://www.iso.org/obp/ui/#iso:std:iso:11737:-2:en

https://www.iso.org/publication/PUB100424.html

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by:Dr. T. Kavitha

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	L(1)	L(1)	L(1)	-	L(1)	L(1)	M(2)	L(1)	L(1)
CO2	1	M(2)	L(1)	L(1)	L(1)	L(1)	L(1)	M(2)	L(1)	L(1)
CO3	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	L(1)	L(1)	L(1)	L(1)
CO4	L(1)	L(1)	L(1)	L(1)	L(1)	M(2)	M(2)	L(1)	M(2)	M(2)
CO5	L(1)	M(2)	M(2)	L(1)	M(2)	L(1)	L(1)	-	L(1)	M(2)
W.AV	**1.4**	**1.6**	**1.4**	**1.2**	**1.2**	**1.4**	**1.2**	**1.2**	**1.2**	**1.4**

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	M(2)	S(3)	S(3)
CO2	M(2)	L(1)	L(1)	L(1)	L(1)
CO3	M(2)	M(2)	M(2)	M(2)	M(2)
CO4	L(1)	L(1)	L(1)	S(3)	L(1)
CO5	S(3)	M(2)	1	M(2)	M(2)
W.AV	**2.2**	**1.8**	**1.4**	**2.2**	**1.8**

S–Strong(3),M-Medium(2),L-Low(1)

Semester – IV					
Core	**Course code: 530401**	**Applied Microbiology -II**	**T**	**Credits:4**	**Hours: 5**
Unit I					
Objective 1	**Analyse and evaluate various methods of potable water.**				
Mineral water industry: Stages of mineral water production. Analysis of water quality – pH, salinity, alkalinity, dissolved oxygen, carbonates, nitrate, silicate, phosphate, COD and BOD. Determination of microbial load in water: Faecal indicator organisms - coliform bacteria, faecal enterococci, *Clostridium perfringens,* yeast, mould and sulfide reducing anaerobes, viruses and bacteriophages, fungi andyeasts, protozoa and helminths. Methods of mineral water quality assessment –MPN test, membrane filtration technique.					
Outcome 1	Understand the range of techniques for analysis of water sample.				**K2**
Unit II					
Objective2	**Describe clearly about preservation of pharmaceutical products.**				
Preservation of pharmaceutical Products: Chemical preservatives – raw materials– equipment – the role of preservatives. Finished product tests – microbial enumeration test, tests for specified microorganisms. Sterility testing – antimicrobial effectiveness testing. Sterility assurance – biological indicators, sterilization validation process. Microbial risk assessment through HACCP plan.					
Outcome 2	Summarize and assess the preservation and sterility assurance for pharmaceutical products.				**K2, K5**
Unit III					
Objective3	**Modify and develop various assays for detection of toxicity.**				
Endotoxin test methods: gel clot assay, turbidimetric assay and chromogenic methods. Biological assays - vitamin assay, antibiotic susceptibility testing-Disc diffusion and well diffusion assay and mycoplasma testing. Endotoxin activity – risk assessment in parenteral manufacture – pyrogen test – de pyrogenation methods.					
Outcome 3	Evaluate the various assays for toxicity testing.				**K5**
Unit IV					
Objective4	**Discuss rapid methods for detection of microorganism in food samples.**				
Rapid methods for detection of microorganisms in food: conventional and automated. Application of light pulse technology – principles of light pulse generation, mode of action, equipment, application of light pulses, effect of light pulses on foods and microorganisms, advantage and limitations of light pulse treatment. Quality control in fruits and vegetable processing. Risk assessment in food industry – physical, chemical and biological hazards.					
Outcome 4	Classify and compare the methods of rapid detection of food.				**K4**

Unit V		
Objective5	**Assess the microbial quality of marine foods.**	
Assessment of microbial quality of marine foods: Conventional and recent development methods – flow cytometry, ATP estimation, radiometric, reflective calorimetry, LAL test, immunoassay, DNA based and microarray methods. Application of additives in food. Food safety and standard act for adulteration. Significance of barcode and its uses in the food industry.		
Outcome 5	Examine and measure the quality analysis of marine foods standards and safety.	**K4, K5**

