Annamalai University

(Accredited with 'A' Grade by NAAC)

Faculty of Science

Department of Microbiology

M.Sc. MICROBIOLOGY (Five – Year)

Programme Code: SMIC51

Regulations, Curricula and Syllabi

2019 – 20 Onwards

Annamalai University

Faculty of Science

DEPARTMENT OF MICROBIOLOGY

M.Sc. Microbiology

Programme Code: SMIC51

These rules and regulations shall govern the Five year post graduate studies leading to the award of degree of **Master of Science in Microbiology** in the Faculty of Science. These academic Regulations shall be called "**Annamalai University, Faculty of Science M.Sc. Microbiology (Five- year) Regulations 2019**". They shall come into force with effect from the academic year 2019 – 2020.

1. Definitions and Nomenclature

1.1 **University** refers to Annamalai University.

1.2 **Department** means any of the academic departments and academic centers at the University.

1.3 **Discipline** refers to the specialization or branch of knowledge taught and researched in higher education. For example, Botany is a discipline in the Natural Sciences, while Economics is a discipline in Social Sciences.

1.4 **Programme** encompasses the combination of courses and/or requirements leading to a Degree. For example, M.Sc., M.A.

1.5 **Course** is an individual subject in a programme. Each course may consist of Lectures/ Laboratory /Seminar/ Project work/ viva-voce, etc. Each course has a course title and is identified by a course code.

1.6 **Curriculum** encompasses the totality of student experiences that occur during the educational process.

1.7 **Syllabus** is an academic document that contains the complete information about an academic programme and defines responsibilities and outcomes. This includes course information, course objectives, policies, evaluation, grading, learning resources and course calendar.

1.8 **Academic Year** refers to the annual period of sessions of the University that comprises two consecutive semesters.

1.9 **Semester** is a half-year term that lasts for a minimum duration of 90

days.

1.10 **Choice Based Credit System**: A mode of learning in higher education that enables a student to have the freedom to select his/her own choice of elective courses across various disciplines for completing the Degree programme.

1.11 **Core Course** is mandatory and an essential requirement to qualify for the Degree.

1.12 **Elective Course** is a course that a student can choose from a range of alternatives.

1.13 **Value-added Courses** are optional courses that complement the students' knowledge and skills and enhance their employability.

1.14 **Credit** refers to the quantum of course work in terms of number of class hours in a semester required for a programme. The credit value reflects the content and duration of a particular course in the curriculum.

1.15 **Credit Hour** refers to the number of class hours per week required for a course in a semester. It is used to calculate the credit value of a particular course.

1.16 **Programme Outcomes (POs)** are statements that describe crucial and essential knowledge, skills and attitudes that students are expected to achieve and can reliably manifest at the end of a programme.

1.17 **Programme Specific Outcomes (PSOs)** are statements that list what the graduate of a specific programme should be able to do at the end of the programme.

1.18 **Learning Objectives** are statements that define the expected goal of a course in **Course Objectives** in terms of demonstrable skills or knowledge that will be acquired by a student.

1.19 **Course Outcomes (COs)** are statements that describe what students should be able to achieve/demonstrate at the end of a course. They allow follow-up and measurement of learning objectives.

1.20 **Grade Point Average (GPA)** is the average of the grades acquired in various courses that a student has taken in a semester. The formula for computing GPA is given in section 11.3

1.21 **Cumulative Grade Point Average (CGPA)** is a measure of overall cumulative performance of a student over all the semesters. The CGPA is the ratio of total credit points secured by a student in various

courses in all semesters to the sum of the total credits of all courses in all the semesters is given in section11.4.

1.22 **Letter Grade** is an index of the performance of a student in a particular course. Grades are denoted by the letters S, A, B, C, D, E, RA, and W.

2. Programme Offered and Eligibility Criteria:

The Department of Microbiology offers a M.Sc. Microbiology (Five - Year) programme. A pass in HSE (10+2 level) or Equivalent thereto under academic stream with Physics, Chemistry and Biology or Computer Science or Biochemistry or Home Science or Agri. or any Vocational Course with Biology or Botany and Zoology.

3. Reservation Policy: Admission to the various programmes will be strictly based on the reservation policy of the Government of Tamil Nadu.

4. Programme Duration

4.1 The Five-Year Master's Programme consists of five academic years.

4.2 Each academic year is divided into two semesters, the first being from July to November and the second from December to April.

4.3 Each semester will have 90 working days (18 weeks).

5. Programme Structure

5.1 The Five-Year Integrated Programme consists of Language Courses, Core Courses, Allied Courses, Elective Courses, Experiential Learning and Project. Students shall also participate in Extension Activities as part of their curriculum.

5.2 Language Courses

5.2.1 Each student shall take two languages of four courses each, one in each semester for the first two years of the programme.

5.2.2 Language – I shall be Tamil or another language such as Hindi or French.

5.2.3 Language – II shall be English.

5.3 Core courses

5.3.1 These are a set of compulsory courses essential for each programme.

5.3.2 The core courses include both Theory (Core Theory) and Practical (Core Practical) courses.

5.4 Allied Courses

5.4.1 Each student shall take courses in two disciplines allied to the main subject (Allied – I and Allied – II) of the programme in the first four semesters.

5.5 Elective courses

5.5.1 **Departmental Electives (DEs)** are the Electives that students can choose from a range of Electives offered within the Department.

Interdepartmental Electives (IDEs) are Electives that students can choose from amongst the courses offered by other departments of the same faculty as well as by the departments of other faculties.

5.6 Soft Skills

5.6.1 Soft skills are intended to enable students to acquire attributes that enhance their performance and achieve their goals with complementing hard skills.

5.6.1 Soft skills include communication skills, **computer skills** among others.

5.7 Value Education

5.7.1 All students shall take a course on Value Education that includes human values, sustainable development, gender equity, ethics and human rights.

5.7.2 **Value Educationis** categorized as **Non-Credit Compulsory Course.**

5.8 Experiential Learning

5.8.1 Experiential learning provides opportunities to students to connect

principles of the discipline with real-life situations, either within the classroom, within the community, or within the work place-based learning outcome that are specifically focused on employability skills.

5.8.2 In-plant training/ field trips/ internships/ industrial visits fall under this category.

5.8.3 **Experiential learning** is categorized as **Non-Credit Compulsory Course.**

5.9 Extension Activities

5.9.1 It is mandatory for every student to participate in extension activities.

5.9.2 All the students shall enroll under NSS/NCC/YRC/RRC or any other Service organisation in the University.

5.9.3 Students shall put in a minimum attendance of 40 hours in a year duly certified by the Programme Co-ordinator.

5.9.4 Extension activities shall be conducted outside the class hours.

5.9.5 Extension activities are categorized as **Non-Credit Compulsory**

Course.

5.10 Project

5.10.1 Each student shall undertake a Project and submit a dissertation as per guidelines in the final semester.

5.10.2 The Head of the Department shall assign a Research Supervisor to the student.

5.10.3 The Research Supervisor shall assign a topic for research and monitor the progress of the student periodically.

5.10.4 Students who wish to undertake project work in recognized institutions/ industry shall obtain prior permission from the University. The Research Supervisor will be from the host institute.

5.11 Value added Courses (VACs)

5.11.1 Students may also opt to take Value added Courses beyond the minimum credits required for award of the Degree. VACs are outside the normal credit paradigm.

5.11.2 These courses impart employable and life skills.

5.11.3 Each VAC carries 2 credits with 30 hours of instruction. Classes for a VAC are conducted beyond the regular class hours and preferably in the VIII and IX Semester.

5.12 Online Courses

5.12.1 The Heads of Departments shall facilitate enrolment of students in Massive Open Online Courses (MOOCs) platform such as SWAYAM to provide academic flexibility and enhance the academic career of students.

5.12.2 Students who successfully complete a course in the MOOCs platform shall be exempted from one elective course of the programme.

5.13 Credit Distribution: The credit distribution is organized as follows:

	Credits
Semester I to VI	
Language-I (Tamil or any other Language)	12
Language-II (English)	12
Core Courses	83
Allied-I (1st Year- SEM I & II)	10
Allied-II (2nd Year- SEM III & IV)	10
Electives	09
Soft Skill (Computer Skill)	03
Environmental studies (UGC mandated)	03

Value Education	02*
Experiential learning	02*
Extension activities	01*
Total Credits (Semester I to VI)	**142**
Semester VII to X	
Core Courses	72
Electives (DE)	06
Electives (IDE)	09
Project	06
Constitution of India	02*
Total Credits (Semester VII to X)	**93**
Total Credits (Semester I to X)	**235**

Note: '*' - Non -Credit Compulsory Course

5.9 Credit Assignment

Each course is assigned credits and credit hours on the following basis:

1 Credit is defined as

1 Lecture period of one-hour duration per week over a semester

1 Tutorial period of one-hour duration per week over a semester

1Practical/ Project period of two hours duration per week over a semester.

6 Attendance

6.1 Each faculty handling a course shall be responsible for the maintenance of Attendance and Assessment Record for candidates who have registered for the course.

6.2 The Record shall contain details of the students' attendance, marks obtained in the Continuous Internal Assessment (CIA) Tests, Assignments and Seminars. In addition the Record shall also contain the organization of lesson plan of the Course teacher.

6.3 The record shall be submitted to the Head of the Department and Dean once a month for monitoring the attendance and syllabus coverage.

6.4 At the end of the semester, the record shall be placed in safe custody for any future verification.

6.5 The Course teacher shall intimate to the Head of the Department at least seven calendar days before the last instruction day in the semester about the attendance particulars of all students.

6.6 Each student shall have a minimum of 75% attendance in all the courses of the particular semester failing which he or she will not be

permitted to write the End-Semester Examination. The student has to redo the semester in the next year.

6.7 Relaxation of attendance requirement up to 10% may be granted for valid reasons such as illness, representing the University in extracurricular activities and participation in NCC/NSS/YRC/RRC.

7 Mentor-Mentee System

7.1 To help the students in planning their course of study and for general advice on the academic programme, the Head of the Department will attach certain number of students to a member of the faculty who shall function as a Mentor throughout their period of study.

7.2 The Mentors will guide their mentees with the curriculum, monitor their progress, and provide intellectual and emotional support.

7.3 The Mentors shall also help their mentees to choose appropriate electives and value-added courses, apply for scholarships, undertake projects, prepare for competitive examinations such as NET/SET, GATE etc., attend campus interviews and participate in extracurricular activities.

8 Examinations

8.1 The examination system of the University is designed to systematically test the student's progress in class, laboratory and field work through Continuous Internal Assessment (CIA) Tests and End-Semester Examination (ESE).

8.2 There will be two CIA Tests and one ESE in each semester.

8.3 The Question Papers will be framed to test different levels of learning based on Bloom’s taxonomy viz. Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation/ Creativity.

8.4 Continuous Internal Assessment Tests

8.4.1 The CIA Tests shall be a combination of a variety of tools such as class tests, assignments and seminars. This requires an element of openness.

8.4.2 The students will be informed in advance about the assessment procedures.

8.4.3 The question paper will be set by the respective faculty using Blooms Taxanomy.

8.4.4 CIA Tests will be for one- or two-hours duration depending on the quantum of syllabus.

8.4.5 A student cannot repeat the CIA Test-I and CIA Test-II. However, if for

any valid reason, the student is unable to attend the test, the prerogative of arranging a special test lies with the teacher in consultation with the Head of the Department.

8.4.6 For the CIA Tests, the assessment will be done by the Course teacher.

8.5 End Semester Examinations (ESE)

8.5.1 The ESEs for the odd semester will be conducted in November and for the even semester in May.

8.5.2 Candidates who failed in any course will be permitted to reappear in failed course in the subsequent examinations.

8.5.3 The ESE will be of three hours duration and will cover the entire syllabus of the course.

9 Evaluation

9.1 Marks Distribution

9.1.1 For each course, the Theory, Practical and project shall be evaluated for a maximum of 100 marks.

9.1.2 For the theory courses and project CIA Tests will carry 25% and the ESE 75% of the marks.

9.1.3 For the Practical courses, the CIA Tests will carry 40% and the ESE 60% of the marks.

9.2 Assessment of CIA Tests

9.2.1 For the CIA Tests, the assessment will be done by the Course Instructor

9.2.2 For the Theory Courses, the break-up of marks shall be as follows:

CIA for Theory Courses	Marks
Test-I & Test-II	**15**
Seminar	**5**
Assignment	**5**
Total	**25**

9.2.3 For the Practical Courses (wherever applicable), the break-up of marks shall be as follows:

CIA for Practical	Marks
Test-I	15
Test-II	15
Viva-voce and Record	10
Total	40

9.3 Assessment of End-Semester Examinations

9.3.1 Evaluation for the ESE is done by Internal examiner.

9.4 Assessment of Project/ Dissertation

9.4.1 The Project Report/ Dissertation shall be submitted as per the guidelines.

9.4.2 The Project shall carry a maximum of 100 marks.

9.4.3 CIA for Project will consist of a Review of literature survey, experimentation/ field work, attendance etc.

9.4.4 The Project Report evaluation and viva-voce will be conducted by a committee constituted by the Head of the Department.

9.4.5 The Project Evaluation Committee will comprise the Head of the Department, Project Supervisor, and a senior faculty.

9.4.6 The marks shall be distributed as follows:

Continuous Internal Assessment (25 Marks)		End Semester Examination (75 Marks)	
Review - I	Review - II	Project / Dissertation Evaluation	Viva-Voce
10	15	50	25

9.5 Assessment of Value-added Courses

9.5.1 Assessment of VACs shall be internal. Two CIA Tests shall be conducted by the Department(s) offering VAC.

9.5.2 The grades obtained in VACs will not be included for calculating the GPA/CGPA.

9.6 Passing Minimum

9.6.1 A student is declared to have passed in each course if he/she secures not less than 50% marks in the ESE and not less than 50% marks in aggregate taking CIA and ESE marks together.

9.6.2 A candidate who has not secured a minimum of 50% of marks in a course (CIA + ESE) shall reappear for the course in the next semester/ year.

10. Conferment of the Master's Degree

A candidate who has secured a minimum of 50% marks in all courses prescribed in the programme and earned the minimum required credits shall be considered to have passed the Master's Programme.

11. Marks and Grading

11.1 The performance of students in each course is evaluated in terms Grade Point (GP).

11.2 The sum total performance in each semester is rated by Grade Point Average (GPA) while Cumulative Grade Point Average (CGPA) indicates the Average Grade Point obtained for all the courses completed.

11.3 **The GPA** is calculated by the formula

$$GPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i}$$

where, C_i is the Credit earned for the Course i in any semester;

$G_i$is the Grade Point obtained by the student for the Course i

n is the number of Courses passed in that semester.

11.4 **CGPA** is the Weighted Average Grade Point of all the Courses passed starting from the first semester to the current semester.

$$CGPA = \frac{\sum_{i=1}^{m} \sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{m} \sum_{i=1}^{n} C_i}$$

Where, C_i is the Credit earned for the Course i in any semester;

G_i is the Grade Point obtained by the student for the Course i

n is the number of Courses passed in that semester.

m is the number of semester.

11.5 Evaluation :

11.5.1 **Performance of the student for each course will be rated as shown in the Table.**

Range of Marks	Grade Points	Letter Grade
90 and above	10	S
80-89	9	A
70-79	8	B
60-69	7	C
55-59	6	D
50-54	5	E
Less than 50	0	RA
Withdrawn from the examination	0	W

11.5.2 A ten-point rating scale is used for evaluation of the performance of the student to provide overall grade for the Master's Programme.

CGPA	Classification of Final Result
8.25 and above	First Class with Distinction
6.5 and above but below 8.25	First Class
5.0 and above but below 6.5	Second Class
0.0 and above but below 5.0	Re-appear

11.6 Classification of Results. The successful candidates are classified as follows:

11.6.1 **First Class with Distinction:** Candidates who have passed all the courses prescribed in the Programme in the first attempt with a CGPA of 8.25and above within the programme duration. Candidates who have withdrawn from the End Semester Examinations are still eligible for First Class with Distinction (See Section 12 for details).

11.6.2 **First Class:** Candidates who have passed all the courses with a CGPA

of 6.5and above.

11.6.3 **Second Class:** Candidates who have passed all the courses with a CGPA between 5.0 and less than 6.5.

11.6.4 Candidates who obtain overall highest CGPA in all examinations in the first appearance itself are eligible for **University Rank.**

11.7 Course-Wise Letter Grades

11.7.1 The percentage of marks obtained by a candidate in a course will be indicated in a letter grade.

11.7.2 A student is considered to have completed a course successfully and earned the credits if he/she secures an overall letter grade other than RA.

11.7.3 A course successfully completed cannot be repeated for the purpose of improving the Grade Point

11.7.4 A letter grade RA indicates that the candidate shall reappear for that course. The RA Grade once awarded stays in the grade sheet of the student and is not deleted even when he/she completes the course successfully later. The grade acquired later by the student will be indicated in the grade sheet of the Odd/Even semester in which the candidate has appeared for clearance of the arrears.

11.7.5 If a student secures RA grade in the Project Work/Field Work/Practical Work/Dissertation, he/she shall improve it and resubmit if it involves only rewriting/ incorporating the clarifications suggested by the evaluators or he/she can re-register and carry out the same in the subsequent semesters for evaluation.

12. Provision for Withdrawal from the End Semester Examination

12.1 The letter grade W indicates that a candidate has withdrawn from the examination.

12.2 A candidate is permitted to withdraw from appearing in the ESE for one course or courses in ANY ONE of the semesters ONLY for exigencies deemed valid by the University authorities.

12.3 Permission for withdrawal from the examination shall be granted only once during the entire duration of the programme.

12.4 Application for withdrawal shall be considered only if the student has registered for the course(s), and fulfilled the requirements for attendance and CIA tests.

12.5 The application for withdrawal shall be made ten days prior to the commencement of the examination and duly approved by the

Controller of Examinations. Notwithstanding the mandatory prerequisite of ten days' notice, due consideration will be given under extraordinary circumstances.

12.6 Withdrawal will not be granted for arrear examinations of courses in previous semesters and for the final semester examinations.

12.7 Candidates who have been granted permission to withdraw from the examination shall reappear for the course(s) when the course(s) are offered next.

12.8 Withdrawal shall not be taken into account as an appearance for the examination when considering the eligibility of the candidate to qualify for First Class with Distinction.

13. Academic misconduct: Any action that results in an unfair academic advantage/ interference with the functioning of the academic community constitutes academic misconduct. This includes but is not limited to cheating, plagiarism, altering academic documents, fabrication/falsification of data, submitting the work of another student, interfering with other students' work, removing/defacing library or computer resources, stealing other students' notes/assignments, and electronically interfering with other students'/University's intellectual property. Since many of these acts may be committed unintentionally due to lack of awareness, students shall be sensitized on issues of academic integrity and ethics.

14. Transitory Regulations: Wherever there has been a change of syllabi, examinations based on the existing syllabus will be conducted for two consecutive years after implementation of the new syllabus in order to enable the students to clear the arrears. Beyond that, the students will have to take up their examinations in equivalent subjects, as per the new syllabus, on the recommendation of the Head of the Department concerned.

15. Not with standing anything contained in the above pages as Rules and Regulations governing the Five-Year Master's Programmes at Annamalai University, the Syndicate is vested with the powers to revise them from time to time on the recommendations of the Academic Council.

ANNAMALAI UNIVERSITY

DEPARTMENT OF MICROBIOLOGY

FACULTY OF SCIENCE

M. Sc. Microbiology (Five Year Integrated) Programme

Programme Code: SMIC51

Curricula and Scheme of Examination

(For students admitted from the academic year 2019-2020 onwards)

Course Code	Course Title	L	P	C	CIA	ESE	Total
		Hours/Week					
SEMESTER - I							
19IXXXC11	Language – I: Course 1	3		3	25	75	100
19IENGC12	Language – II: Course 1	3		3	25	75	100
19IENSC13	Environmental Studies	3		3	25	75	100
19IMICC14	Core 1: Basic Microbiology – I	4		4	25	75	100
19IBOTA01	Allied – I: Botany - I Course 1	4		4	25	75	100
19IMICE1X	Elective 1: Department Elective	3		3	25	75	100
	Total Credits			**20**			
SEMESTER – II							
19IXXXC21	Language – I: Course 2	3		3	25	75	100
19IENGC22	Language – II: Course 2	3		3	25	75	100
19ICISC23	Soft Skill- Computer Applications – I	3		3	25	75	100
19IMICC24	Core 2: Basic Microbiology - II	4		4	25	75	100
19IMICP25	Core 3: Practical – 1 (Core course - 1 & 2)		10	5	40	60	100
19IBOTA02	Allied – I: Botany - II Course 2	4		4	25	75	100
19IBOTP01	Allied Practical – I: Botany Course 3		04	2	40	60	100
	Total Credits			**24**			
SEMESTER - III							

19IXXXC31	Language – I: Course 3	3		3	25	75	**100**
19IENGC32	Language – II: Course 3	3		3	25	75	**100**
19IMICC33	Core 4: Microbial Taxonomy	4		4	25	75	**100**
19IMICP34	Core 5: Practical – 2 (Core course – 4)		10	5	40	60	**100**
19IBITA01	Allied – II: Biochemistry – I Course 1	4		4	25	75	**100**
19IMICE3X	Elective 2: Department Elective	3		3	25	75	**100**
	Total Credits			**22**			
SEMESTER - IV							
19IXXXC41	Language – I: Course 4	3		3	25	75	**100**
19IENGC42	Language – II: Course 4	3		3	25	75	**100**
19IMICC43	Core 6: Microbial Physiology	4		4	25	75	**100**
19IMICP44	Core 7: Practical – 3 (Core course - 6)		10	5	40	60	**100**
19IBITA02	Allied – II: Biochemistry – II Course 2	4		4	25	75	**100**
19IBITP01	Allied Practical – II Biochemistry Course 3		04	2	40	60	**100**
19IMICF40*	Extension Acitivities		2	1*	40	60	**100**
	Total Credits			**21**			
SEMESTER – V							
19IMICC51	Core 8: Immunology	5		5	25	75	**100**
19IMICC52	Core 9: Medical Microbiology	5		5	25	75	**100**
19IMICC53	Core 10: Microbial Genetics & Molecular biology	5		5	25	75	**100**
19IMICC54	Core 11: Soil, Agricultural & Environmental Microbiology	5		5	25	75	**100**
19IMICP55	Core 12: Practical – 4 (Core courses - 8,9,10 & 11)		12	6	40	60	**100**
19IMICE5X	Elective 3: Department Elective	3		3	25	75	**100**

19IMICV50*	Value Education	2	0	2*	25	75	**100**
	Total Credits			**29**			
SEMESTER - VI							
19IMICC61	Core 13: Industrial Microbiology	5		5	25	75	**100**
19IMICC62	Core 14: Genetic Engineering	5		5	25	75	**100**
19IMICC63	Core 15: IPR, Biosafety and Bioethics	5		5	25	75	**100**
19IMICC64	Core 16: Food & Dairy Microbiology	5		5	25	75	**100**
19IMICP65	Core 17: Practical – 5 (Core courses - 13,14,15 &16)		12	6	40	60	**100**
19IMICF60*	Experiential learning*		4	2*	40	60	**100**
	Total Credits			**26**			
SEMESTER - VII							
19IMICC71	Core 18: General Microbiology	4		4	25	75	**100**
19IMICC72	Core 19: Pharmaceutical Chemistry & Pharmaceutical Microbiology	4		4	25	75	**100**
19IMICC73	Core 20: Immunology & Immuno Technology	4		4	25	75	**100**
19IMICP74	Core 21: Practical – 6 (Core Courses -18,19 & 20)		12	6	40	60	**100**
19XXXXXXX	Elective 4: Interdepartmental Elective	3		3	25	75	**100**
	Total Credits			**21**			
SEMESTER - VIII							
19IMICC81	Core 22: Bioprocess Technology	4		4	25	75	**100**
19IMICC82	Core 23: Bacteriology & Virology	4		4	25	75	**100**
19IMICC83	Core 24: Mycology & Parasitology	4		4	25	75	**100**
19IMICP84	Core 25: Practical – 7 (Core courses - 22, 23 & 24)		12	6	40	60	**100**
19IMICE8X	Elective 5: Department Elective	3		3	25	75	**100**
19XXXXXXX	Elective 6: Interdepartmental Elective	3		3	25	75	**100**

	Total Credits			**24**			
SEMESTER - IX							
19IMICC91	Core 26: Molecular biology & Recombinant DNA Technology	4		4	25	75	**100**
19IMICC92	Core 27: Biofuel & Bioenergy	4		4	25	75	**100**
19IMICC93	Core 28: Microbial Inoculants & Mushroom Technology	4		4	25	75	**100**
19IMICC94	Core 29: Bioinstrumentation & Research Methodology	4		4	25	75	**100**
19IMICP95	Core 30: Practical – 8 (Core course - 26, 27, 28 & 29)		12	6	40	60	**100**
19IMICE9X	Elective 7: Department Elective	3		3	25	75	**100**
19XXXXXXX	Elective 8: Interdepartmental Elective	3		3	25	75	**100**
19IPSC090*	Constitution of India* (Non credit - compulsory course)	2		2*	25	75	**100**
	Total Credits			**28**			
SEMESTER - X							
19IMICCX1	Core 31: Medical Diagnostic Technology	4		4	25	75	**100**
19IMICCX2	Core 32: Applied Microbiology	4		4	25	75	**100**
19IMICPX3	Core 33: Practical – 9 (Core course – 31 & 32)		12	6	40	60	**100**
19IMICDX4	Project work (Dissertation & Viva-voce)		12	6	25	75	**100**
	Total Credits			**20**			
	Semesters I - X Total Credits			**235**			
	Value Added Courses						
	Online courses (SWAYAM, MOOC NPTEL)						

NOTE: * ⟹ Non-Credit Compulsory Course

L- Lectures; T-Tutorials; P- Practical; C- Credits; CIA- Continuous Internal Assessment; ESE- End-Semester Examination

Note:

1. Students shall take both Department Electives (DEs) and Interdepartmental Electives (IDEs) from a range of choices available. The details of interdepartmental electives are given in the "**Handbook of Interdepartmental Electives-Two Year Programme**" and listed in the University website.

2. Students may opt for any Value-added Courses listed in the University website. The details of Value Added Courses are given in the "**Handbook of Value Added Courses**" and listed in the University website.

3. Guidance/Discussion on course specific **experiential learning** to Students will be provided wherever feasible to apply the knowledge, skills and attitude taught in the course, either within the classroom, within the community, or within the workplace, to learn by experience which would improve their employability skills.

DEPARTMENT ELECTIVE COURSES (DE)

Course Code	COURSE	L	P	C	CIA	ESE	Total
		Hours/ Week					
19IMICE15	Techniques in Microbiology	3		3	25	75	100
19IMICE16	Phycology & Mycology	3		3	25	75	100
19IMICE17	Biological Science	3		3	25	75	100
19IMICE35	Public Health Microbiology	3		3	25	75	100
19IMICE36	Virology	3		3	25	75	100
19IMICE37	Rhizosphere Biology	3		3	25	75	100
19IMICE56	Microalgal Technology	3		3	25	75	100
19IMICE57	Commercial Biotechnology	3		3	25	75	100
19IMICE58	Microbiome Science	3		3	25	75	100
19IMICE85	Entrepreneurship and Management for Microbiology	3		3	25	75	100
19IMICE86	Bioremediation	3		3	25	75	100
19IMICE87	Microbial Nanotechnology	3		3	25	75	100
19IMICE96	Microbial Diversity and Extremophiles	3		3	25	75	100

19IMICE97	Environmental Microbial Technology	3		3	25	75	**100**
19IMICE98	Vermitechnology	3		3	25	75	**100**

ALLIED COURSES (Offered to other Departments)

Course Code	COURSE	L	P	C	CIA	ESE	Total
		Hours/ Week					
19IMICA01	Allied - I: Microbiology Course 1	4		4	25	75	**100**
19IMICA02	Allied - I: Microbiology Course 2	4		4	25	75	**100**
19IMICP01	Allied Practical I Microbiology Course 3		04	2	40	60	**100**

ANNAMALAI UNIVERSITY

Department of Microbiology

[Question Paper Pattern - INTERNAL TESTS I & II (CIA)]

(Based on Revised Bloom's Taxonomy)

Programme: M.Sc.: Five Year Integrated

Semester: All

Time: 2 Hrs **Max.Marks:50**

Part - A (Level - K1) **Marks: (6x2=12)**

(Answer ALL of the questions)

1. Define /Choose/ Relate……
2. What / Why / How?
3. Multiple Choices a. b. c. d.
4. Multiple Choices a. b. c. d.
5. Match the following i - a ii - b iii - c iv - d v - …..
6. Match the following i - a ii - b iii - c iv - d v - …..

Part-B (Level-K2) **Marks: (3x5=15)**

(Answer any THREE of the questions)

7. Explain…..
8. Describe…..
9. Select……
10. Compare

Part-C (Level-K3/ Level-K4) **Marks: (2x7=14)**

(Answer any TWO of the questions)

11. Apply….
12. Calculate….
13. Categorize…

Part-D (Level-K5/ Level-K6) **Marks: (1x9=9)**

(Answer any ONE of the questions)

14. Discuss….
15. Summarize….

ANNAMALAI UNIVERSITY

[End Semester Examinations]

(Based on Revised Bloom's Taxonomy)

Programme: M.Sc.,: Five Year Integrated PG Year: I/II Semester:

Time: 3 Hrs Max. Marks:100

Part-A (Level-K1) **Marks: (15x2=30)**

(Answer ALLof the questions)

1. Define……
2. What …….?
3. Choose/Relate……
4. How ……?
5. Why ……?
6. Find……
7. Spell out……
8. Multiple Choices a. b. c. d.
9. Multiple Choices a. b. c. d.
10. Multiple Choices a. b. c. d.
11. Multiple Choices a. b. c. d.
12. Match the following i - a ii - b iii - c iv - d v - …..
13. Match the following i - a ii - b iii - c iv - d v - …..
14. Match the following i - a ii - b iii - c iv - d v - …..
15. Match the following i - a ii - b iii - c iv - d v - …..

Part-B (Level-K2) **Marks: (5x5=25)**

(Answer any FIVE of the questions)

16. Explain…..
17. Describe…..
18. Select……
19. Classify….
20. Compare….
21. Interpret…

Part-C (Level-K3/ Level-K4) **Marks: (5x7=35)**

(Answer any FIVE of the questions)

22. Apply….
23. Show…..
24. Solve….
25. Calculate….
26. Categorize…
27. Distinguish….
28. Test for…..

Part-D (Level-K5) **Marks: (1x10=10)**

(Answer any ONE of the questions)

29. Discuss….
30. Summarize….

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ANNAMALAI UNIVERSITY

[End Semester Examinations]

(Based on Revised Bloom's Taxonomy)

Programme: M.Sc.,: Five Year Integrated PG Year: III Semester:

Time: 3 Hrs Max.Marks:100

Part-A (Level-K1) **Marks: (10x2=20)**

(Answer ALL of the questions)

1. Define……
2. What ……..?
3. Multiple Choices a. b. c. d.
4. Multiple Choices a. b. c. d.
5. Multiple Choices a. b. c. d.
6. Multiple Choices a. b. c. d.
7. Match the following i - a ii- b iii- c iv - d v - …..
8. Match the following i - a ii- b iii- c iv - d v - …..
9. Match the following i - a ii- b iii- c iv - d v - …..
10. Match the following i - a ii- b iii- c iv - d v - …..

Part-B (Level-K2) **Marks: (5x3=15)**

(Answer any FIVE ofthe questions)

11. Explain…..
12. Describe…..
13. Select……
14. Classify….
15. Compare….
16. Outline ….

Part-C (Level-K3/Level-K4) **Marks: (9x5=45)**

(Answer any NINE of the questions)

17. Apply….
18. Prepare….
19. Show…..
20. Solve….
21. Illustrate…..
22. Sketch….
23. Infer….
24. Categorize…
25. Analyze…
26. Distinguish….
27. Take part in…

Part-D (Level-K5/Level-K6) **Marks: (2x10=20)**

(Answer any TWO of the questions)

28. Discuss….
29. Summarize….
30. Design….

***

ANNAMALAI UNIVERSITY

[End Semester Examinations]

(Based on Revised Bloom's Taxonomy)

Programme: M.Sc.,: Five Year Integrated PG **Year: IV**
Semester:

Time: 3 Hrs **Max.Marks:100**

Part-A (Level-K1/ Level-K2) **Marks: (10x2=20)**

(Answer ALL of the questions)

1. Define……
2. Multiple Choices a. b. c. d.
3. Multiple Choices a. b. c. d.
4. Match the following i - a ii- b iii- c iv –d v - …..
5. Match the following i - a ii- b iii- c iv –d v - …..
6. Explain…….
7. Select…..
8. Describe……
9. Classify….
10. Elucidate….

Part-B (Level-K3/ Level-K4) **Marks: (8x5=40)**

(Answer any EIGHT of the questions)

11. Prepare…..
12. Solve…..
13. Apply……
14. Show…..
15. Categorize…
16. Analyze…
17. Distinguish….
18. Infer….
19. Compare….
20. Compute

Part-C (Level-K5) **Marks: (3x10=30)**

(Answer any THREE of the questions)

21. Discuss…
22. Summarize….
23. Evaluate…..
24. Disprove….

Part-D (Level-K6) **Marks: (1x10=10)**

(Answer any ONE of the questions)

25. Design….
26. Develop…

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ANNAMALAI UNIVERSITY

All PG in the Faculties of Arts / Sci. / M. Sci. / Ind. Lan. / Edn. / Fine Arts.

[2019-20]

[End Semester Examinations]

(Based on Revised Bloom's Taxonomy)

Programme: M.Sc., : Five Year Integrated **PG Year:V**
Semester:

Time: 3 Hrs **Max.Marks:100**

Part-A (Level-K1/ Level-K2) **Marks: (10x2=20)**

(Answer ALL of thequestions)

1. Define……
2. Multiple Choices a. b. c. d.
3. Multiple Choices a. b. c. d.
4. Match the following i - a ii- b iii- c iv –d v - …..
5. Match the following i - a ii- b iii- c iv –d v - …..
6. Explain…….
7. Select…..
8. Describe…..
9. Classify….
10. Elucidate….

Part-B (Level-K3/ Level-K4) **Marks: (6x5=30)**

(Answer any SIX of the questions)

11. Apply……
12. Show…..
13. Prepare
14. Make use of….
15. Categorize…
16. Analyze…
17. Distinguish….
18. Simplify…..

Part-C (Level-K5) **Marks: (3x10=30)**

(Answer any THREE of the questions)

19. Discuss…
20. Recommend with
21. Evaluate…..
22. Justify….
23. Optimize…

Part-D (Level-K6)* **Marks: (2x10=20)**

(Answer any TWO of the questions)

24. Design….
25. Formulate …
26. Modify …..

*****

M.Sc. MICROBIOLOGY (FIVE YEAR) PROGRAMME

[End Semester Examinations]

Bloom's Taxonomy - Questions Conforming to Levels K1 to K6

I Year(Five Year PG)				II Year (Five Year PG)				III Year(Five Year PG)			
Level	Part	Questions & Marks	Total Marks	Level	Part	Questions & Marks	Total Marks	Level	Part	Questions & Marks	Total Marks
K1	A	15 x 2	30	K1	A	15 x 2	30	K1	A	10 x 2	20
K2	B	5 x 5	25	K2	B	5 x 5	25	K2	B	5 x 3	15
K3	C	3 x 7	21	K3	C	3 x 7	21	K3	C	5 x 5	25
K4		2 x 7	14	K4		2 x 7	14	K4		4 x 5	20
K5	D	1 x 10	10	K5	D	1 x 10	10	K5	D	1 x 10	10
			100				100	K6		1 x 10	10
											100

IV Year (Five Year PG)				V Year (Five Year PG)			
Level	Part	Questions & Marks	Total Marks	Level	Part	Questions & Marks	Total Marks
K1	A	5 x 2	10	K1	A	5 x 2	10
K2		5 x 2	10	K2		5 x 2	10
K3	B	4 x5	20	K3	B	2 x 5	10
K4		4 x5	20	K4		4 x 5	20
K5	C	3 x 10	30	K5	C	3 x10	30
K6	D	1 x 10	10	K6	D	2x 10	20
			100				100

Programme Outcomes (POs):

On completion of five year M.Sc. Microbiology, students will be able to

PO1:	Domain knowledge: Demonstrate knowledge of basic concepts, principles and applications of the specific science discipline.
PO2:	**Resource Utilisation.** Cultivate the skills to acquire and use appropriate learning resources including library, e-learning resources, ICT tools to enhance knowledge- base and stay abreast of recent developments.
PO3:	**Analytical and Technical Skills:** Ability to handle/ use appropriate tools/ techniques/ equipment with an understanding of the standard operating procedures, safety aspects/ limitations.
PO4:	**Critical thinking and Problem solving:** Identify and critically analyse pertinent problems in the relevant discipline using appropriate tools and techniques as well as approaches to arrive at viable conclusions/ solutions.
PO5:	**Project Management**: Demonstrate knowledge and scientific understanding to identify research problems, design experiments, use appropriate methodologies, analyse and interpret data and provide solutions. Exhibit organisational skills and the ability to manage time and resources.
PO6:	**Individual and team work**: Exhibit the potential to effectively accomplish tasks in dependently and as a member or leader in diverse teams, and in multidisciplinary settings.
PO7:	**Effective Communication**: Communicate effectively in spoken and written form as well as through electronic media with the scientific community as well as with society at large. Demonstrate the ability to write dissertations, reports, make effective presentations and documentation.
PO8:	**Environment and Society**: Analyse the impact of scientific and technological advances on the environment and society and the need for sustainable development.
PO9:	**Ethics**: Commitment to professional ethics and responsibilities.
PO10:	**Life-long learning:** Ability to engage in life-long learning in the context of the rapid developments in the discipline.