Suggested Readings :-

Ashutosh, K. (2008). Pharmaceutical Microbiology. New Delhi: New Age International Publishers.
John A. J. Barbara, Fiona A. M. Regan, Marcela Contreras. (2008). Transfusion Microbiology, United Kingdom: Cambridge University Press.
Joseph, A. Bellanti. (2016). Immunology IV: Clinical Applications in Health and Disease. Washington, DC: Georgetown University School of Medicine.
Kevin, W. (2007). Endotoxins – Pyrogens, LAL Testing and Depyrogenation (3rd ed). Informa Press.
Manivasakam, N. (2001). Chemical and Microbial analysis of mineral and packaged drinking waters. Coimbatore: Sakthi Book Service.
Michael J. Day, Ronald D. Schultz. (2014). Veterinary Immunology: Principles and Practice (2nd ed). CRC Press.
Raif Geha, Luigi Notarangelo. (2016). Case Studies in Immunology. A Clinical Companion (7th ed). ASM Press.
Rao, C. V. (2013). Immunology (2nd ed). New Delhi: Narosa Publishing House.
Richard Coico and Geoffrey Sunshine. (2015). Immunology: A Short Course, (7th ed). Wiley Blackwell.
Trivedy, R.K., Goel, P.K. and Trishal, C.L. (1987). Practical methods in Ecology and Environmental science. Environmental publishers

Online resources

https://www.acs.org/content/acs/en/policy/publicpolicies/sustainability/water-statement.html
https://doh.wa.gov/community-and-environment/wastewater-management/site-sewage-systems-oss
https://www.toftigers.org/best-practice/water-conservation-and-treatment/
https://krishi.icar.gov.in/jspui/bitstream/

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. A. Arun

CourseOutcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	M (2)	S (3)	M (2)	M (2)
CO2	S (3)	M (2)	M (2)	M (2)	M (2)	M (2)	L (1)	M (2)	S (3)	S (3)
CO3	S (3)	S (3)	M (2)	S (3)	S (3)	M (2)	L (1)	L (1)	M (2)	M (2)
CO4	S (3)	M (2)	M (2)	M (2)	L (1)	M (2)	L (1)	M (2)	S (3)	M (2)
CO5	M (2)	M (2)	S (3)	L (1)	M (2)	L (1)	M (2)	L (1)	M (2)	S (3)
W.AV	**2.8**	**2.4**	**2.4**	**2.2**	**2.2**	**1.8**	**1.4**	**1.8**	**2.4**	**2.4**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M (2)	M (2)	S (3)	S (3)
CO2	S (3)	S (3)	S (3)	S (3)	S (3)
CO3	S (3)	S (3)	M (2)	L (1)	M (2)
CO4	S (3)	M (2)	S (3)	L (1)	M (2)
CO5	S (3)	M (2)	S (3)	S (3)	S (3)
W.AV	**3**	**2.4**	**2.6**	**2.2**	**2.6**

S –Strong (3), M-Medium (2), L- Low (1)

IV-Semester					
Core	**Course Code: 530999**	**Dissertation Work**		**Credits:10**	**Hours: 25**

Non-Major Electives Course (NME) (For III Semester) - To be chosen by other PG degree students

II-Semester					
NME	**Course Code**	**Molecular Biology**	**T**	**Credits:2**	**Hours:3**

Unit–I

Objective1	**Acquire knowledge on structure and functions of genetic material**	
Discovery of DNA. Molecular basis of DNA as genetic material. Structure of DNA –A, B and Z form. Forms of DNA – DNA heteroduplex, circular, superhelical DNA, twisted circle. Properties of DNA – denaturation, renaturation, melting curve, hyperchromicity. Structure of RNA. Types of RNA – Trna, Mrna and Rrna.		
Outcome1	On completion of this course students will define the structure of DNA and RNA	**K1**

UnitII

Objective2	**Explain replication of DNA**	
Replication of DNA – semi-conservative model, Meselson – Stahl experiment. Enzymology of DNA replication – DNA polymerase I, II and III; topoisomerase I and II; helicase; primase and gyrase. Molecular mechanism of DNA replication. Replication fork, origin and Okazaki fragments. Types of replication – circular andmtheta.		
Outcome2	Analyze, modify and characterize replication of DNA and DNA modifying enzymes	**K4**

UnitIII

Objective3	**Discuss the transcription process of Prokaryotes**	
Transcription process in Prokaryotes: Initiation – promotors, upstream and downstream sequences, transcription factors; Elongation – RNA polymerase, subunits; Termination – Rho-dependent and Rho-independent; nus A protein and antitermination. RNA processing (post- transcriptional modifications), inhibitors of transcription. Reverse transcription.		
Outcome3	Studentsinterpret thetranscription process in Prokaryotes	**K4**

UnitIV

Objective4	**Discuss about genetic code and translation process of prokaryotes**	
Genetic code: Elucidation of triplet code, code characteristics and codon dictionary. Reading frames, sense and nonsense code. Degeneracy – wobble hypothesis, the universality of genetic code. Process of translation in prokaryotes: Initiation and Termination. Role of Rrna in protein synthesis. Post-translational modifications –post-translational transport. Signal hypothesis.		
Outcome4	Learnersacquireknowledgeon genetic code and translation process of prokaryotes	**K2**

UnitV

Objective5	**Elucidate the tumor viruses and oncogenes**	
Tumor viruses and oncogenes: Transformed cells, detection of integral viral DNA, the structure of integral viral DNA. Protein kinase and transformation by retroviruses.Cellular counterpart of src. Carcinogens. Activation of oncogenes. Oncogenic proteins – protein kinases, growth factors, ras protein. Transformation protein in DNA viruses.		
Outcome5	Learnerscriticallyevaluatethetumor causing viruses, oncogenes and Transformation protein in DNA viruses	**K5**

Suggested Readings :-

Benjamin Lewin. (2007). Genes XI. New York: Oxford University Press.

Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. (2008). Molecular Biology of the Cell (5th ed). Garland Science.

David Freifelder. D. (2008). Microbial Genetics (18th ed). NewDelhi: Narosa Publishing House.

Freifelder, D. (2000). Molecular Biology (2nd ed). NewDelhi: Narosa Publishing house.

Jeyanthi, G.P. (2009). Molecular Biology. Chennai: MJP Publishers.

Stanley R. Maloy, John E.C. and Freifelder, D. (2008). Microbial Genetics. New Delhi: Narosa Publishing House.

Stryer, L. (2019). Biochemistry (9th ed). New York: W.H. Freeman and Company.

Veer Russel, P. (2009). IGenetics: A Molecular Approach. India: Pearson Education.

Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A. M. (2013). Molecular Biology of the Gene (17th ed). Tokyo: The Benjamin Cummings Publishing Company Inc.

Online resources

https://www.sciencedirect.com/book/9780128132883/molecular-biology

https://aliazamani.files.wordpress.com/2015/09/molecular_biology_r-_f-_weaver_5th_ed.pdf

K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course Designed by: Dr. T. Kavitha

Course Outcome VS Programme Outcomes

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S(3)	S(3)	L(1)	M(2)	L(1)	S (3)	L(1)	M(2)	L(1)	L(1)
CO2	L(1)	L(1)	M(2)	L(1)	L(1)	S(3)	L(1)	M(2)	L(1)	L(1)
CO3	M(2)	M(2)	L(1)	L(1)	M(2)	S(3)	M(2)	M(2)	M(2)	L(1)
CO4	M(2)	M(2)	M(2)	L(1)	M(2)	S(3)	M(2)	M(2)	M(2)	L(1)
CO5	L(1)	L(1)	-	L(1)	M(2)	M(2)	M(2)	M(2)	M(2)	L(1)
W.AV	**1.8**	**1.8**	**1.2**	**1.2**	**1.6**	**2.8**	**1.6**	2	1.6	**1**

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	L(1)	L(1)	L(1)
CO2	M(2)	M(2)	M(2)	L(1)	L(1)
CO3	M(2)	M(2)	S(3)	L(1)	M(2)
CO4	M(2)	L(1)	M(2)	S(3)	L(1)
CO5	M(2)	L(1)	S(3)	L(2)	L(2)
W.AV	**2.2**	**1.8**	**2.2**	**1.6**	**1.4**

S–Strong(3),M-Medium(2),L-Low(1)

Non-Major Electives Course (NME) (For III Semester) - To be chosen by other PG degree students

II-Semester					
NME	**Course Code**	**Agriculture and Environmental Microbiology**	**T**	**Credits:2**	**Hours:3**

Unit-I

Objective1	**Explain microbial interactions with plants and biofertilizer**

Diversity and distribution of microorganisms in soil; Soil Microflora- Bacteria, Fungi and Actinomycetes. Classification, physical, chemical properties and structure of soil. Microbial interactions - mutualism, synergism, commensalism, amensalism, parasitism, predation and competition. Microbial interactions with plants– phyllosphere, mycorrhizae, rhizosphere and symbiotic association in root nodules. Biofertilizer – VAM, Rhizobium, Frankia, Azospirillum, Azotobacter, Cyanobacteria, Phospho bacteria and Azolla.