Programme Specific Outcomes (PSOs):

After the completion of five year M.Sc. Microbiology, students will be able to

PSO1:	Acquire basic Microbiology laboratory skills and expertise in the use of instruments applicable to research, clinical methods and analysis of the observations.
PSO2:	Understand prokaryotic and eukaryotic genetic systems & physiology of microorganisms.
PSO3:	Gain familiarity with applications of microbes for synthesis of valuable products through fermentation.
PSO4:	Explore the application of genetic engineering to create GMO, transgenic plants, animals, Gene therapy, etc.,
PSO5:	Understand the role of microorganisms in human health, immune response to infection and antibiotic resistance.

Overall, the Programme is reasoning and applications oriented, equipping the students eligible for higher studies, jobs in various sectors and entrepreneurship abilities.

முதலாம் ஆண்டு – முதற் பருவம்

Semester	19ITAMC11: Language -I: Course -1	L	T	P	C
I	நவீன இலக்கியமும் நாடகமும்	3	-	-	3

கற்பித்தலின் நோக்கம் (Learning Objective (LO))

LO1	**தமிழில் தோன்றிய நவீன இலக்கியங்களின் வளர்ச்சியைக் கூறல்.**
LO2	சிறுகதை, புதினங்கள் காட்டும் சமூகச் சிக்கல்களையும் கதை உத்திகளையும் விளக்குதல்.
LO3	தமிழின் நீட்யாக வளர்ந்துள்ள புதுக்கவிதை வகைமைய எடுத்துரைத்தல்.
LO4	நவீன நாடகங்களை இலக்கிய நாடகங்களோடு ஒப்பிடல்.
LO5	ஐரோப்பியர் வருகையால் தமிழில் ஏற்பட்ட மாற்றங்களையும் மறுமலர்ச்சியை விளக்குதல்.

Course Outcomes

At the end of the course, the student will be able to

CO1:	மொழிப் பாடம் வழியே தமிழின் சிறப்புக்களை மாணவர்கள் அறிந்து கொள்வர்.
CO2:	உலக இலக்கியங்களுக்குத் தமிழ் இணையானது என்னும் மனநிலையை அடைவர்.
CO3:	மாணவர்களுக்கு நாவல்கள், சிறுகதை வாசிப்புத் திறன் மேன்படும்.
CO4:	புதுக்கவிதைப் படைப்புத் திறன் தோன்றும்.
CO5:	பாடப்பகுதிக்குரிய நாடகங்களை விழாக்களில் நிகழ்த்தும் ஆர்வம் ஏற்படும்.

அலகு - 1 சிறுகதை

1. புதுமைப்பித்தன் - பால்வண்ணம் பிள்ளை
2. கி.ராஜநாராயணன் - கதவு
3. கு.அழகிரிசாமி - ராஜா வந்திருக்கிறார்
4. கண்மணி குணசேகரன் - உயிர்த் தண்ணீர்
5. மேலாண்மை பொன்னுச்சாமி - தேசிய மயில்

அலகு – 2 புதுக்கவிதை

1. பாரதியார் - புதுமைப்பெண்
2. பாரதிதாசன் - தமிழ் உணவு

3. உவமைக் கவிஞர் சுரதா - தமிழில் பெயரிடுங்கள் (துறைமுகம்)
4. தேவதேவன் - புகட்டல் (அமுதம் மாத்திரமே வெளிப்பட்டது)
5. அறிவுமதி - நட்புக்காலம் (முதல் 20- கவிதைகள் மட்டும்)
6. மித்ரா - ஹைகூ என் தோழி (முதல் 20- கவிதைகள் மட்டும்)

அலகு - 3 புதினம்

1.. டி.செல்வராசு - பொய்க்கால் குதிரை

அலகு - 4 நாடகம்

1. இன்குலாப் - ஔவை

அலகு - 5 இக்கால இலக்கிய வரலாறு

ஐரோப்பியர் வருகை - நவீன இலக்கியங்கள் அறிமுகம் - புதுக்கவிதை - சிறுகதை - புதினம் ஆகியவற்றின் தோற்றமும் வளர்ச்சியும் - இலக்கிய முன்னோடிகள் - செய்தித்தாள் வருகை - நாடகம் - தோற்றமும் வளர்ச்சியும்.

அலகு - 6

(மாணவர்கள் அறிந்து கொள்வதற்கு மட்டும் – தேர்வுக்கான பகுதி அல்ல)

இலக்கியங்களையும் அவை தொடர்பான இலக்கிய வரலாற்றையும் இணைத்துப் படித்தல். நவீன இலக்கியங்கள் சமூகத்தைப் படம் பிடித்துக்காட்டுவதை சமூகக் கண்ணோட்டத்தோடு அறிதல். நவீன இலக்கிய வடிவங்களின் வளர்ச்சி வாழ்வியலுக்குப் பயன்படும் முறையை விளக்குதல்.

பாட நூல்

1. புதுமைப்பித்தன் - பால்வண்ணம் பிள்ளை
நியூ செஞ்சரி புக் ஹவுஸ், சென்னை
ஐந்தாம் பதிப்பு - 2015

2. கி.ராஜநாராயணன் - கதவு
அன்னம் வெளியீடு,
தஞ்சாவூர், ஏழாம் பதிப்பு - 2015

3. கு.அழகிரிசாமி - ராஜா வந்திருக்கிறார்
காலச்சுவடு பதிப்பகம், நாகர்கோயில்
முதற்பதிப்பு -2012

4. கண்மணி குணசேகரன் - உயிர்த் தண்ணீர்
தாமரைச்செல்வி பதிப்பகம்
சென்னை, முதற்பதிப்பு- 1997

5. மேலாண்மை பொன்னுச்சாமி - தேசிய மயில்
வானதி பதிப்பகம், சென்னை
முதற்பதிப்பு - 1997

6. பாரதியார் - பாரதியார் கவிதைகள்
நியூ செஞ்சரி புக் ஹவுஸ், சென்னை
முதற்பதிப்பு – 2014
இரண்டாம் பதிப்பு- செப்டம்பர்- 2017

7. பாரதிதாசன் - பாரதிதாசன் கவிதைகள்
மணிவாசகர் பதிப்பகம், சென்னை
ஏழாம் பதிப்பு -2016

8. உவமைக் கவிஞர் சுரதா - துறைமுகம்
சுவாதி பதிப்பகம்,
அம்பத்தூர், சென்னை, முதற்பதிப்பு 2010

9. தேவதேவன் - அமுதம் மாத்திரமே வெளிப்பட்டது
நியூ செஞ்சரி புக் ஹவுஸ், சென்னை
முதற்பதிப்பு – 2016

10. அறிவுமதி - நட்புக்காலம்
கவிதா பதிப்பகம், சென்னை
எட்டாம் பதிப்பு-2005

11. மித்ரா - மித்ரா கவிதைகள்
சாரல் வெளியீடு, சென்னை
முதற்பதிப்பு, 1990

12. டி.செல்வராசு - பொய்க்கால் குதிரை
நியூ செஞ்சரி புக் ஹவுஸ், சென்னை
முதற்பதிப்பு – 2014

13. இன்குலாப் - ஔவை
அகரம் பதிப்பகம், தஞ்சாவூர்
ஐந்தாம் பதிப்பு - 2015

14. ச.வே.சுப்பிரமணியன் -தமிழ் இலக்கிய வரலாறு
மணிவாசகர் பதிப்பகம்
சென்னை, ஏழாம் பதிப்பு- 2015

15. சோ.நா. கந்தசாமி -தமிழ் இலக்கிய வரலாறு
மணிவாசகர் பதிப்பகம்
சென்னை, முதற்பதிப்பு- 2004

பார்வை நூல்கள்

1. வல்லிகண்ணன் - புதுக்கவிதையின் தோற்றமும் வளர்ச்சியும்
பாரிநிலையம், சென்னை-108
முதற்பதிப்பு- 2008

2. க. கைலாசபதி - தமிழ் நாவல் இலக்கியம்
குமரன் பதிப்பகம்
வடபழனி சென்னை
முதற்பதிப்பு- 1968, மறுபதிப்பு 2010

3. கார்த்திகேசுசிவதம்பி - தமிழில் சிறுகதை தோற்றமும் வளர்ச்சியும், நியூசெஞ்சரி, புத்தகநிலையம்,
சென்னை- 98, முதற்பதிப்பு- 2013

4. ஆறு. அழகப்பன் - தமிழ் நாடகத் தோற்றமும் வளர்ச்சியும்
பாரி நிலையம், சென்னை, மு.ப. 2011

5. சு. சக்திவேல் - இருபதாம் நூற்றாண்டுத் தமிழ் உரைநடை
மணிவாசகர் பதிப்பகம், சிதம்பரம்

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	-	-	2	2	-	-	2	2	2	3	3	3	2

CO2	3	3	-	-	-	2	-	-	3	-	-	2	2	-	-
CO3	-	2	3	-	3	2	-	-	-	-	3	-	-	2	3
CO4	3	-	3	-	-	2	-	-	-	2	2	2	2	-	-
CO5	3	2	-	-	2	-	-	-	2	2	2	-	-	3	2

Semester	19IHINC11: Language -1: Course 1	L	P	C
I	Basic Hindi-1	3	-	3

Learning Objectives:

LO1	**To know the Hindi terms for various professions.**
LO2	To gain knowledge of poem and prose.
LO3	To help the student to learn the importance of the moral, spiritual and human values.
LO4	To study short stories and imbibe morals.
LO5	To know about national leaders.

Course Outcomes (CO)

By the end of the course the student will be able to:

CO1:	Understand the basic structure of poems.
CO2:	Knowledge on various common hindi words.
CO3:	Describe the basic concepts of moral stories.
CO4:	Apply the concepts of in life.
CO5:	Analyze the difference between prose and poem.

Unit – 1: Introduction

Mathru vandana (poem), peshwar, chalo bazaar chalo, ahimsa ki vijay

Unit – 2: Poem, Prose

Balwan bano, Gandhiji ke asheram me chor,

Unit – 3: Vani ka theer, Bharth, daku se mahatma.

Unit – 4: Chandhini, samay ki pabandhi, vitamin.

Unit – 5: Rajiv Gandhi, titiali (poem), Bangalore.

Current Streams of Thought:

The Faculty will impart the current developments in the subject during the semester to the students and this component will not be a part of Examinations. Understanding on Hindi drama basis and concepts and nibandh.

Text Books

1. Adharsha hindi reader I-DBHP sabha- Chennai.17.
2. Parichya DBHPS **,** Trichi 17.

Supplementary Reading

1. Naveen Hindi Patamala: Part - I , D.B.H.P. Sabha, Chennai - 600 017.
2. Hindi prachar vahini.1, DHBS, sabha Chennai 17.

Outcome Mapping

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	-	-	-	-	-	-	-	1	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	1	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	1	-	-	-
CO5	2	2	2	-	-	-	-	-	-	-	1	-	-	-	-

Semester	19IFREC11: Language- I: Course -1 French-I	L	T	P	C
I		3	-	-	3

Learning Objective (LO):

LO1	Greet People.
LO2	Introduce oneself (Basic 1).
LO3	Identify the things and the persons; spell a word.
LO4	Ask about the day, the time and the date.
LO5	Asking excuse.

Course Outcomes (CO):

At the end of the course, the student will be able to:

CO1	Greet people appropriately, ask how they are, tell them how I am and ask how others are.
CO2	Obtain another different culture, the sound of the French language, certain words in French, some famous French symbols/landmarks.
CO3	Understand basic classroom instructions.
CO4	Can use different forms of address to speak to friends, teachers and people I do not know, using formal and informal modes of address and language.
CO5	Understand when the teacher is speaking to one or more persons in class and understand simple commands (mostly passive, receptive language with some active, productive language) and polite language. I can recognise 'tu' and 'vous' forms and help phrases such as *'Pardon', 's'il vous plaît', 'excusez-moi', 'merci'.*

Unit – 1 :

Aborder quelqu'un; Dire son nom

Identifier une langue, la nationalité et le nombre.

Identifier les choses et les personnes

Unit – 2 :

Remplir une fiche de renseignements.

Découvrir la carte postale, un message sur internet et le blog très simples.

Les pays francophones ; Les lieux de la ville

Dire si on comprend ; Saluer ; Prendre congé

Dire s'excuser ; Affirmer et nier ; Epeler son nom

Unit – 3 :

L'espace francophone ; Découvrir la France et les pays francophones

Exprimer ses gouts ; Identifier les professions

Demander quelque chose à quelqu'un

Unit – 4 :

Comprendre un article de presse sur un portrait d'une personne.

Première approche de la société française (noms, âges, origines, lieux d'habitation)

Parler des loisirs ; Faire un projet

Unit – 5 :

Proposer-accepter ou refuser une proposition

Demander une explication

Ecrire les cartes et messages d'invitation, d'acceptation ou de refus.

Découvrir la carte de France et les connaissances.

Text Book:

1. J. Girardet et J. Pecheur, (2012), ***Echo A1*** - méthode de français***,*** Langers, Paris

Supplementary Readings:

1. Marie-Noelle Cocton et Emilie Pommier, (2015), ***Saison A1*** - méthode de français, Les Editions Didier, Paris.
2. Angels Campa, Claude Mestreit, Julio Murillo et Manuel Tost, (2001), ***FORUM*** – Méthode de français, HACHETTE LIVRE, Paris.
3. Mauger Bleu, (2014), ***Le Cours de langue et de la civilisation française***, - Méthode de français, Hachette, Paris
4. Michele Boulares et Jean-Louis Frerot, (1997), ***Grammmaire Prograssive du Français avec 400 exerices***, CLE International, Paris.

Outcome Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	2	3	2	2	3	2	3	3	3	3	3	-	-	-
CO2	3	-	2	-	3	-	2	2	-	3	-	-	-	-	-
CO3	3	2	-	-	2	3	-	2	3	-	-	-	2	-	-
CO4	3	3	3	3	3	-	3	-	2	2	2	-	-	2	-
CO5	-	-	3	3	3	3	3	2	2	2	2	-	-	-	3

Semester	19IENGC12: Language – II: Course 1	L	P	C
I	English Through Literature I: Prose	3	-	3

LEARNING OBJECTIVE (LO):

By introducing the course, it is intended to:

LO1	Develop the Language ability of the students Enable students to understand the passage, to read fluently, to enrich their vocabulary, and to enjoy reading and writing.
LO2	Make the students proficient in the four language skills.
LO3	Make the students read with correct pronunciation, stress, intonation, pause, and articulation of voice.
LO4	Develop their inquiry skills.

COURSE OUTCOMES (CO)

At the end of the course, the student will be able to

CO1:	Obtain competency in communication, both in written and oral skills.
CO2:	Acquire fluency in English language.
CO3:	Become knowledgeable about construction of sentence structures.
CO4:	Develop English vocabulary to use the English language effectively.
CO5:	Exhibit proficy in the four communication skills.

Unit – 1:

Stephen Leacock	"With the Photographer"
Winston S. Churchill	"Examinations"
Grammar:	Parts of Speech: Nouns, Verbs, Adjectives, and Adverbs

Unit – 2:

G.B. Shaw	"Spoken English and Broken English"
M.K. Gandhi	"Voluntary Poverty"
Grammar:	Articles

Unit – 3:

Robert Lynd "On Forgetting"

Virginia Woolf "Professions for Woman"

Grammar: Pronouns

Unit – 4:

A. G. Gardiner "On Umbrella Morals"

R.K. Narayan "A Snake in the Grass"

Grammar: Prepositions

Unit – 5:

Martin Luther King (Jr.) "I Have a Dream"

George Orwell "The Sporting Spirit"

Grammar: Conjunctions & Interjections

Text Book:

1. Ayyappa Raja, S T. Deivasigamani. N. Saravana Prabhakar, B .Karthikeyan. *English through Literature: Prose, Chidambharam, Manibharathi Publishers, 2010.*
2. David Green: *Contemporary English Grammar: Structures and Composition*, Macmillan, 2012.

Outcome Mapping

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	-	-	-	-	-	-	-	1	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	1	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	1	-	-	-
CO5	2	2	2	-	-	-	-	-	-	-	1	-	-	-	-

Semester	19IENSC13: Environmental Studies	L	P	C
I		3	-	3

Learning Objectives (LO):

LO1	To make the student aware of World Environmental System.
LO2	To make the student aware of the fundamental Concepts and
LO3	Principles of Eco- system and energy-flow.

Course Outcomes (CO)

By the end of the course the student will be able to:

CO1:	To evaluate the present condition of environmental pollution.
CO2:	To understand the nature of the atmosphere.
CO3:	To be aware of causes of pollution and precautionary measure.

Unit – 1: Environmental System

(1.1)The Services provided by the Environmental System.

(1.2) Ecosystems: Food Chains, Food Webs, Ecological Pyramids.

(1.3) Biochemical Cycles: Hydrological Cycle, Carbon Cycle.

Unit - 2: Environmental Damage –Pollution

Sources and impact of

(2.1) Air Pollution

(2.2) Water Pollution

(2.3) Land Pollution

(2.4) Municipal Solid Waste (2.5) Noise Pollution.

Unit – 3: Resource Depletion

(3.1) Importance of Forests: Causes and Consequences of Deforestations.

(3.2) Bio Diversity: Meaning and Importance – Reasons and Consequences of Biodiversity Decline.

(3.3) Consequences of over drawing Water Resources.

Unit – 4: Global Climate Change

(4.1) The Science of Climate Change The Green House Effect (4.2) Sources. and Impact of Climate Change (4.3) Coping with Climate Change.

Unit – 5: Sustainable Development

(5.1) Concept and Definition of Sustainable Development (Brundtland Commission Definition).

(5.2) Poverty, Population Growth and Environmental Damage.

(5.3) Policies for Sustainable Development.

Current Streams of Thought

For Knowledge Purpose and not for Examinations

Current issues in environmental eco system Effects, Climate Change and Global Warming.

Text Books

1. Erach Bharucha, *Environmental Studies*, New Delhi: UGC, 2004.
2. Richard Wright and Dorothy F. Boorse, *Environmental Science: Toward a Sustainable Future,* New Delhi: Prentice-Hall India, 2010.

Supplementary Readings

1. Kumarasamy, K., A. Alagappa Moses and M. Vasanthy, *Environmental Studies*, Trichy: Bharathidasan University Publications, 2004.
2. Rajamannar, *Environmental Studies*, Trichy: EVR College Publications, 2004.
3. Kalavathy, S. (Ed), *Environmental Studies,* Trichy: Bishop Heber College Publication, 2004.

Outcome Mapping

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	3	-	-	-	-	3	2	2	3	-	-	3	2	3
CO2	-	3	-	-	-	-	2	2	2	3	-	-	3	2	3
CO3	-	3	-	-	-	-	2	2	2	3	-	-	3	2	3

Semester	19IMICC14: Basic Microbiology - I	L	P	C
I		4	-	4

Learning Objective (LO):

LO	To learn about the Introduction, Historical development, Staining reactions and Media preparation for the cultivation of microorganisms.

Course Outcomes (CO)

By the end of the course the student will be able to:

CO1:	Understand the history and recent developments in Microbiology
CO2:	Understand the principle and operation of different types of microscopes and their applications.
CO3:	Understand staining reactions and structure of bacteria.
CO4:	Gain knowledge about different methods of sterilization.
CO5:	Explain the media types and pure culture techniques.

Unit – 1: History Of Microbiology

History and scope of Microbiology. Recent developments - Spontaneous generation - Biogenesis. Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Elie Metchnikoff, Edward Jenner, Lister and Fleming.

Unit – 2: Microscopy

Microscopy: Principles and applications of Simple, Compound, Bright field, Dark field, Phase contrast, Fluorescence and Electron microscope [SEM & TEM].

Unit – 3: Bacterial Structure and Staining

Structure and organization of bacterial cell- Gram positive and Gram negative bacterial cell wall. Principles of staining: Nature of dyes, Types of staining – Simple, Differential, Negative and Spore staining.

Unit – 4: Sterilization Methods

Sterilization methods – Physical (Moist heat, Dry heat, Filtration, Pasteurization, Tyndalization, Radiation) and Chemical methods (Alcohols, Aldehydes, Phenols, Halogens and Hypochlorite).

Unit – 5: Cultivation of Bacteria

Culture and Media preparation – Solid and liquid – Types of media - Semi synthetic, Synthetic, Enriched, Enrichment, Selective and Differential media. Pure culture techniques - Tube dilution, Pour, Spread, Streak plate. Anaerobic culture techniques.

Text Books:

1. Dubey, R.C. and Maheswari, D.K. (2013). *A Textbook of Microbiology* 3rd ed. S. Chand and Company Ltd., New Delhi.
2. Ananthanarayan. R. and Paniker C.K.J. (2013). *Text Book of Microbiology*, 9th ed. Orient Longman, Chennai.

Supplementary Books:

1. Pelczar, M.J.J.R. Chan, E.C.S and Kreig, N.R. (2012). *Microbiology* 5th ed. Tata McGraw Hill, New Delhi.
2. Willey, J. Sherwood, L. and Woolverton, C.J. (2017). *Prescott's Microbiology*. 10th Edition: McGraw-Hill. New York.
3. Sumbali, G and Mehrotra, R.S. (2009). *Principles of Microbiology*. 1st ed. Tata McGraw Hill Pvt. Ltd. New Delhi.

Web References:

1. http://abrc.sinica.edu.tw/icm/app_out/main/theorem_E.php
2. https://vlab.amrita.edu/?sub=3&brch=73&sim=208&cnt=1

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	2	2	3	3	3	2	2	2
CO2	3	3	3	3	3	3	3	2	2	3	2	3	3	3	2
CO3	3	3	3	3	3	3	3	3	2	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3	2	3	2	3	3	2	2
CO5	3	3	3	3	3	3	3	3	2	3	3	2	2	3	3

Semester	19IBOTA01: Allied – I: Botany I: Plant Diversity, Anatomy and Embryology	L	P	C
I		4	-	4

Learning Objective (LO):

LO	To acquire basic knowledge in Plant Science.

Course Outcomes (CO)

By the end of the course, the student will be able to:

CO1:	Understand the structure and reproduction of bacteria.
CO2:	Appreciate the diverse Algae & Fungi groups and their characteristic features.
CO3:	Comprehend the structure and reproductions of Bryophytes, Pteridophytes and Gymnosperms.
CO4:	Understand the anatomy of vascular plants.
CO5:	Understand the structure and types of embryo of seed plants.

Unit – 1:

General account of bacteria – ultrastructure, nutrition and nutritional types, reproduction- asexual and parasexual. Economic importance.

Viruses: Structure- ultrastructure of TMV, bacteriophage, reproduction of viruses.

Unit – 2:

Structure, Reproduction and Life history of *Nostoc, Oedogonium, Ectocarpus* and *Polysiphonia, Albugo, Pencillium* and *Agaricus.*

Unit – 3:

Structure, reproduction and life history of *Funaria*, *Lycopodium* and *Cycas*.

Unit – 4:

Anatomy – simple and complex tissues, Internal structure of dicot root, stem and leaf - monocot stem and leaf. Normal secondary thickenings of dicot stem.

Unit – 5:

Embryology – Microsporogenesis – male gametophyte, Megasporogenesis (*Polygonum* Type) – types of ovule, double fertilization, Types of endosperms.

Text Books:

1. Bhojwani,S.S and Bhatnagar,S.P. 2015. Embryology of Angiosperms. Vikas Publications PVT Ltd., New Delhi.
2. Pandey, S.N. 2009. Plant Anatomy. S.Chand & Company, New Delhi.
3. Sambamoorthy, A.V.S.S.2005. A Textbook of Algae. I.K.International Pvt Ltd., New Delhi.
4. Sharma,O.P.2007. Textbook of Algae. Tata McGraw Hill Publications Pvt Ltd, New Delhi.
5. Vashista, B.R. 2014. Textbook of Fungi. S.Chand & Company, New Delhi.
6. Vashista, B.R., A.K.Sinha and Adarsh Kumar. 2011. Botany for Degree students- Bryophyta. S.Chand & Company, New Delhi.
7. Vashista, B.R. 2015. Textbook of Pteridophyta. S.Chand & Company, New Delhi.

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	-	-	-	-	-	3	3	3	3	-	-
CO2	3	3	-	-	-	-	-	-	-	3	3	3	3	-	-
CO3	3	3	-	-	-	-	-	-	-	3	3	3	3	-	-
CO4	3	3	-	-	-	-	-	-	-	3	3	3	2	-	-
CO5	3	3	-	-	-	-	-	-	-	3	3	3	3	-	-

முதலாண்டு – இரண்டாம் பருவம்

Semester	19ITAMC21: Language–I:Course -2	L	T	P	C
II	பக்தி இலக்கியமும் சிற்றிலக்கியமும்	3	-	-	3

கற்பித்தலின் நோக்கம் (Learning Objective (LO))

LO1	**பக்தி மற்றும் சிற்றிலக்கிய வரையறைகளையும் வகைகளையும் அறிமுகம் செய்தல்.**
LO2	தமிழின் தனித்துவமான பக்தி இலக்கிய வகைமையை ஒப்பிட்டுக்காட்டல்.
LO3	சைவ வைணவ இலக்கியங்களின் தனித்துவத்தை எடுத்துரைத்தல்.
LO4	கிறித்துவ, இசுலாமிய இலக்கியங்களையும் பாடு பொருட்களையும் விளக்குதல்.
LO5	சிற்றிலக்கியத் தோற்ற பின்னணிகளின் வழி அவ்விலக்கியங்களை அறிய வைத்தல்.

Course Outcomes

At the end of the course, the student will be able to

CO1:	பக்தி இலக்கியம் சிற்றிலக்கியம் வகைமைகளையும் உத்திகளையும் அறியும் திறன்.
CO2:	திருஞானசம்பந்தரின் பக்தித் திறத்தை உணர்தல்.
CO3:	ஆண்டாளின் பக்தி மார்க்கதையும் பாவை நோன்பையும் குறித்துத் தெளிதல்.
CO4:	வள்ளலாரின் உயிர் நேயக் கோட்பாட்டை அவசியம் அறிவர்.
CO5:	இந்தியத் தத்துவ ஞான வரலாற்றுடனும் இதிகாசங்களுடன் தொடர்பு ஏற்பட்டிருக்கும்.

அலகு- 1 பக்தி இலக்கியம்

1. திருஞானசம்பந்தர் - திருநள்ளாறு - பச்சைப் பதிகம் (முதல் 5 பாடல்கள்)
2. திருமூலர் - திருமந்திரம் (உடம்பினை முன்னை, யாவர்க்குமாம், ஒன்றே குலமும், உள்ளம் பெருங்கோயில், ஆர்க்கும் எனத் தொடங்கும் பாடல்கள்)
3. சிவவாக்கியர் - அறிவுநிலை (5 பாடல்கள்)

அலகு – 2 பக்தி இலக்கியம்

1. ஆண்டாள் - திருப்பாவை (முதல் 5 பாடல்கள்)

2. வள்ளலார் விண்ணப்பம் - திருவருட்பா - பிள்ளைச் சிறு

அலகு – 3 பக்தி இலக்கியம்

1.தேம்பாவணி - குழவிகள் வதைப்படலம்

2.சீறாப்புராணம் - மானுக்குப் பிணை நின்ற படலம்

அலகு – 4 சிற்றிலக்கியம்

1. குற்றாலக் குறவஞ்சி - மலை வளம் (வானரங்கள்... பாடல் முதல்)

2. முக்கூடற்பள்ளு - நாட்டு வளம்

அலகு - 5 இலக்கிய வரலாறு

பக்தி சிற்றிலக்கிய வரலாறு - இடைக்காலத் தமிழகச் சூழல் - சைவ வைண சமயங்களின் செல்வாக்கு - சமண பௌத்த சமய இலக்கியங்கள் - கிறித்துவ இசுலாம் இலக்கியங்கள் - நாயக்கர் காலச் சிற்றிலக்கியங்கள் தோற்ற பின்னணி - சிற்றிலக்கிய வகை.

அலகு – 6

(மாணவர்கள் அறிந்துகொள்வதற்கு மட்டும் – தேர்வுக்கான பகுதி அல்ல)

இலக்கியங்களையும் அவை தொடர்பான இலக்கிய வரலாற்றையும் இணைத்துப் படித்தல். பக்தி இலக்கிய வளர்ச்சியில் தமிழ்ப் பனுவல்களில் ஏற்பட்ட வளர்ச்சியைச் சுட்டிக்காட்டுதல். மனித மனத்தை பண்படுத்தவும், சமூக அமைதியை நிலைநாட்டவும், உலக நல்லிணக்கம் காணவும் பக்தி இலக்கியம் பயன்படுமாற்றை விளக்குதல்.

பாட நூல்:

1. ச.வே.சுப்பிரமணியன் (ப.ஆ) - பன்னிருதிருமுறைகள்
மணிவாசகர் பதிப்பகம், சென்னை
மூன்றாம் பதிப்பு – 2010

2. ச.வே.சுப்பிரமணியன் (ப.ஆ) - நாலாயிரத்திவ்ய பிரபந்தங்கள்
முல்லைநிலையம்
சென்னை-17
முதற்பதிப்பு – 2000, இரண்டாம் பதிப்பு 1996

3. சி.எஸ். முருகேசன் (ப.ஆ) - சித்தர் பாடல்கள்
மணிவாசகர் பதிப்பகம், சென்னை
இரண்டாம் பதிப்பு – 1996

4. வள்ளலார் - திருவருட்பா,
அண்ணாமலைப் பல்கலைக்கழகப் பதிப்பு
அண்ணாமலைநகர்

5. வீரமாமுனிவர் - தேம்பாவணி
பாரி நிலையம்,
சென்னை - 8
முதற்பதிப்பு – 2010

6. உமறுப்புலவர் - சீராப்புராணம்
நேஷ்னல் பதிப்பகம்
சென்னை
முதற்பதிப்பு – 2004

7. திரிகூடராசப்பக்கவிராயர் - குற்றாலக்குறவஞ்சி
பாவை பதிப்பகம்
சென்னை
இரண்டாம் பதிப்பு – 2014

8. முனைவர் கதிர்முருக (ப.ஆ) - முக்கூடற்பள்ளு
பாரி நிலையம்
சென்னை -108 , மறுபதிப்பு – 2015

பார்வை நூல்கள்

1. ந.வீ.செயராமன் - சிற்றிலக்கியச் செல்வம்
மணிவாசகர் பதிப்பகம், சென்னை.
முதற்பதிப்பு- 1968.

2. ந.வீ. செயராமன் - பள்ளு இலக்கியம்
மணிவாசகர் பதிப்பகம், சென்னை.
முதற்பதிப்பு- 1980.

3. கோ.கேசவன் - பள்ளு இலக்கியம் ஒரு சமூகவியல் பார்வை
அன்னம் வெளியீடு, தஞ்சாவூர் - 1981.
முதற்பதிப்பு - 1981

4. ச.வே.சுப்பிரமணியன் - தமிழ் இலக்கிய வரலாறு
மணிவாசகர் பதிப்பகம், சென்னை.
ஏழாம் பதிப்பு - 2010

5. சோ.நா.கந்தசாமி - தமிழ் இலக்கிய வரலாறு
மணிவாசகர் பதிப்பகம், சென்னை.
முதற்பதிப்பு – 2004

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	-	-	2	2	-	-	2	2	2	3	3	3	2
CO2	3	3	-	-	-	2	-	-	3	-	-	2	2	-	-
CO3	-	2	3	-	3	2	-	-	-	-	3	-	-	2	3
CO4	3		3	-	-	2	-	-	-	2	2	2	2	-	-
CO5	3	2	-	-	2		-	-	2	2	2	-	-	3	2

Semester	19IHINC21: Language – 1: Course 2	L	P	C
II	Basic Hindi-II	3	-	3

Learning Objectives:

LO1	To know the life of National leaders
LO2	To introduce the Gandhijji's thought.
LO3	To understand the concepts of teaching and learning from Dr.Sarvapalli Radhakrishnan's life.

Course Outcomes

At the end of the course, the student will be able to:

CO1:	Understand the basic structure of poem and prose.
CO2:	Classify and compare various poems.
CO3:	Describe the basic concepts of moral stories.
CO4:	Apply the teachings of various national leaders.
CO5:	Understand the spirit of spirituality.

Unit - I: Introduction

man ki shakti dena ,prathighna palan, hamara Rajchinga,adhbhud maya..

Unit - II: Poem, Prose

sarvapalli radhakrishnan,amedkar, mahaveer, sadak ke niyam,sanghi ka phal(poem),

Unit - III: Stories.

Tyog ka such, bhavan sabka ek hai, chirjivan ka jharna, lob ka parinam.

Unit - IV: dadha ki moorkatha, kuthe ki poonch ande barabar dhana.

Unit - V: bakri do ghav kha gayi, Dhan ki magima,

Current Streams of Thought

(Not for final Examination only for discussion):

The Faculty will impart the current developments in the subject during the semester to the students and this component will not be a part of Examinations.

Text Books

1. Naveen Hindi Patamala: Part - II D.B.H.P. Sabha, Chennai - 600 017.
2. Manohar Kahaniyam, Part – II D.B.H.P. Sabha, Chennai - 600 017.

Supplementary Reading

1. Naveen Hindi Patamala: Part - I , D.B.H.P. Sabha, Chennai - 600 017.
2. Hindi prachar bodhini-DHBS, Chennai 17

Outcome Mapping

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	-	-	1	-	-	-	-	-	1	-	-	-	-
CO2	2	2	-	-	-	1	-	-	-	-	1	-	-	-	-
CO3	2	2	2	-	-	-	1	-	-	-	1	-	-	-	-
CO4	2	2	2	-	-	-	-	1	-	-	-	1	-	-	-
CO5	2	2	-	-	3	-	-	-	-	-	-	-	-	1	-

Semester	19IFREC21: Language- I: Course -2 French-II	L	T	P	C
II		3	-	-	3

Learning Objective (LO):

LO1	Talk about their family members.
LO2	Engage a simple conversation about family members.
LO3	Talk about your likes and dislikes.
LO4	Fill in a simple form

Course Outcomes (CO):

At the end of the course, the student will be able to:

CO1	Understand simple texts providing personal details of others.
CO2	State how many people are in my family and who they are, using vocabulary including family members, possessive adjectives and negatives such as 'je n'ai pas de frères/sœurs'.
CO3	Write a short text to inform others of my likes and dislikes and provide reasons. Ask others about their likes and dislikes, showing that I appreciate diverse viewpoints and personalities e.g. 'Quel est ton … favori/préféré?'
CO4	Understand in filling up a simple form.
CO5	Write a short introduction about myself, providing personal details and use simple connectors, such as *'et' , 'mais' and 'aussi'.*

Unit I

Demander /donner des précisions sur le temps

Demander / indiquer l'heure et la date

Demander / dire ce qu'on a fait

Féliciter

Unit II

Comprendre et écrire un journal personnel en français.

Comprendre l'agenda de quelqu'un

Les rythmes de vie en France

Evaluez-vous

Unit III

Evasion en français par l'Internet, la télévision, la radio et la presse.