Outcome1	Apply knowledge on microbial interactions with beneficial application of biofertilizers for sustainable agriculture	**K3**

UnitII

Objective2	**Acquire knowledge on Bacterial diseases of agricultural crops**

Bacterial diseases of agricultural crops - pathogens, symptoms, control measures with reference to paddy, cotton, maize, tomato, citrus, mango and potato. Plant protection – phenolics – phytoalexins and related compounds. Bioinsecticides – viral,bacterial and fungal- a brief note.

Outcome2	Apply knowledge about Bacterial diseases of agricultural crops and benefits of biopesticides	**K3**

UnitIII

Objective3	**Ilustrate the bio-geo chemical cycles of soil and aerobiology**

Bio-geo chemical cycles in soil – Carbon cycle, Nitrogen cycle – Nitrogen fixation, nitrification, denitrification, sulphur, iron and phosphorus cycles. Aerobiology – a brief introduction - droplet nuclei – aerosols - air-borne transmission of microbes and diseases and assessment of air quality.

Outcome3	Analysis and assess the nitrogen fixation and soil borne microorganisms	**K4**

UnitIV

Objective4	**Discuss about aquatic microbiology**

Aquatic microbiology - factors affecting microbial growth – temperature – pressure – light – salinity - turbidity – pH -inorganic and organic constituents. Aquatic habitats - freshwater - lakes, ponds and streams; marine habitats - estuaries, deep sea, hydrothermal vents, saltpans, coral reefs and mangroves and their microbial communities; zonation – food chain and food web.

Outcome4	Ilustrate theaquatic microbial communities and food chain	**K2**

UnitV

Objective5	**Explain about types of wastes and waste treatment**

Types of wastes - solid and liquid wastes. Treatment of solid wastes – Thermal Treatment: Incineration, Gasification, Pyrolysis and Open Burning- Dumps and Landfills: Sanitary landfills, Controlled dumps, Bioreactor Landfills-Biological Waste Treatment: Composting, Vermicomposting and termi composting.Treatment of liquid wastes –primary, secondary, tertiary treatment; anaerobic (methanogenesis), aerobic, trickling, activated sludge, oxidation pond. Production of biogas from waste

Outcome5	Define the solid and liquid waste management	**K1**

Suggested Readings:

Alexander M. (1997). Introduction to soil microbiology, New York: John Wiley & Sons, Inc.

EcEldowney S., Hardman, D.J. and Waite, S. (1993). Pollution Ecology and Biotreatment. Longman Scientific Technical.

Grant, W.D. and Long, P.L. (1981). Environmental Microbiology. Blalckie Glasgow and London.

Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. (2000). Twelfth Edition, Biology Microorganisms, New Jerry: Prentice Hall.

Mark Wheelis, (2010). Principles of Modern Microbiology, New Delhi: Jones & Bartlett India Pvt. Ltd.
Mehrotra, R.S. (1983). Plant Pathology, New Delhi: Tata McGraw Hill Publishing Company Ltd.
Pandy, B.P. (1997). Plant Pathology (Pathogen & Plant Disease), New Delhi: S.Chand& Company Ltd.
Ray Chadhuri, S.P. (1977). A Manual of Virus Diseases of Tropical Plants, New Delhi: MacMillan Company of India Ltd.
Rengaswami, G. and Rajagopalan, S. (1973). Bacterial Plant Pathology. Coimbatore: Tamil Nadu Agriculture University.
SubbaRao, N.S. (1995). Soil Microorganisms and Plant Growth (3rd ed). New Delhi: Oxford &Veer
Russel, P. (2009). iGenetics: A Molecular Approach. India: Pearson Education.
Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J. A. and Weiner, A. M. (2013). Molecular Biology of the Gene (17th ed). Tokyo: The Benjamin Cummings Publishing Company Inc.