Découvrir la France dans votre pays.

Unit IV

Les voyages et les transports

Comparer les choses ; Montrer ; Indiquer une appartenance

Demander / donner une explication.

Unit V

Voyager en France ; Situations pratiques relatives au voyage.

Parler d'un repas.

Situations pratiques à l'hôtel et au restaurant

Les habitudes des Français sur un repas.

Text Book:

1. J. Girardet et J. Pecheur, (2012), ***Echo A1*** - méthode de français**,** Langers, Paris.

Supplementary Readings:

1. Marie-Noelle Cocton et Emilie Pommier, (2015), *Saison A1* - méthode de français, Les Editions Didier, Paris.
2. Angels Campa, Claude Mestreit, Julio Murillo et Manuel Tost, (2001), *FORUM* – Méthode de français, HACHETTE LIVRE, Paris.
3. Mauger Bleu, (2014), *Le Cours de langue et de la civilisation française*, - Méthode de français, Hachette, Paris.
4. Michele Boulares et Jean-Louis Frerot, (1997), *Grammmaire Prograssive du Français avec 400 exerices*, CLE International, Paris.

Outcome Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PS03	PSO4	PS
CO1	-	2	3	2	2	3	2	3	3	3	3	3	-	-	-
CO2	3	-	2	-	3	-	2	2	-	3	-	-	-	-	-
CO3	3	2	-	-	2	3	-	2	3	-	-	-	2	-	-
CO4	3	3	3	3	3	-	3	-	2	2	2	-	-	2	-
CO5	-	-	3	3	3	3	3	2	2	2	2	-	-	-	3

Semester	19IENGC22: English Through Literature II: Poetry	L	P	C
II		3	-	3

Learning Objective (LO):

LO1	Develop the ability of the learner to comprehend and appreciate poems in English.
LO2	Enhance the competence of the learner in using the English language.
LO3	Improve the interest of the learner in human values and perceptions.
LO4	Enable students to study and analyze the use of language in poetry.
LO5	Provide learners with the theoretical and practical understanding of Grammar.

Course Outcomes (CO)

Upon successful completion of the course, the students will be able to:

CO1:	Become competent in communication, both in written and oral skills.
CO2:	Gain fluency in English language.
CO3:	Attain knowledge about construction of sentence structures.
CO4:	Acquire the vocabulary to use the English language effectively.
CO5:	Acquire the aesthetic sense for appreciating poetry.

Unit I

William Shakespeare	“Sonnet 116”
William Blake	“Lamb”
Robert Burns	“A Red, Red Rose”
Grammar	Finite & Non-finite verbs

Unit II

PB Shelley	“To Wordsworth”
John Keats	“Sonnet to Sleep”

Thomas Hardy	"Neutral Tones"
Grammar	Strong and Weak Verbs, Auxiliaries and Modals

Unit III

Robert Frost	"Stopping By Woods on a Snowy Evening"
Wilfred Owen	"Anthem for Doomed Youth"
Emily Dickinson	"A Narrow Fellow in the Grass"
Grammar	Transitive, Intransitive Verbs, Active and Passive Voice

Unit IV

Sri Aurobindo	"The Tiger and the Deer"
AK Ramanujan	"Obituary"
Sarojini Naidu	"Queen's Rival"
Grammar	Concord

Unit V

Roger Mc Gough	"My Bus Conductor"
Maya Angelou	"Still I Rise"
Langston Hughes	"The Negro Speaks of Rivers"
Grammar	Tenses and their forms

TEXT BOOKS

1. Jack.Hydes, *Touched With Fire.* London: Cambridge UP, 1985.
2. C. D Narasimhaiah, *An Anthology of Common Wealth Literature*. New Delhi: Macmillan, 2006.

SUPPLEMENTARY READING

1. Thomas, C.T. *Twentieth Century Verse: An Anglo-American Anthology*. New Delhi: Macmillan, 2006.
2. Henry Louis, and Y. Nellie McKay. *The Norton Anthology of African American Literature.* New York: W.W. Norton & Co, 2004.
3. Ramachandran, C.N. and Radha Achar. *Five Centuries of Poetry.* New Delhi: Laxmi, 1998.

OUTCOME MAPPING

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	-	-	-	-	-	-	-	-	2	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	2	-	-	-	-

CO3	3	2	-	-	-	-	-	-	-	-	2	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	2	-	-	-

Semester	19ICISC23: Soft Skill- Computer Applications – I	L	P	C
II		3	-	3

Learning Objective (LO):

LO1	To Study the Fundamentals Concepts of Computers and Operating Systems.
LO2	To get familiar with basics of the Internet Programming.
LO3	To acquire knowledge and skills for creation of web site considering both client and server side programming.
LO4	To explore different web extensions and web services standards and ability to develop responsive web applications.

Course Outcomes (CO)

At the end of the course, the student will be able to

CO1:	Describe the usage of computers and why computers are essential components in business and society.
CO2:	Solve common business problems using appropriate Information Technology applications and systems.
CO3:	Identify categories of programs, system software and applications. Organize and work with files and folders and utilize the Internet Web resources and evaluate on-line e-business system.
CO4:	Design a responsive web site using HTML5 and demonstrate Rich Internet Application.

Unit – 1: Introduction to computers, Applications of computers, Concepts of data and information, A typical computer system, Memory concepts, History of computers, Types of computers. Input, output devices, data storage devices, software, the definition, the role of software, House keeping.

Unit – 2: The computer internals, typical PC configuration, booting, virus, antivirus, vaccine, versions of software. Operating system, definition, classification, basics of MSDOS, introduction to windows operating system, features of

windows OS, desktop and desktop icons, starting programs, browsing and managing windows explorer, setting, Taskbars and creating shortcuts.

Unit – 3: Introduction to internet, client sever basics, E-mail, Telnet and Archie, FTR – Gopher, Jug head and Veronica, WAIS and world wide web, fundamentals of HTML, TCP / IP and E – Commerce.

Unit – 4: Issues involved in web site management, addressing, designing web sites with front page.

Unit – 5: Multimedia, concept, requirements, applications and future, hardware and software requirements for Multimedia development and delivery platforms, multimedia methodologies fundamental and use of hypertext, hypermedia, sound, images, animation, video. Using multimedia, multimedia interface, planning and development of multimedia projects.

Text Books:

1. Sanjay Saxena, (2015), *"A first course in computers"*, Vikas Publishing House, New Delhi.
2. Alexies Leon and Mathews Leon *"Internet in a nutshell"* Leon Press, Chennai and Vikas Publishing House, New Delhi.
3. Tay Vaughan (1999), "*Multimedia Making it work"*, Osborne, Tata McGraw Hill.

Reference Books:

1. Ron Mansfield, (1997), "*Windows 95 for Busy People"*, Obsorne, McGraw Hill.
2. *Krishnan, "Computer fundamentals and Windows with Internet Technology"*, Scitech Publications Pvt Ltd, Chennai, India.
3. *Krishnan, "Windows and MS-Office 2000 with database concepts"*, Scitech Publications Pvt Ltd, Chennai, India.

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	1	3	2	-	2	-	2	3	3	1	-	3	-
CO2	3	2	3	-	-	-	-	3	-	2	-	-	-	3	1
CO3	-	-	3	-	3	-	1	-	-	-	2	3	-	-	-
CO4	3	2	-	3	2	1	-	3	-	-	3	-	-	3	3

Semester	19IMICC24: Basic Microbiology - II	L	P	C
II		4	-	4

Learning Objective (LO):

LO	To acquire fundamental knowledge about the Classification of microorganisms, Structure, differences and antimicrobial chemotherapy.

Course Outcomes (CO)

By the end of the course, the student will be able to:

CO1:	Differentiate prokaryotic and eukaryotic cells.
CO2:	Understand the ultra-structure of the bacteria.
CO3:	Describe the characteristics of Archaebacteria, Eubacteria and Cyanobacteria
CO4:	Gain knowledge about isolation and preservation of microorganisms.
CO5:	Gain knowledge about the antimicrobial drugs.

Unit – 1: Classification of Microorganisms

Prokaryotic and Eukaryotic Cells- Structure and differences. Classification of microorganisms - General principles and nomenclature - Haeckel's three kingdom concept, Whittaker's five kingdom concept.

Unit –2: Ultra Structure of Bacteria

Microbial cell: Ultrastructure of bacteria, Subcellular structures and cell envelope - Slime, Capsule, Cell wall, Pili, Flagella, Cell inclusions, Biosynthesis of bacterial cell wall, Cell membrane

Unit – 3: General Characteristics of Microorganisms

General characteristics and nature of Archaebacteria, Eubacteria, Cyanobacteria, Mycoplasmas, Rickettsiae, Chlamydias, Spirochaetes, Actinomycetes, Protozoa, Algae, Fungi and Viruses.

Unit – 4: Isolation of Microorganisms

Isolation of different types of Bacteria - Fungi - Actinomycetes - Cyanobacteria -Protozoa. Preservation methods of microbes. Type culture collections

Unit – 5: Antimicrobial Chemotherapy

Antimicrobial Chemotherapy – Antibiotics – Mode of action antimicrobial resistance, Tests for sensitivity to antimicrobial agents.

Text Books:

1. Pelczar, M.J.J.R. Chan, E.C.S and Kreig, N.R. (2012). *Microbiology* 5th ed. Tata McGraw Hill, New Delhi.
2. Dubey, R.C. and Maheswari, D.K. (2013). *A Textbook of Microbiology* 3rd ed. S. Chand and Company Ltd., New Delhi.
3. Ananthanarayan, R. and Paniker, C.K.J. (2013). *Text Book of Microbiology*, 9th ed. Orient Longman, Chennai.

Supplementary Books:

1. Willey, J. Sherwood, L. and Woolverton, C.J. (2017). *Prescott's Microbiology*. 10th Edition: McGraw-Hill. New York.
2. Meenakumari. S. (2006). *Microbial Physiology*. 1st ed. MJP Publishers, A unit of Tamil Nadu Book House, Chennai.

Web References:

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1254764/
2. http://microbialcell.com/
3. http://www.biologydiscussion.com/microbiology-2/antimicrobial-drugs-features-and-mechanisms-microbiology/66222

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	2	2	3	3	3	3	2	3
CO2	2	3	3	3	2	2	3	2	2	3	3	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	2	2	2	3
CO5	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3

Semester	19IMICP25: Practical - 1 (Basic Microbiology - I & II)	L	P	C
II		-	10	5

Learning Objective (LO):

LO	To acquire basic laboratory skills like Pure culture techniques, Staining techniques and Media preparation.

Course Outcomes (CO)

By the end of the course, the student will be able to:

CO1:	Understand the sterilization methods and media preparation.
CO2:	Perform the pure culture techniques.
CO3:	Enumerate bacteria and yeast.
CO4:	Understand the staining methods and slide culture techniques.

Practicals:

1. Sterilization techniques.
2. Preparation of Media:

   i. Nutrient broth ii. Nutrient agar iii. Plates iv. Slants v. Soft agar vi. Blood agar vii. Selective Media.
3. Pure culture technique:

   i. Streak plate ii. Spread plate iii. Pour plate methods.
4. Measurement of microbes - Micrometry.
5. Enumeration of bacterial Viable count (Plate count),
6. Motility determination- Hanging drop method.
7. Staining methods:

   i. Simple staining ii. Gram's staining iii. Negative staining iv. Spore staining v. Metachromatic granular staining vi. Lacto phenol cotton blue staining

Reference Books:

1. Sundararajan, T. (2007). Microbiology laboratory manual. 2nd edition.
2. Kannan, N. (2002). Laboratory manual in General Microbiology. Panima publishing corporation, New Delhi.

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	2	3	2	3	3	3	2	2	2	3	3
CO2	3	2	3	3	2	3	2	2	2	2	3	3	2	3	3
CO3	3	3	3	3	3	3	2	3	2	3	3	3	2	3	3
CO4	3	3	3	3	3	2	2	3	2	3	3	2	2	2	3
CO5	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3

Semester	19IBOTA02: Allied Botany II: Taxonomy, Physiology, Ecology and Biotechnology	L	P	C
II		4	-	4

Learning Objective (LO):

LO	To understand the principles, classification, and salient features of Angiosperm families. To understand the physiology and ecology of plants

Course Outcomes (CO)

Upon successful completion of the course, the students will be able to:

CO1:	Understand the Bentham and Hooker's Classification
CO2:	Understand the characteristic features various angiosperm families
CO3:	Comprehend the photosynthesis and respiration of plants
CO4:	Appreciate the knowledge on ecological principles
CO5:	Analyze various tissue culture methods and its applications

Unit – 1

Outline the classification of natural system- Bentham and Hooker, A detailed study of following families and their economic importance: *Annonaceae, Zygophyllaceae, Caesalpiniae* and *Cucurbitaceae*

Unit – 2

A detailed study of following families and their economic importance: *Rubiaceae, Apocynaceae, Lamiaceae, Nyctaginaceae, Cannaceae* and *Poaceae*

Unit – 3 Physiology

Absorption of water, absorption of minerals, photosynthesis- photo system I and Photo system II, C_3 C_4 and CAM pathways. Respiration- Glycolysis, TCA cycle and electron transport system, Pentose phosphate pathway. Growth hormones- physiological effects of growth substance – Auxins, Gibberellins and Cytokinins.

Unit – 4 Ecosystem

Biotic and abiotic components – food chain – food web – energy flow. Plant Ecology: Factors affecting vegetation- abiotic and biotic. Morphological and anatomical adaptations in hydrophytes and *Xerophytes.*

Unit – 5 Plant Biotechnology

Enzymes (restriction enzymes, DNA Ligase)- cloning vectors (Plasmid, Cosmid, Tiplasmid). Production of rDNA. Production of transgenic plants. Tissue culture techniques (Aseptic conditions, MS media and callus induction)

Text Books:

1. Devlin, R.M.1996. Plant Physiology. PWS Publishers, Boston.
2. Dubey, R.C.2009. A Textbook of Biotechnology. S.Chand & Company, New Delhi
3. Dutta, S.C.2003. Systematic Botany. New Age International pvt Ltd., New Delhi
4. Jain, V.K. 2009. Fundamentals of Plant Physiology. S.Chand & Company, New Delhi.
5. Pandey, B.P. 2009.Taxonomy of Angiosperms. S.Chand & Company, New Delhi
6. Sambamoorthy, A.V.S.S.2005. Molecular Biology. Narosa Publishers, New Delhi.
7. Shukla R.S and R.S. Chandel. 1998. Plant Ecology. S.Chand &Co. Pvt.Ltd, New Delhi.

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	-	-	-	-	-	3	3	3	3	-	-
CO2	3	3	-	-	-	-	-	-	-	3	3	3	3	-	-
CO3	3	3	-	-	-	-	-	-	-	3	3	3	3	-	-
CO4	3	3	-	-	-	-	-	-	-	3	3	3	2	-	-
CO5	3	3	-	-	-	-	-	-	-	3	3	3	3	-	-

Semester	19IBOTP01: Allied Practical I: Botany	L	P	C
II		-	4	2

Learning Objective (LO):

LO1	**To know about the microbes, Algae, Bryophytes, Pteridophytes and Gymnosperms.**
LO2	To gain knowledge on the anatomy of leaf , stem and roots.
LO3	To gain knowledge on the physiology of plants.

Course Outcomes (CO)

Upon successful completion of the course, the students will be able to:

CO1:	Analyze the microbes, Algae, Bryophytes, Pteridophytes and Gymnosperms.
CO2:	Analyze the anatomy of leaf , stem and roots.
CO3:	Analyze the physiological aspects of plants.

Practicals:

1. To make suitable micropreparations, describe and identify the specimens of Algae, Fungi, Bacteria, Viruses, Bryophytes, Pteridophytes and Gymnosperms prescribed in theory syllabus.
2. Study of Anatomical features of leaf, stem and root of dicots and monocots
3. Study of different types of anther, LS of ovule.
4. Detailed study of families mentioned in the theory with one representative specimen from the local Flora.
5. Simple experiments and experimental set up in Plant Physiology section of the syllabus.
6. Study of anatomical structure of Hydrophytes and Xerophytes.

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	-	-	-	-	-	-	-	3	3	3	3	-	-
CO2	3	3	-	-	-	-	-	-	-	3	3	3	3	-	-
CO3	3	3	-	-	-	-	-	-	-	3	3	3	3	-	-
CO4	3	3	-	-	-	-	-	-	-	3	3	3	2	-	-
CO5	3	3	-	-	-	-	-	-	-	3	3	3	3	-	-

இரண்டாம் ஆண்டு – மூன்றாம் பருவம்

Semester	19ITAMC31: Language– I: Course -3	L	T	P	C
III	அற இலக்கியமும் காப்பியமும்	3	-	-	3

கற்பித்தலின் நோக்கம் (Learning Objective (LO))

LO1	**தமிழ் அற இலக்கிய வரலாற்றை அறிமுகம் செய்து விளக்கப்படும்.**
LO2	அற இலக்கியங்களின் வழித் தனி மனித ஒழுக்கம் வலியுறுத்தப்படும்.
LO3	காப்பிய இலக்கிய இலக்கணத்துடன் அதன் வரலாறும் புகட்டப்படும்.
LO4	தமிழில் தோன்றியுள்ள காப்பியங்களின் தனித்துவம் உணர்த்தப்படும்.
LO5	தமிழில் அற இலக்கியங்களின் தேவையைப் புரிய வைத்தல்.

Course Outcomes

At the end of the course, the student will be able to

CO1:	திருக்குறள் வழி மனித மான்புகளையும் ஒழுக்கங்களையும் அறியும் திறன்.
CO2:	பெரியவர்களை மதிக்கும் மனப்பான்மையும் பிழைக் கூறாமையும் வளரும்.
CO3:	இந்திர விழா கொண்டாடிய தமிழர்கள் பண்பாட்டை உணர்ந்திருப்பர்.
CO4:	நாயன்மார்கள் வரலாற்றையும் பக்தி நெறியையும் பெற்றிருப்பர்.
CO5:	வாலி வதைப் படலம் வழிவிவாத திறன் ஏற்படும்.