Online resources

Environment and agriculture Microbiology

https://onlinelibrary.wiley.com/doi/book/10.1002/9781119525899

https://www.kopykitab.com/Agriculture-And-Environmental-Microbiology-by-Dr-Sangeeta-S-Ahiwale-Vaishali-E-Sonawane-Ahire-Laxmi-S-Singh

Course Designed by: Dr. T. Kavitha

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M (2)	M(2)	L(1)	M(2)	L(1)	L(1)	L(1)	M(2)	L(1)	L(1)
CO2	L(1)	M(2)	M(2)	L(1)	L(1)	L(1)	L(1)	M(2)	L(1)	L(1)
CO3	M(2)	M(2)	L(1)	L(1)	L(1)	S(3)	M(2)	L(1)	M(2)	L(1)
CO4	L(1)	M(2)	L(1)	L(1)	M(2)	S(3)	M(2)	M(2)	L(1)	L(1)
CO5	L(1)	L(1)	L(1)	L(1)	M(2)	S(3)	M(2)	L(1)	M(2)	L(1)
W.AV	**1.4**	**1.8**	**1.2**	**1.2**	**1.4**	**2.2**	**1.6**	**1.6**	**1.4**	**1.0**

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	M(2)	M(2)	M(2)	S(3)	S(3)
CO3	S(3)	M(2)	M(2)	L(1)	M(2)
CO4	M(2)	L(1)	M(2)	S(3)	M(2)
CO5	M(2)	L(1)	M(2)	S(3)	M(2)
W.AV	**2.4**	**1.8**	**2.2**	**2.6**	**2.4**

S–Strong(3),M-Medium(2),L-Low(1)

Non-Major Electives Course (NME) (For III Semester) - To be chosen by other PG degree students

Semester III					
NME-II:	**Course Code**	**Medical Microbiology**	**T**	**Credits:2**	**Hours:3**
Unit-I					
Objective1	**Acquire knowledge on Normal flora of humans and microbiological examination of various samples**				
Laboratory management: Normal flora of human systems – skin, respiratory tract, gastrointestinal tract and genitourinary tract. Nosocomial infections. Collection, transport of clinical samples and laboratory waste disposal system. Microbiological examination of urine, blood, feces, cerebrospinal fluid, throat swabs, sputum, pus and wound exudates.					
Outcome1	Learnersunderstandthefundamental conceptslaboratory management and microbiological examination of samples				**K2**
UnitII					
Objective2	**Explain general characteristics, pathogenesis and laboratory diagnosis and control measures of bacterial diseases**				
Bacterial Diseases: Morphology, classification, cultural characteristics, pathogenicity, laboratory diagnosis and prevention of infections caused by the following organisms: Gram positive cocci– *Staphylococci*, *Streptococci*. Gram negative cocci– *Gonococci*. Gram positive non-spore-forming bacilli: aerobic – *Corynebacteria* and anaerobic					
Outcome2	Describe the general characteristics, pathogenesis and laboratory diagnosis and control measures of bacterial diseases				**K1**
UnitIII					
Objective3	**Ilustrate the general characteristics, pathogenesis and laboratory diagnosis and control measures of fungal diseases**				
Fungal Disease: General characteristics, pathogenesis and laboratory diagnosis and control measures of: Yeast–Cryptococcus neoformans. Yeast-like fungus – Candida spp. Filamentous fungi – *Aspergillus* and *Penicillium*. Dimorphic fungi, yeast morphology, general characteristics and reproduction. – Blastomyces dermatitis.					
Outcome3	Explain general characteristics, pathogenesis and laboratory diagnosis and control measures of fungal diseases				**K5**
UnitIV					
Objective4	**Discuss about general characteristics, pathogenesis and laboratory diagnosis and control measures of viral diseases**				
Viral Disease: Infectious diseases- Definition of emerging & re-emerging diseases. Factors contributing to emergence. Examples (Chickungunya, Zika virus, H1N1 and Ebola). National programs in the prevention of infectious diseases					
Outcome4	Understand the general characteristics, pathogenesis and laboratory diagnosis and control measures of viral diseases				**K2**
UnitV					
Objective5	**Elucidate the general characteristics, pathogenesis and laboratory diagnosis and control measures of parasitic diseases**				
Parasitic Diseases: General characteristics of Intracellular parasites-*Cryptosporidium* and *Plasmodium*. Intralumen parasites – *Entameoba histolytica* and *Ascaris lumbricoides*. Parasitic zoonosis– *Toxoplasma* and *TaeniaF*					
Outcome5	Apply knowledge on general characteristics, pathogenesis and laboratory diagnosis and control measures of parasitic diseases				**K3**
Suggested Readings: Anathanarayan R and Jeyaram Panikers C.K. (2013). Text Book of Microbiology (9th ed). New Delhi: Jain book depot. Arora D.R., Brij Bala Arora.(2015). Textbook of Microbiology. Chennai: CBS.					