அலகு – 1 அற இலக்கியம்

1. திருக்குறள் - உழவு, ஒழுக்கமுடைமை, காலமறிதல், நட்பு, பிரிவாற்றாமை

அலகு – 2 அற இலக்கியம்

1. நாலடியார் - பெரியாரைப் பிழையாமை
2. பழமொழி நானூறு - கல்வி

அலகு - 3 காப்பியம்

1. சிலப்பதிகாரம் - இந்திர விழவு ஊரெடுத்த காதை
2. மணிமேகலை - ஆபுத்திரன் திறன் அறிவித்த காதை

அலகு - 4 காப்பியம்

1. பெரிய புராணம் - அப்பூதி அடிகள் புராணம்
2. கம்பராமாயணம் - வாலி வதைப்படலம்

அலகு - 5 இலக்கிய வரலாறு

சங்க மருவிய கால அற இலக்கியங்கள் - திருக்குறளின் பெருமை - அற இலக்கியங்களின் வளர்ச்சி - காப்பிய இலக்கணம் - பகுப்புகள் - காலந்தோறம் தோன்றிய காப்பியங்கள் - வரலாறு.

அலகு – 6 (மாணவர்கள் அறிந்துகொள்வதற்கு மட்டும் – தேர்வுக்கான பகுதி அல்ல)

அறஇலக்கியங்கள் மனதை நெறிப்படுத்துவதோடு சமூக நடத்தைகளையும்
கற்றுத்தருகின்றன. அற இலக்கியங்களின் தொடர்பால் மாணவர்கள் நல்லக்கருத்துகளைக் கற்றுக்கொள்வதோடு வாழ்விலும் கடைபிடிக்க எண்ணுதல் நல்ல சமூகம் உருவாகும். சமூகத்திற்கு அறநெறிகளில் தேவையானவை எடுத்துரைத்தல்.

பாடநூல்கள்

1. பதிப்பாசிரியர் ச. மெய்யப்பன்- திருக்குறள்
மணிவாசகர் பதிப்பகம்,
சென்னை- 08.
இரண்டாம் பதிப்பு -2017

2. ச.வே.சுப்பிரமணியன் - நாலடியார்,பழமொழி நானூறு
மணிவாசகர் பதிப்பகம்,
சென்னை- 08.
இரண்டாம் பதிப்பு -2012

3. இளங்கோவடிகள் - சிலப்பதிகாரம்
டாக்டர் உ.வே.சா. பதிப்பு
2, அருண்மடல் கடற்கலை சாலை
பெசன்ட் நகர், சென்னை
பதினொன்றாம் பதிப்பு -2008

4. சீத்தலைச்சாத்தனார் - மணிமேகலை
டாக்டர் உ.வே.சா. பதிப்பு
2, அருண்மடல் கடற்கலை சாலை
பெசன்ட் நகர், சென்னை
எட்டாம் பதிப்பு -2008

5. சேக்கிழார் - பெரியபுராணம்
முல்லை நிலையம், சென்னை
முதற்பதிப்பு -2010

6. கம்பர் - கம்பராமாயணம்
அண்ணாமலைப்
பல்கலைக்கழகம்
வெளியீடு,

7. ச.வே.சுப்பிரமணியன் - தமிழ் இலக்கிய வரலாறு
மணிவாசகர் பதிப்பகம்,
சென்னை.
முதற்பதிப்பு- 1999

பார்வை நூல்கள்

1. சோ.ந.கந்தசாமி - தமிழ் இலக்கிய வரலாறு மணிவாசகர் பதிப்பகம், சென்னை. முதற்பதிப்பு - 2004

2. க.ப. அறவாணன் - அறஇலக்கியக்களஞ்சியம் தமிழ்க்கோட்டம் சென்னை, முதற்பதிப்பு - 2000

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	-	-	2	2	-	-	2	2	2	3	3	3	2
CO2	3	3	-	-	-	2	-	-	3	-	-	2	2	-	-
CO3	-	2	3	-	3	2	-	-	-	-	3	-	-	2	3
CO4	3	-	3	-	-	2	-	-	-	2	2	2	2	-	-
CO5	3	2	-	-	2	-	-	-	2	2	2	-	-	3	2

Semester	19HINC31: Language – I: Course 3	L	P	C
III	Basic Hindi-III	3	-	3

Learning Objective (LO):

CO1:	To study various comedy stories.
CO2:	To introduce Indian epics.
CO3:	To understand the concepts of drama.

Course Outcomes (CO)

Upon successful completion of the course, the students will be able to:

CO1:	**Understand the basic structure of short stories.**
CO2:	Knowledge on Mahabharath.
CO3:	Describe the basic concepts of human feelings.
CO4:	Apply the concepts of comedy in stories.
CO5:	Describe the effects of western culture.

Unit - I: Introduction, ekanki.

Andher Nagari - Bharathendhoo Harishchandra

Unit - II: Mahabharath Ki Ek Sanj - Bharath Bhoosahn Agrwal [Full]

Unit - III: Drama.

3. Ladai - Sarveswar Dayal Saxeena [Full]

Unit - IV: stories, Tatava-vyanghya

Unit - V: Upstick Ki Muskhan - Vishnu Prabakar [Full]

Current Streams of Thought

(Not for final Examination only for discussion)

The Faculty will impart the current developments in the subject during the semester to the students and this component will not be a part of Examinations.

Text Books

1 Andher Nagari - Bharathendhoo Harishchandra, Vinodh Pustak Mandir, Agra-2

2. Prathinidhi Ekanaki - Dr. Dashrath Oojaa, Jawahar Pustakalya, Mathura

3. Ekanaki Manach - Dr.V.P. Abhithap, Jawahar Pustakalya, Mathura

4. Ladai - Sarveswar Dayal Saxeena, Rajkamal Prakashan, New Delhi

Supplementary Reading

1. Hindi natak uthbhav aur vikas-dashrath ojha-rajpal and saons, New Delhi.7.

2. Hindi natak aur rangmanch-pahachan aur parak-Dr. Indranath madan, Newdelhi.7.

Outcome Mapping

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	-	-	-	-	-	-	-	-	2	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	2	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	2	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	2	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	2	-	-	-	-

Semester	19IFREC31: Language- I: Course -3 French-III	L	T	P	C
III		3	-	-	3

Learning Objective (LO):

LO1	Buy some products in a shop.
LO2	Ask the news of someone.
LO3	Talk about the climate.
LO4	Introduce their family.
LO5	Talk about their accommodation.

Course Outcomes (CO):

At the end of the course, the student will be able to:

CO1	Ask the price of the product, pay the product.
CO2	Ask about their daily activities.
CO3	To give and ask information about the climate.
CO4	Describe their family.
CO5	Describe their accommodation where they live.

Unit I

Demander des nouvelles de quelqu'un(les activités de la journée)

Choisir, acheter, payer un objet

Unit II

S'informer sur la présence ou l'existence d'une personne ou d'un objet (Parler d'un logement ; s'orienter, Décrire un trajet, Exprimer un besoin)

S'informer sur l'état physique de quelqu'un

Le temps en France et parler du temps

Unit III

Evaluez-vous

Evasion dans la Poésie

Unit IV

Souvenez-vous (Les moments de la vie)

Demander /donner des informations sur la biographie d'une personne (enchainer les idées)

Unit V

Demander /donner des informations sur ses relations amicales ou familiales.

Présenter sa famille.

Text Book:

1. J. Girardet et J. Pecheur, (2012), ***Echo A1*** - méthode de français**,** Langers, Paris

Supplementary Readings:

1. Marie-Noelle Cocton et Emilie Pommier, (2015), ***Saison A1*** - méthode de français, Les Editions Didier, Paris.
2. Angels Campa, Claude Mestreit, Julio Murillo et Manuel Tost, (2001), ***FORUM*** – Méthode de français, HACHETTE LIVRE, Paris.
3. Mauger Bleu, (2014), ***Le Cours de langue et de la civilisation française***, - Méthode de français, Hachette, Paris
4. Michele Boulares et Jean-Louis Frerot, (1997), ***Grammmaire Progressive du Français avec 400 exerices***, CLE International, Paris.

Outcome Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PS	PS O3	PS O4	PS
CO1	-	2	3	2	2	3	2	3	3	3	3	3	-	-	-
CO2	3	-	2	-	3	-	2	2	-	3	-	-	-	-	-
CO3	3	2	-	-	2	3	-	2	3	-	-	-	2	-	-
CO4	3	3	3	3	3	-	3	-	2	2	2	-	-	2	-
CO5	-	-	3	3	3	3	3	2	2	2	2	-	-	-	3

Semester	19IENGC32: Language – II: Course 3	L	P	C
III	English Through Literature III: Drama	3	-	3

Learning Objective (LO):

LO1	**Enhance the conversational competence of the learners by introducing drama in English.**
LO2	Make the students the understand characteristics of the Elizabethan Age.
LO3	Make them appreciate Shakespearean drama.
LO4	Make them learn the key elements of sentence structures.
LO5	Make the students master the mechanics of writing.

Course Outcomes (CO)

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

CO1:	Obtain a literary acumen to answer MCQs of NET/SET examinations and other competitive examination.
CO2:	Appreciate conversational English.
CO3:	Recognize the dramatic elements of Shakespearean dramas.
CO4:	Use punctuations and capitals effectively in their composition.
CO5:	Recognize the elements of the spoken discourses.

Unit I

William Shakespeare	*The Tempest* (Act I)
Grammar	"Phrases and Clauses"

Unit II

William Shakespeare	*The Tempest* (Act II)
Grammar	"Simple, Compound, and Complex Sentences"

Unit III

William Shakespeare	*The Tempest* (Act III)

	Grammar	"Transformation of Sentences"

Unit IV

William Shakespeare	*The Tempest* (Act IV)
Grammar	"Sequence of Tenses and Reported Speech"

Unit V

William Shakespeare	*The Tempest* (Act V)
Grammar	"Punctuation and Capitals"

Text Books:

1. Shakespeare, William. *The Tempest*, New Delhi: S. Chand & Co., 2008.
2. Green, David. *Contemporary English Grammar, Structures, and Composition*. Chennai: MacMillan, 2010.

Supplementary Reading:

1. Cahn. L Victor. *Shakespeare the Playwright: A Companion to the Complete Tragedies Histories, Comedies, and Romances*. London: Praeger, 1996.
2. Crystal, David. *Shakespeare's Words: A Glossary and Language Companion*. London: Penguin, 2009.
3. Greenbaum, Sidney. *Oxford English Grammar.* London: Oxford UP, 2005.
4. McCarthy. *Cambridge Grammar of English*. London: Cambridge UP, 2018.
5. Quirk, Randolph. *A Comprehensive Grammar of the English Language*. London: Pearson, 2010.

Outcome Mapping

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	-	-	-	-	-	-	-	-	2	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	2	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	2	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	2	-	-	-

Semester	19IMICC33: Microbial Taxonomy	L	P	C
III		4	-	4

Learning Objective (LO):

LO	To emphasize the Principles of Classification, rules and its applications in Microbial taxonomy

Course Outcomes (CO)

After completion of the course, students will be able to:

CO1:	Understand the techniques used for the classification and Taxonomy of microorganisms.
CO2:	Compare different groups of bacteria.
CO3:	Understand the virus structure, classification, and cultivation.
CO4:	Understand the morphology, cytology and classification of fungi.
CO5:	Gain knowledge about the classification of algae and protozoa.

Unit – 1: Microbial Taxonomy

Microbial Classification and Taxonomy- Taxonomic Ranks. Techniques used for determination of Microbial Taxonomy & Phylogeny, Systems of Prokaryotic and Eukaryotic Phylogeny.

Unit – 2: Classification Of Microorganisms

Classification systems in Prokaryotes, Bergey's Manual of systematic Bacteriology. Prokaryotic groups with unusual characteristics: Cyanobacteria, Green and Purple sulphur bacteria, Gliding bacteria, Rickettsia and Chlamydia, Actinomycetes, Archaea- Classification and Significance.

Unit – 3: Classification And Life Cycle Of Virus

Viruses, Viroids and Prions, Classification systems of Viruses - LHT, Baltimore. General Structure of viruses, Replication of virus, Lytic and Lysogenic life cycles, Virus cultivation methods.

Unit – 4: Cell Structure Of Microorganisms

Eukaryotic Diversity - Three Domains of Life, Endosymbiotic theories, Eukaryotic cell cycle and cell division – Mitosis and Meiosis. Fungi: Distribution and importance. Morphology of fungi – cell wall structure, fungal thallus and filaments. Cytology of fungi- Mitochondria, Golgi bodies, Endoplasmic reticulum. Recent classification of fungi. Study of yeasts and moulds.

Unit – 5: Algae & Protozoa

Algae: General properties and Classification. Cytology of algae - Type of vegetative forms - Heterocyst and non-heterocyst forms, Pigment and cell inclusions. Distribution and importance. Classification of protozoa. Morphology of protozoa – Shapes and size. Cytology of protozoa - Body covering and skeletons, Locomotory and internal organelles.

Current Streams of Thought

(Not for final Examination only for discussion)

Review on Numerical and chemotaxonomy, morphological, biochemical and molecular taxonomy- Types of rRNA, Importance of 16sRNA in microbial identification and taxonomy. G+C content, DNA-DNA, DNA–RNA hybridization. Methods of 16s RNA/ rDNA fingerprinting and sequencing. Hands-on training on algae sample collection, monitoring algal diversity; hands on training on microalgal identification using standard methods. Phylogenetic tree construction (Discussion)

Text Books:

1. Dubey, R.C. (2014). *A Textbook of Biotechnology*. 5th ed. First Multicolor Illustrative Edition. S. Chand Limited. New Delhi.
2. Gerard J. Tortora, Berdell R. Funke, Christine L. Case. (2016). *Microbiology – An Introduction*, 12th ed. Pearson Education. New York.
3. PelczarTR M J Chan ECS and Kreig N R (2006). Microbiology. Fifth edition, Tata McGraw-Hill INC. New York.
4. Robert F Boyd (1984). General Microbiology. Times mirror/Mosby college publishers.

Supplementary Books:

1. Willey, J. Sherwood, L. and Woolverton, C.J. (2017). *Prescott's Microbiology*. 10th Edition: McGraw-Hill. New York.
2. Talaro, K.P. (2011). *Foundations in Microbiology*, 8th Int ed. McGraw Hill.
3. Madigan, M.T. Martinko, J.M. Dunlap, P.V. and Clark, D.P. (2009). *Brock Biology of Microorganisms,* 12th ed. Pearson Education. New York.

Web References:

1. http://www.asmscience.org/content/book/10.1128/9781555817770.chap6
2. https://www.medicinenet.com/script/main/art.asp?articlekey=5997
3. https://www.cliffsnotes.com/study-guides/biology/microbiology/the-unicellular-algae/general-characteristics-of-algae

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1:	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3
CO2:	3	3	3	3	3	3	3	2	2	3	3	3	3	2	2
CO3:	3	3	3	3	3	3	2	3	3	3	3	3	2	3	3
CO4:	3	3	3	3	3	3	2	2	2	3	3	3	2	2	2
CO5:	3	3	3	3	3	3	3	3	2	3	3	3	2	3	3

Semester	19IMICP34: Practical - 2 (Microbial Taxonomy)	L	P	C
III		-	10	5

Learning Objective (LO):

LO	To learn the various techniques to study the morphology of Bacteria, yeast, Fungi, Algae, Protozoa and Viruses.

Course Outcomes (CO)

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

CO1:	Identify the morphological characters of different bacteria.
CO2:	Identify the yeast and filamentous fungi.
CO3:	Identify the protozoa, algae and viruses.

Practicals:

1. Morphology of Bacteria: *Escherichia coli, Staphylococcus aureus, Vibrio cholera.*
3. Culture characteristics of Microorganisms on solid and liquid media
4. Morphology of *Candida albicans, Saccharomyces cerevisiae.*
5. Morphology of *Aspergillus sp., Mucor sp., Penicillium sp., Rhizopus sp.*
6. Morphology of *Plasmodium* sp., *Paramecium sp.*
5. Morphology of *Chlorella, Oscillatoria, Nostoc.*
6. Morphology of Viruses: HIV, TMV, T4 Bacteriophage.

Reference Books:

1. Sundararajan, T. (2007). *Microbiology laboratory manual*. 2nd edition
2. Rajan, S and Selvi Christy. R. (2010). *Experimental procedures in life sciences*. 1st edition. Anjanaa Book House, Chennai.
3. Kannan, N. (2002). *Laboratory manual in General Microbiology*. Panima publishing corporation, New Delhi.

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	2	3	3	3	3	3	3	3	2
CO2	3	3	3	3	3	3	2	2	2	3	3	2	2	3	3
CO3	3	3	3	3	3	3	3	2	2	3	3	2	3	3	3

Semester	19IBITA01: Biochemistry- Paper I	L	P	C
III		4	-	4

Learning Objective (LO):

LO	To learn about laws of thermodynamics, basics of enzymology, structure and functions of amino acids, proteins, carbohydrates and lipids.

Course Outcomes (CO)

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

CO1:	Understand the bioenergetics principles.
CO2:	Understand the classification, nomenclature, kinetics, inhibition and applications of enzymes.
CO3:	Learn the classification, properties of carbohydrate and understand their biological functions.
CO4:	Understand the biochemistry of amino acids and proteins.
CO5:	Know the composition of various types of lipids, their biological functions and membrane structure.
CO6:	Understand the metabolic reaction of carbohydrates, proteins and lipids.

Unit–1: Bioenergetics

Laws of thermodynamics. Basic concepts of free energy, entropy and enthalpy. Standard free energy change. Exergonic and endergonic reactions. Bioenergetics: high energy phosphate compounds, the ATP/ADP cycle. Electron transport chain: components. Oxidative phosphorylation - Chemiosmotic theory. Introduction to metabolism-anabolism and catabolism.

Unit – 2: Enzymes

Nomenclature and classification. Enzyme units. Factors affecting enzyme activity - substrate, pH, and temperature. Michaelis-Menten equation and Lineweaver Burk plot. Enzyme inhibition- competitive, non-competitive and uncompetitive (derivation of rate equation not required), allosteric enzymes,

feedback inhibition. Coenzymes and isoenzymes. Applications of enzymes in clinical diagnosis and therapy.

Unit – 3: Carbohydrates

Classification and general properties of carbohydrates. Biologically important monosaccharides and disaccharides. Homopolysaccharides: structure and biological functions of starch, glycogen, and cellulose. Heteropolysaccharides: biological role of glycosaminoglycans. Carbohydrate metabolism- glycolysis, citric acid cycle, gluconeogenesis, glycogen metabolism.