Awetz Melnick and Adelberg's. (2010). Medical Microbiology, 21st Century. Appleton & Lange.
Bhattacharjee R.N.(2015). Introduction to Microbiology (1st ed). New Delhi: Kalyani Publishers.
Connie R Mahon. (2010). Textbook of Diagnostic Microbiology (3rd ed). Pearson.
David Greenwood, Richard Slack, John Peutherer. (2012). Medical Microbiology. Churchill Livingstone.
Jesse Russell, Ronald Cohn. (2012). Medical Microbiology. Book on Demand Ltd. Myra
Patrick R. Murray. (2015). Medical Microbiology. Elsevier
Patrick Murray & Ken Rosenthal & Michael Pfalle. (2015). Medical Microbiology (8th ed). New York: Academic Press.
Wilkinson. (2011). Medical Microbiology. Scion Publishing

Online resources

Medical_Microbiology
https://books.google.com/books/about/Medical_Microbiology_E_Book.html?id=ecxRX1dvdXAC
medical-microbiology
https://www.store.elsevierhealth.com/asia/medical-microbiology-e-book-9780323674508.html

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course Designed by: Dr. T. Kavitha

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	L(1)	M(2)	L(1)	S (3)	L(1)	M(2)	L(1)	L(1)
CO2	L(1)	L(1)	M(2)	L(1)	L(1)	S(3)	-	M(2)	L(1)	L(1)
CO3	M(2)	M(2)	L(1)	L(1)	M(2)	S(3)	M(2)	M(2)	M(2)	L(1)
CO4	M(2)	M(2)	M(2)	L(1)	M(2)	S(3)	M(2)	M(2)	M(2)	L(1)
CO5	L(1)	L(1)	L(1)	L(1)	M(2)	S(3)	M(2)	M(2)	M(2)	L(1)
W.AV	**1.8**	**1.8**	**1.6**	**1.2**	**1.6**	**3**	**1.4**	**2**	**1.6**	**1**

S–Strong(3),M-Medium(2),L-Low(1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	M(2)	L(1)	L(1)
CO2	M(2)	M(2)	M(2)	M(2)	M(2)
CO3	M(2)	M(2)	M(2)	L(1)	M(2)
CO4	M(2)	L(1)	M(2)	S(3)	M(2)
CO5	M(2)	L(1)	M(2)	S(3)	M(2)
W.AV	**2.2**	**1.8**	**2**	**2**	**1.8**

S–Strong(3),M-Medium(2),L-Low(1)

Non-Major Electives Course (NME) (For III Semester) - To be chosen by other PG degree students