Unit – 4 : Amino acids and Proteins

Classification. Biologically important peptides. Proteins - classification, functions, and denaturation. Orders of protein structure: Primary, secondary (α-helix, β-pleated sheet), supersecondary, tertiary, and quaternary structures Urea cycle, catabolism of carbon skeletons (overview only). Conversion of amino acids to specialized products.

Unit – 5: Lipids and Biomembrane

Classification of lipids. Structure and functions of cholesterol. Brief account of lipoproteins. Lipid metabolism: β-oxidation of fatty acids, biosynthesis of fatty acids. Biosynthesis of ketone bodies, utilization and clinical significance. Membrane structure - lipid bilayer, integral and peripheral proteins, the fluid mosaic model.

Text Books:

1. David L. Nelson and Michael M. Cox, (2017), *Lehninger Principles of Biochemistry*, 7th Ed. Freeman Publishers, New York.
2. Rodwell, VW, et al. (2018), *Harper's Illustrated Biochemistry*. 31st Ed. McGraw Hill, New York
3. Satyanarayana U. (2017) *Biochemistry*. 5th ed. Books and Allied Publishers, New Delhi.

Supplementary Reading:

Voet, D, Voet JG, and Pratt CW (2018), *Fundamentals of Biochemistry,* 5th Ed. Wiley, New York.

Outcome Mapping

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	2	3	3	3	3	-	-	-	-	-
CO2	3	3	2	2	2	3	2	2	2	3	-	-	-	-	-
CO3	3	3	3	3	3	2	3	3	3	3	-	-	-	-	-
CO4	3	3	3	3	3	2	3	3	3	3	-	-	-	-	-
CO5	3	3	2	2	2	3	2	2	3	3	-	-	-	-	-

இரண்டாம் ஆண்டு – நான்காம் பருவம்

Semester	19ITAMC41: Part-I Language I: Course - 4	L	T	P	C
IV	சங்க இலக்கியமும் செம்மொழி வரலாறும்	3	-	-	3

கற்பித்தலின் நோக்கம் (Learning Objective (LO))

LO1:	தமிழ்ச் செம்மொழி இலக்கியங்கள் குறித்து அறிமுகம் செய்தல்..
LO2:	செம்மொழி வரலாற்றுடன் அதன் தகுதிபாடுகளுக்கான வரையறைகள் சுட்டப்படும்.
LO3:	சங்க அக, புற இலக்கியங்களின் தனித்தன்மைகளை உணர்துதல்.
LO4:	பத்துப்பாட்டு இலக்கியங்களில் நெடுநல்வாடை வழிப் பண்பாட்டைச் சுட்டிக் காட்டல்.
LO5:	தமிழின் பயன்பாடும் தேவையும் எடுத்துக்காட்டுகளுடன் விளக்குதல்.

Course Outcomes

At the end of the course, the student will be able to

CO1:	சங்க அக இலக்கியங்களைத் திணை அடிப்படையில் ஆராய்ந்து கற்கும் திறன்.
CO2:	புற இலக்கியங்களில் பெண்பாற் புலவர்களின் புலமையை அறியும் ஆற்றல்.
CO3:	நெடுநல்வாடை வழி இலக்கியங்களில் இயற்கைப் பெறுமிடத்தைச் சுட்டுவர்.
CO4:	சங்க இலக்கியங்களின் வகைமை, வடிவம், உள்ளடக்கம் குறித்த அறிவைப் பெற்றிருப்பர்.
CO5:	தொல்காப்பியம் என்னும் தனித்துவமான இலக்கணத்தை விவரிக்கும் திறன்.

அலகு – 1 அக இலக்கியங்கள்

1.	குறுந்தொகை	-	125, 128, 177, 303, 397	(நெய்தல்)
2.	நற்றிணை	-	206, 217, 304, 334, 383	(குறிஞ்சி)
3.	ஐங்குறுநூறு	-	17, 18, 71, 75, 96,	(மருதம்)
4.	அகநானூறு	-	147, 303, 371	(பாலை)
5.	கலித்தொகை	-	104, 105	(முல்லை)

அலகு - 2 புற இலக்கியங்கள்

1. புறநானூறு - பெண்பாற்புலவர்கள் 66, 83, 112, 140, 187, 226, 269,271, 278,290

அலகு - 3 பத்துப்பாட்டு

1. நெடுநெல்வாடை

அலகு - 4 சங்க இலக்கிய வரலாறு

தொல்காப்பியம் - சங்க காலம் - முற்சங்கங்கள் - பாட்டும் தொகையும் - தொகுப்புமுறை - தனித்தன்மைகள்.

அலகு - 5 பயன்பாட்டுத் தமிழும் செம்மொழி வரலாறும்

மொழி விளக்கம் - மொழிக்குடும்பங்கள் - உலகச் செம்மொழிகள் - இந்தியச் செம்மொழிகள் - செம்மொழித் தகுதிகள் - வரையறைகள் - வாழும் செம்மொழித் தமிழ் - தமிழின் தொன்மை - தமிழின் சிறப்புக்கள் - தமிழ்ச் செம்மொழி நூல்கள் - தமிழ் செம்மொழி அறிந்தேற்பு - பரிதிமாற்கலைஞர் முதல் தற்கால அறிஞர்கள் வரை (அறிஞர்கள் - அமைப்புகள் - நிறுவனங்கள் - இயக்கங்கள் தொடர்முயற்சிகள் - அறப்பேராட்டங்கள் - உலகத் தமிழ்ச் செம்மொழி மாநாடு, கோவை-2010)

அலகு – 6

(மாணவர்கள் அறிந்துகொள்வதற்கு மட்டும் – தேர்வுக்கான பகுதி அல்ல)

பண்டைய தமிழ் மரபுகளையும் சமூக அமைப்புகளையும் விளக்குதல், தமிழ் மொழியில் தனித்துவத்தையும் செம்மொழி இயல்புகளையும் சங்க இலக்கியங்களின் துணைக்கொண்டு விளக்குதல். சங்கப் பனுவல்களில் பொதுமைத்தன்மையையும் அவற்றின் சிறப்பியல்புகளையும் விளக்குதல்.

பாட நூல் :

1. ச.வே.சுப்பிரமணியன் (ப.ஆ) - குறுந்தொகை, நற்றினை, ஐங்குறுநூறு, " அகநானூறு, கலித்தொகை, மணிவாசகர் பதிப்பகம், சென்னை
இரண்டாம் பதிப்பு -2011

2. ச.வே.சுப்பிரமணியன் (ப.ஆ) - புறநானூறு, மணிவாசகர் பதிப்பகம், சென்னை
இரண்டாம் பதிப்பு -2011

3. ச.வே.சுப்பிரமணியன் (ப.ஆ) - பத்துப்பாட்டு (நெடுநல்வாடை) மணிவாசகர் பதிப்பகம், சென்னை
இரண்டாம் பதிப்பு -2011

4. தெ.பொ.மீனாட்சி சுந்தரம் - சங்க மொழி வரலாறு நியூசெஞ்சரி, புத்தக நிலையம் முதற்பதிப்பு -2018

5. மணவை முஸ்தபா - செம்மொழி உள்ளும் புறமும் சீதை பதிப்பகம், சென்னை முதற்பதிப்பு -2010

6. ச.வே.சுப்பிரமணியன் - சங்க இலக்கியம் மணிவாசகர் பதிப்பகம், சென்னை
இரண்டாம் பதிப்பு -2011

7. மு.வரதராசன் - தமிழ் இலக்கிய வரலாறு, சாகித்திய அகாதெமி வெளியீடு, புதுதில்லி மூன்றாம் பதிப்பு- 2015

Outcome Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	-	-	-	3	3	-	-	3	3	3	3	3	3	2
CO2	3	3	-	-	-	3	-	-	3	-	-	3	2	-	-
CO3	-	2	3	-	3	3	-	-	-	-	3	-	-	3	3
CO4	3	-	3	-	-	2	-	-	-	3	2	2	3	-	-
CO5	3	2	-	-	2		-	-	2	3	2	-	-	3	2

Semester	19IHIC41: Language – 1: Course 4	L	P	C
IV	Basic Hindi - IV	3	-	3

Learning Objective (LO):

LO1:	To learn the important poems of famous Hindi poets.
LO2:	To imbibe the knowledge of writing in Premchand stories.
LO3:	To understand the relation between poems and stories.
LO4:	To gain knowledge on stories of Beeshma Sahini

Course Outcomes (CO)

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

CO1:	Understand the concepts of Hindi poems.
CO2:	Knowledge on stories of Premchand.
CO3:	Describe the basic concepts of hindi stories.
CO4:	Apply the concepts of writings of Jai sankar Prasad.
CO5:	Understand the writing style of Beeshma Sahini.

Unit - I: Introduction, Poem

Kabeer - 1 To 10 Dohas Tulasi - 1 To 10 Dohas.

Unit - II: Rahim - 1 To 10 Dohas

Unit – III: Edgaah - Premchand. Madhuva - Jayashankar Prasad.

Unit - IV: stories,

Chief Ki Daavat - Beeshma SahinI

Unit - V: 7. HANUMAN JI ADHALATH ME - HARISHAKNA PARSAYE

Current Streams of Thought

(Not for final Examination only for discussion)

The Faculty will impart the current developments in the subject during the semester to the students and this component will not be a part of Examinations.

Text Books

1. Padhya Manjari - DR. T.Nirmala & DR.S.Mohan Rajkamal Prakashan, New Delhi.
2. Premchand ki Pradhini Kahaniya, Rajkamal Prakshan, New Delhi.7.
3. Kahani: Nayi Kahani: Namvirsingh, Rajkamal Prakashan, New Delhi.
4. Bihari-Ompraksh.Vani Prakshan, New Delhi 110002.

Supplementary Reading

1. Nayi kahani:prakruti aur paat:surendra chowdari.
2. Naveen ekanki, D.B.H.P. SABHA, madras17.
3. Bihari ki kavya sruti: jaya praksh.

Outcome mapping

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	-	-	-	-	-	-	-	-	2	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	2	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	2	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	2	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	2	-	-	-	-

Semester	19IFREC41: Language- I: Course -2 French-IV	L	T	P	C
IV		3	-	-	3

Learning Objective (LO):

LO1	Draw a France map and name its regions and cites.
LO2	Fix an appointment .
LO3	Draw a person physically and name its parts.
LO4	Talk about the qualities and defects of the person.
LO5	Talk about their health problems.

Course Outcomes (CO):

At the end of the course, the student will be able to:

CO1	Describe a country
CO2	Take an appointment with a doctor or with friends, etc.
CO3	Express in which part of the body they have pain.
CO4	Describe a person physically and mentally.
CO5	Ask others about how they are feeling using expressions such as 'Qu'est-ce que tu as? Où est-ce que tu as mal?'

Unit I

Faire un bilan du sondage

Aborder quelqu'un (Parler de moyens de communication)

Unit II

Faire valoir son droit

Exprimer une opinion sur la vérité d'un fait.

Savoir-vivre en France

Unit III

Donner un conseil

Téléphoner /Prendre rendez-vous

Unit IV

Exposer un problème/ réagir

Parler du corps et des problèmes de santé

Unit V

Parler des qualités et des défauts des personnes

Demander / donner une explication

décrire une personne

Evaluez-vous

Text Book:

1. J. Girardet et J. Pecheur, (2012), *Echo A1* - méthode de français, Langers, Paris.

Supplementary Readings:

1. Marie-Noelle Cocton et Emilie Pommier, (2015), *Saison A1* - méthode de français, Les Editions Didier, Paris.
2. Angels Campa, Claude Mestreit, Julio Murillo et Manuel Tost, (2001), *FORUM* – Méthode de français, HACHETTE LIVRE, Paris.
3. Mauger Bleu, (2014), *Le Cours de langue et de la civilisation française*, - Méthode de français, Hachette, Paris
4. Michele Boulares et Jean-Louis Frerot, (1997), *Grammmaire Prograssive du Français avec 400 exerices*, CLE International, Paris.

Outcome mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	2	3	2	2	3	2	3	3	3	3	3	-	-	-
CO2	3	-	2	-	3	-	2	2	-	3	-	-	-	-	-
CO3	3	2	-	-	2	3	-	2	3	-	-	-	2	-	-
CO4	3	3	3	3	3	-	3	-	2	2	2	-	-	2	-
CO5	-	-	3	3	3	3	3	2	2	2	2	-	-	-	3

Semester	19IENGC42: Language – II: Course 4	L	P	C
IV	English Through Literature Iv: Short Story	3	-	3

Learning Objective (LO):

LO1	Develop the communicative competence of learners in the English Language through training them in the skills of listening, speaking, reading, and writing.
LO2	Enable the students to know about the origin and development of short story
LO3	Write objectively, avoiding vagueness, prejudice, and exaggeration.
LO4	Enable the learner to function through the written mode of English language in all situations including classroom, library, laboratory etc.
LO5	Discover an author's purpose, and draw conclusions about certain events, evaluating cause and effect, and understanding point of view.

Course Outcomes (CO)

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

CO1:	Use more vocabularies while writing
CO2:	Ensure about the history and development.
CO3:	Develop a flow in writing.
CO4:	Come up with new ideas while reading stories from different perspectives.
CO5:	Write in a style appropriate for communicative purposes.

Unit I

1. O' Henry — "The Gift of The Magi"
2. Ken Liu — "The Paper Menagerie"

Grammar — Synonyms and Antonyms

Unit II

1. Flora Annie Steel — "Valiant Vicky"
2. Oscar Wilde — "Happy Prince"

Grammar — Words often confused

Unit III

1. R. K. Narayan — "The Martyr's Corner"

2. Mahasweta Devi “Draupati”

Grammar Paragraph-Writing

Unit IV

1. Leo Tolstoy “How much Land Does a Man Need?”

2. Somerset Maugham “The Verger”

Grammar Letter-Writing

Unit V

1. Langston Hughes “On the Road”
2. Premchand “Bakthi Marg”

Grammar Precis-Writing

Text Books

1. Srinivasa Iyengar, K.R.. Indian Writing in English. New Delhi: Sterling Pub., 1996.
2. Michael Swan, Practical English Usage, New Delhi: Oxford University Press, 2016.

Supplementary Reading:

1. Frank Robert Palmer,. Grammar: (by) Frank Palmer. New Delhi: Penguin Books, 1975.
2. Browns, Julie, ed., Ethnicity and the American Short Story, New York: Garland, 1997.
3. Patea, Viorica. Short Story Theories: A Twenty-First-Century Perspective. Amsterdam [etc.]: Rodopi, 2012.

Outcome Mapping

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	-	-	-	-	-	-	-	1	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	1	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	1	-	-	-
CO5	2	2	2	-	-	-	-	-	-	-	1	-	-	-	-

Semester	19IMICC43: Microbial Physiology	L	P	C
IV		4	-	4

Learning Objective (LO):

LO	To learn about the nutritional requirements of microbes, microbial growth, cell division and metabolism

Course Outcomes (CO)

After completion of course, students will be able to

CO1:	Understand the structure and function of microbial cell.
CO2:	Analyze the microbial growth and factors affecting growth.
CO3:	Explain the autotrophs and microbial pigments.
CO4:	Explain microbial metabolism.
CO5:	Gain knowledge about cell division and dormancy.

Unit – 1: Nutritional Requirements Of Microorganism

Nutritional requirements of microorganism – Autotrophs, Heterotrophs, Chemotrophs, Copiotrophs and Oligotrophs. Transport mechanisms - Active, Passive, Facilitated diffusions - Uni, sym, antiports.

Unit – 2: Bacterial Growth & Extremophiles

Phases of growth curve, Measurement of growth - Calculations of growth rate, Generation time. Synchronous growth - induction of synchronous growth, synchrony index. Factors affecting growth - pH, Temperature, Substrate and Osmotic condition. Survival at extreme environments- Adaptative mechanisms in Thermophilic, Alkalophilic, Osmophilic and Psychrophilic and Starvation conditions.

Unit – 3: Bacterial Metabolism

Respiratory metabolism – Glycolysis, Embden Meyerhof pathway, Entner Doudoroff pathway, Krebs cycle. Electron transport chain, Oxidative and substrate level phosphorylation, Reverse TCA cycle, Gluconeogenesis.

Unit - 4: Photosynthesis

Photosynthesis – Characteristics and types of photosynthetic prokaryotes, Photosynthetic pigments. CO_2 fixation, Oxygenic - Anoxygenic Photosynthesis - Calvin cycle. Bioluminescence

Unit – 5: Cell and Cellular Organizations

Bacterial cell wall- Composition, structure and biosynthesis. Bacterial Cell division – Replication of bacterial chromosome, Co- ordination of cell division with replication of chromosome, partitioning of chromosome in to daughter cells. Endospore – Structure, Properties and Germination. Sporulation and morphogenesis. Hyphae vs. Yeast forms and their significance. Multicellular organization of selected microbes. Dormancy.

Current Streams of Thought

(Not for final Examination only for discussion)

Recent developments related to metabolism of various microbes to be sourced from multiple informative sources. Quiz and self reading on Bioluminescence - Nutritional requirements of Extremophiles. Seminar on quorum sensing, Metabolic pathway for degradation of pollutants etc.

Text Books:

1. White, D. (2011). *The physiology and biochemistry of Prokaryotes*, 4th ed. Oxford University Press, Oxford.
2. Poole, R.R.K. (2017). *Advances in Microbial Physiology*. Volume 71. Elsevier Science & Technology.

Supplementary Books:

1. Kim, B.H. and Gadd, G.M. (2008). *Bacterial Physiology and metabolism*. United States of America. Cambridge University Press. New York.
2. Moat, A.G. Foster, J.W. and Spector, M. P. (2002). *Microbial Physiology.* 4th ed. Wiley. New Jersey.
3. Drummond, J. and Fuqua. (2011). *The Physiology and Biochemistry of Prokaryotes*. 4th ed. David White. Oxford University Press. Oxford.

Web References:

1. https://www.sciencedirect.com/science/article/pii/B978012374546000016X
2. https://www.thoughtco.com/bacterial-growth-curve-phases-4172692
3. https://www.sciencedirect.com/science/article/pii/S0167730608601337
4. https://en.wikipedia.org/wiki/Microbial_metabolism
5. https://en.wikipedia.org/wiki/Cell_division

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	2	3	3	3	3	3	3	2	2
CO2	3	3	3	3	3	2	3	3	3	3	2	2	3	3	3
CO3	3	3	3	3	3	3	2	3	3	3	2	2	2	2	2
CO4	3	3	3	3	3	3	2	3	2	3	3	3	3	2	3
CO5	3	3	3	3	3	3	2	3	2	3	3	3	2	3	3

Semester	19IMICP44: Practical - 3 (Microbial Physiology)	L	P	C
IV		-	10	5

Learning Objective (LO):

LO	To analyze the effect of carbon and nitrogen sources, Environmental factors on the growth of microorganisms.