Semester III					
NME -II:	**Course Code**	**Food and Industrial Microbiology**	**T**	**Credits:2**	**Hours:3**
Unit-I					
Objective1	**Acquire knowledge on Production of fermented dairy products**				
History and development of Food microbiology: Role and Significance of Microorganisms in Foods, Outline of food spoilage and preservation, Food safety and microbiological Quality Assurance. Production of fermented dairy products: Cheese, yogurt, buttermilk, sour cream, Fermented vegetables; Sauerkraut.					
Outcome1	Apply knowledge in quality analysis techniques suitable for industries				**K3**
UnitII					
Objective2	**Explain spoilage and preservation of food and foodborne diseases**				
Food spoilage, **preservation and foodborne diseases**: organism involved in spoilage of fruits and vegetables, cereal and cereal products, meat and meat products. Foodborne diseases- Bacterial foodborne diseases- (Staphylococcal intoxication, Botulism, Salmonellosis, Shigellosis, EPEC Diarrhoea,; Food-borne fungi- Mycotoxins- Aflatoxicosis.					
Outcome2	Explain spoilage and preservation of food and foodborne diseases				**K2**
UnitIII					
Objective3	**Discuss the fermentation process and their types**				
An introduction to fermentation process: - Screening of industrial microbes –Detection and assay of fermentation products. Classification of fermentation types.Inoculum development, media formulation, optimization methods, media sterilization,statistical design for media formulation, and optimization.					
Outcome3	Analyzethefermentation products and types of fermentation				**K4**
UnitIV					
Objective4	**Discuss about the fermentation of microbial products**				
Fermentation of microbial products:– Single Cell Protein (SCP). Anaerobic fermentation (beer and wine). Aerobic fermentation (vinegar and citric acid. Antibiotic fermentation (penicillin and streptomycin). Vitamins (B12, riboflavin), Hormone (gibberellic acid, IAA). Enzyme (amylase, protease). Biogas production					
Outcome4	Describe the fermentation of microbial products				**K1**
UnitV					
Objective5	**Illustrate the purification of fermentation products**				
Downstream processing: - Cell disruption – physical and chemical methods, Precipitation. Filtration- batch and continuous filters. Centrifugation - types, liquid liquid extraction, chromatography, membrane process, drying, crystallization					
Outcome5	Learners can evaluatethepurification of fermentation products				**K5**

Suggested Readings:

Adams, M.R. and Moss, M.O. (2008). Food Microbiology. UK: RSC Publishing, Cambridge. Aneja, K.N. (2018). Modern Food Microbiology, Medtec Publisher.

Casida, L.E.J.R. (2019). Industrial Microbiology (2nd ed). New Delhi: New Age International (P) Ltd., Publishers.

Crueger, W. (2017). Biotechnology: A Test Book of Industrial Microbiology (3rd ed), MEDTECH Publishers.

Demain, A.L. and Davis, J.E.2004, Industrial Microbiology and Biotechnology, (2/e), ASM Press Washington, DC.

Dick M, (2017). Food Microbiology An Introduction (2nd ed). Bengaluru: Medtech.

El-Mansi, E. M. T., Bryce, C. F. A., Arnold L. Demain and Allman, A.R. (2012). Fermentation Microbiology and Biotechnology, CRC Press.

Frazier, W.C., and Westhoff, D.C. (1988). Food Microbiology (Reprint 1995). New Delhi: Tata

McGraw Hill Publishing Ltd.
Stanbury, P.F, Whitaker, A. and Hall, S.J. (2016). Principles of Fermentation Technology (3rd ed). New Delhi: Aditya Book (P) Ltd.
Prescott, L.M., Harley, J.P. and Helin, D.A. (2015). Microbiology (5th ed). New Delhi: McGraw Hill.

Online resources

Food-and-industrial-microbiology
https://agrimoon.com/food-and-industrial-microbiology-icar-ecourse-pdf-book/
https://www.icar.gov.in/content/food-and-industrial-microbiology

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course Designed by: Dr. T. Kavitha

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	L(1)	M(2)	L(1)	S (3)	L(1)	M(2)	L(1)	L(1)
CO2	L(1)	M(2)	M(2)	M(2)	L(1)	S(3)	L(1)	M(2)	L(1)	M(2)
CO3	M(2)	M(2)	L(1)	L(1)	M(2)	S(3)	M(2)	M(2)	M(2)	L(1)
CO4	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	L(1)
CO5	L(1)	L(1)	L(1)	L(1)	M(2)	M(2)	M(2)	L(1)	M(2)	L(1)
W.AV	**1.8**	**1.8**	**1.6**	**1.6**	**1.6**	**2.8**	**1.6**	1.8	2	**1.2**

S–Strong(3),M-Medium(2),L-Low(1)

CourseOutcomeVSProgrammeSpecific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	M(2)	L(1)	L(1)
CO2	M(2)	M(2)	M(2)	M(2)	M(2)
CO3	M(2)	M(2)	M(2)	L(1)	M(2)
CO4	M(2)	L(1)	M(2)	S(3)	M(2)
CO5	M(2)	L(1)	M(2)	S(3)	M(2)
W.AV	**2.2**	**1.8**	**2**	**2**	**1.8**

S–Strong(3),M-Medium(2),L-Low(1)

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