Course Outcomes (CO)

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

CO1:	Analyze the effect of various parameters on the growth of bacteria – carbon and nitrogen sources, pH, Temperature and Pesticides.
CO2:	Study the bacterial growth by turbidity measurement.

Practicals:

1. Growth of Microorganisms on various carbon and Nitrogen sources.
2. Determinations of molar growth yield and ATP.
3. Turbidity measurement.
4. Determination of the effect of pH on microbial growth
5. Determination of the effect of temperature on microbial growth
6. Determination of the effect of salinity on microbial growth
7. Determination of the effect of antimicrobials on microbial growth
8. Cultivation of anaerobes by candle jar technique
9. Cultivation of anaerobes by Pyrogallic acid method
10. Cultivation of anerobes by gas pack method

Reference Books:

1. Kannan, N. (2002). *Laboratory manual in General Microbiology*. Panima publishing corporation, New Delhi.
2. Rajan, S and Selvi Christy. R. (2010). *Experimental procedures in life sciences*. 1st ed. Anjanaa Book House, Chennai.
3. Maheshwari, D. K., and Dubey. R.C. (2012). *Practical microbiology*. Revised ed. S. Chand and Co. New Delhi.

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	2	3	2	3	2	3	3	2	2
CO2	3	3	3	3	3	2	3	3	2	3	2	3	3	3	3

Semester	19IBITA02: Biochemistry - Paper II	L	P	C
IV		4	-	4

Learning Objective (LO):

LO	To acquire a comprehensive knowledge on biomolecules and their functions and biochemical basis of diseases.

Course Outcomes (CO)

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

CO1:	Understand the nutritional and biochemical aspects of vitamins and minerals.
CO2:	Learn the structure and functions of nucleic acids.
CO3:	Understand the process of DNA replication, damage and repair and the transcription
CO4:	Gain knowledge on the phases of translation and fundamental aspects of recombinant DNA technology
CO5:	Understand the clinical conditions arising from malnutrition, over nutrition and in born errors in metabolism and biochemical basis of diabetes mellitus, atherosclerosis and jaundice

Unit – 1: Vitamins and Minerals.

Sources, requirements, biological actions and clinical significance of fat-soluble (A, D, E, and K) and water - soluble (thiamine, riboflavin, niacin, pyridoxine, pantothenic acid, biotin, folic acid and vitamin B_{12}) vitamins. Biological functions and clinical significance of calcium, phosphate, and iron.

Unit – 2: Nucleic Acids

DNA structure - Watson and Crick model. A, B, and Z forms of DNA. DNA denaturation. Differences between DNA and RNA. Major classes of RNA - structure and biological functions. Minor classes of RNA.

Unit – 3: DNA and RNA Biosynthesis

The central dogma of molecular biology. DNA replication- enzymes, basic mechanism and inhibitors. DNA damage. DNA repair - photoreactivation,

excision repair. Transcription - RNA polymerase, overview of steps, inhibitors. Brief account of post-transcriptional modifications. Reverse transcription (concept only).

Unit - 4 :Translation and Recombinant DNA Technology

Genetic code-general features. Translation-steps. Inhibitors. Post-translational modifications. The lac operon model.

Recombinant DNA technology: Basic steps in cloning. Restriction endonucleases, cloning vectors (e.g. pBR322). Gene transfer methods (electroporation, lipofection, microinjection). Screening of recombinants by marker inactivation. Applications of rDNA technology.

Unit – 5: Nutritional and Biochemical Disorders

BMR. Essential amino acids and fatty acids. Protein quality. Protein energy malnutrition: marasmus and kwashiorkor. Obesity: causes and consequences. Inborn errors of metabolism (PKU only). Diabetes mellitus: classification, diagnosis, management. Atherosclerosis: risk factors, and management. Jaundice: classification, diagnosis and management.

Text Books:

1. David L. Nelson and Michael M. Cox, (2017), Lehninger Principles of Biochemistry, 7th Ed. Freeman Publishers, New York.
2. Rodwell, VW, et al. (2018), Harper's Illustrated Biochemistry. 31st Ed. McGraw Hill, New York
3. Satyanarayana U. (2017) Biochemistry. 5th ed. Books and Allied Publishers, New Delhi.
4. Nicholls DTS. (2008) An Introduction to Genetic Engineering. 3rd ed. Cambridge Univ Press, Cambridge, UK.

Supplementary Reading:

1. J. L. Jain (2016) *Fundamentals of Biochemistry*. 7th ed. Kalyani Publishers, New Delhi.
2. Voet, D, Voet JG, and Pratt CW (2018), Fundamentals of Biochemistry, 5th Ed. Wiley, New York.

Outcome Mapping

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	2	3	3	3	3	-	-	-	-	-
CO2	3	3	2	2	2	3	2	2	2	3	-	-	-	-	-
CO3	3	3	3	3	3	2	3	3	3	3	-	-	-	-	-
CO4	3	3	3	3	3	2	3	3	3	3	-	-	-	-	-
CO5	3	3	2	2	2	3	2	2	3	3	-	-	-	-	-

Semester	19IBITP01: Biochemistry Practical (Allied)	L	P	C
IV		-	4	2

Learning Objective (LO):

LO	To learn the preparation of solutions and analyze biomolecules.

Course Outcomes (CO)

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

CO1:	Prepare reagents and buffers
CO2:	Analyze quantitatively / qualitatively carbohydrates, amino acids, and proteins.
CO3:	Determine the characteristics of fatty acids in oil samples.
CO4:	Analyze the concentration of glucose and cholesterol in biological samples.
CO5:	Isolate and estimate DNA and RNA concentrations in biological samples.

1. Preparation of buffers.
2. Qualitative analysis of carbohydrates.
3. Qualitative analysis of amino acids.
4. Estimation of protein by Biuret/Lowry et al method.
5. Determination of acid number/ iodine number/ saponification value of a fat.
6. Separation of lipids by TLC (demonstration).
7. Estimation of ascorbic acid in lemon.
8. Isolation of DNA from rat liver and estimation of DNA by diphenylamine method.
9. Estimation of RNA by orcinol method.
10. Estimation of glucose.
11. Estimation of cholesterol.

Supplementary Reading

1. Plummer, D (2017) *An Introduction to Practical Biochemistry*. McGraw-Hill, New York.
2. Alan H. Gowenlock. (2006) Varley's Practical Clinical Biochemistry. 6th ed. CRC Press, New Delhi.

3. Todd S & Stanford V. (2016) *Clinical Diagnosis and Management by Laboratory Methods*. 16th ed. Saunders Publishers, Philadelphia, USA.

Outcome Mapping

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	2	3	-	-	-	-	-
CO2	3	3	3	3	3	3	3	2	3	3	-	-	-	-	-
CO3	3	3	3	3	3	3	3	3	2	3	-	-	-	-	-
CO4	3	3	3	3	3	3	3	3	2	3	-	-	-	-	-
CO5	3	3	3	3	3	3	3	2	1	3	-	-	-	-	-

Semester	19IMICF40: EXTENSION ACITIVITIES	L	P	C
IV		-	2	1

Students are insisted to join NSS/ NCC/ YRC/ RRC or any other service organizations in our University. The Students should visit the nearby communities to disseminate knowledge regarding importance of personal and public hygiene, awareness about communicable diseases and importance of blood donation. They have to educate farmers about the importance of microbes in agriculture, income generation through mushroom cultivation, SCP and biofertilizer production. Students should involve in activities to increase scientific temper among public.

Semester	19IMICC51: IMMUNOLOGY	L	P	C
V		5	-	5

Learning Objective (LO):

LO	To learn the basic concepts of Immunology, Antigen - Antibody reactions and Immunological disorders.

Course Outcomes (CO)

Upon successful completion of the course, the students will be able to:

CO1:	Illustrate the cell types and organs involved in the process of immune response.
CO2:	Understand the properties of antigens and antibodies.
CO3:	Evaluate antigen - antibody interactions.
CO4:	Describe the adverse effects of the immune system including autoimmunity and hypersensitivity.
CO5:	Understand immune hematology and transplantation immunology.

Unit - 1: Immunity

History of immunology, Innate immunity and Acquired immunity. Humoral and cell mediated Immunity. Haematopoeisis, Cells and organs of immune system, B - cell and T - cell activation. Cell surface receptors. Phagocytosis.

Unit - 2: Antigen & Antibody

Antigen – Types and properties of antigen- Immunogen, Hapten, Adjuvant. Antibody structure and types. Theories of antibody diversity, Isotype switching. Complement - Classical and Alternative pathways.

Unit – 3: Antigen & Antibody Reactions

Antigen-Antibody Interactions – Agglutination, Precipitation, Flocculation. Techniques: Immonodiffusion- ODD, Immunoelectrophoresis IFT, CFT, ELISA. Monoclonal antibodies [Hybridoma Technology].

Unit – 4: Autoimmunity & Hypersensitivity

Autoimmune diseases - Types and mechanisms. Hypersensitivity reactions – Types [Type - I, Type - II, Type - III and Type - IV].

Unit – 5: Hematology & Vaccines

Immunohematology, Blood group, Rh - incompatibilities. Transplantation Immunology - HLA Tissue Typing, Mechanism of acceptance and rejection. Vaccines - Types, Domestic & International policy, Immunization schedule.

Current Streams of Thought

(Not for final Examination only for discussion)

Review and debate on latest discovery on immunology- seminar on 'advanced invitro antigen - antibody reaction techniques'- awareness program about immunization schedule , blood grouping, Rh incompatibility to rural community.

Text Books:

1. Latha. P.M. (2012). *A Text book of immunology*, S. Chand publishers, New Delhi
2. Sastri, A.S. (2015). *Review of Microbiology & Immunology*, 9th edition. Jaypee Brothers, New Delhi.
3. Zottan A. Nagy. (2014). *The history of Modern Immunology*, Academic Press. Cambridge.

Supplementary Books:

1. Delves,P.J. Martin,S.J. and Roitt, I.M. (2017). *Essential Immunology.* 3rd ed. Blackwell Scientific Publications, Oxford.
2. Owen, J., Punt, J and Strandford, S. Kuby. (2018). *Immunology*, 8th ed. W. H. Freeman Publication, New York, USA.

Web References:

1. http://www.roitt.com/mcqs/mcqlist.asp
2. https://www.researchgate.net/publication/232773539_textbook_of_immunology
3. https://en.wikipedia.org/wiki/Autoimmune_disease

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	2	2	3	3	3	3	3	2	3
CO2	3	3	3	3	3	3	3	2	3	3	3	2	2	2	3
CO3	3	3	3	3	3	3	3	3	2	3	2	2	2	2	3
CO4	3	3	3	3	3	2	3	3	2	3	3	3	3	2	3
CO5	3	3	3	3	3	2	3	3	2	3	3	3	3	2	3

Semester	19IMICC52: Medical Microbiology	L	P	C
V		5	-	5

Learning Objective (LO):

LO	To acquire In-depth knowledge about the microorganisms associated with human beings, Diseases, diagnosis and Treatment.

Course Outcomes (CO)

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

CO1:	Demonstrate the Microbial virulence Mechanisms and host response to infections.
CO2:	Describe the basic morphology, biochemical properties of pathogenic microorganisms.
CO3:	Describe the life cycle, pathogenicity and diagnosis of viral diseases.
CO4:	Understand the basis of fungal diseases.
CO5:	Understand the importance of protozoan diseases.

Unit – 1: Introduction About Medical Microbiology

History, Koch & River's postulates, Role of microbiology in medicine, Classification of medically important microbes, Normal Microbial flora, Infections-sources, Mode of transmission, Prevention of medically important microbes.

Unit – 2: Bacterial Diseases

Morphology, Classification, Cultural characteristics, epidemiology, symptoms, Pathogenicity, Laboratory diagnosis, Prevention, Control and treatment of *Staphylococcus aureus, Mycobacterium tuberculosis, M. leprae, Vibrio cholerae, Escherichia coli.* Human infections caused by; *Bacillus anthracis, Streptococcus pneumoniae*, *Corynebacterium diphtheriae, Clostridium tetani, Salmonella typhi, Pseudomonas aeruginosa*, *Proteus vulgaris, Neisseria gonorrhoeae and Shigella dysentriae*,

Unit – 3: Viral Diseases

Lifecycle, Pathogenicity, diagnosis, prevention and treatment of Influenza viruses, Measles, Mumps, Hepatitis A & B, Poliomyelitis, AIDS, Rabies, Dengue, Swineflu virus, Ebolavirus, Zikaviruses. Tumor viruses – Parvo and Papilloma virus. Chickungunya virus.

Unit – 4: Fungal Diseases

Superficial mycosis, Cutaneous mycosis, Subcutaneous mycosis, systemic mycosis, Opportunistic mycosis

Unit – 5: Protozoan Diseases

Transmission lifecycle, lab diagnosis, treatment for the following Protozoan diseases – *Entamoeba histolytica, Leishmania donovani, Trypanosoma cruzi, Giardia lamblia, Balantidium coli*. Helminthes - Cestodes –*Taenia solium, Fasciola hepatica, Ascaris lumbricoides*, *Enterobius vermicularis* and *Wuchereria bancrofti.*

Current Streams of Thought

(Not for final Examination only for discussion)

Discussion on advances in diagnostic techniques through internet and webinar. Keeping track of recent outbreaks of bacterial and viral diseases through daily news and research paper - Awareness program on Worlds AIDS day, Worlds TB day - personal hygiene, vaccination, contagious and emerging microbial diseases. Sensitizing the public about contagious fungal and parasitic diseases - antiworm medication.

Text Books:

1) Ananthanarayan, R and Paniker, C.K. (2009).*Text Book of microbiology*. Orient Longman. Chennai.
2) Chander, J. (2009). *A text book of Medical Mycology*. Interprint, New Delhi.
3) Parija, S .C (2013). *Textbook of Medical Parasitology, Protozoology and Helminthology.* 4th ed. All India Publishers and distributors, Medical Book Publisher, New Delhi

Supplementary Books:

1. Greenwood, D. Slack, R.B. and Peutherer, J.F. (2012). *Medical Microbiology*, 18th ed. Churchill Livingstone, London.

2. Norkin, L.C. (2010). *Virology: Molecular Biology and pathogenesis*, American Society for Microbiology.

Web references:

1. https://www.researchgate.net/publication/23412966_Textbook_of_medical_Parasitology_Protozoology_Helminthology
2. http://moscmm.org/pdf/Ananthanarayan%20microbio.pdf
3. https://www.ncbi.nlm.nih.gov/books/NBK7627/
4. https://jmm.microbiologyresearch.org/content/journal/jmm
5. http://moscmm.org/pdf/medical-microbiology.pdf

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	3	3	2	2	2	3	3	3	3	3	3
CO2	2	3	3	3	3	3	3	2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	2	3	3	3	3	2	2	3
CO4	3	3	2	3	3	2	3	3	2	3	2	3	2	2	3
CO5	3	3	3	3	3	2	3	3	2	3	2	3	3	3	3

Semester	19MICC53: Microbial Genetics & Molecular Biology	L	P	C
V		5	-	5

Learning Objective (LO):

LO	To gain knowledge about the microbial genetics and central dogma of molecular biology.

Course Outcomes (CO)

After completion of course students, will be able to

CO1:	Explain recombination methods.
CO2:	Understand the central dogma of molecular biology and the genome of prokaryotic and eukaryotic microorganisms.
CO3:	Explain about replication and mutation in bacteria.
CO4:	Understand the mechanism of transcription.
CO5:	Develop an understanding of operon concept.

Unit - 1: Bacterial Recombination

Recombination – Requirements, Molecular basis, Genetic analysis of recombination in bacteria. Transformation – Natural transformation - Competence, DNA uptake, role of natural transformation, artificially induced competence – electroporation. Transduction - Generalized, Specialized. Conjugation – Self transmissible plasmids, F factor, *tra* genes, *Ori* F and Hfr strains, Steps in conjugation, Sex pili.

Unit – 2: Chromosome Organization

Central dogma of Molecular biology, DNA structure and types. Prokaryotic chromosome (*Escherichia coli)*, Plasmids. Concepts of gene - Typical Structure of protein coding genes. Eukaryotic genome - nucleosome & higher order chromatin structure.

Unit – 3: DNA Replication

Replication – Messelson Stahl Experiment. Enzymes & proteins involved in replication. Steps in replication - Initiation, Elongation, Termination. Rolling circle replication. Mutation and its types. Mutagenesis. DNA damage & repair - Photo reactivation & Excision. Mobile genetic elements – IS elements & Transposons.

Unit – 4: Transcription

Transcription, RNA Polymerase Promotor, Steps in Transcription, Initiation, Elongation & Termination, Reverse transcription, Post transcriptional processing. RNA – Types, structure, Synthesis. Antisense RNA.

Unit – 5: Translation & Gene Expression

Genetic code, Steps in translation - Amino acid activation, Initiation, Chain Elongation & Termination. Inhibitors of protein synthesis. Post translational modification, Regulation of gene expression. Brief account of *lac* operon.

Current Streams of Thought

(Not for final Examination only for discussion)

Molecular computation strategy for classifying complex gene expression- discussion- Quiz related to CRISPR, Site directed mutagenesis, protein engineering- Seminar on genome editing technique in embryo- Group discussion on recombination methods.

Text Books:

1. Chaudhri, K. (2012). *Microbial genetics*, The Energy and Resources Institute, Teri.
2. Sheela.S. (2013). *Genetics of Bacteria*, 1st ed. Springer, India.
3. El Maksoud Zaied, K.E. (2011). *Fundamental Microbial Genetics*.

Supplementary Books:

1. Friedberg, E.C. Walker, G.C. and Siede, W. (2006). *DNA repair and mutagenesis*. ASM press.
2. Maloym, S and Cronon, J. (2014). *Microbial genetics*. 2nd ed. Narosha publishing House.
3. Snyder, L and Champness, W. (2013). *Molecular Genetics of Bacteria*, 4th ed. Wiley. New Jersey.

4. Dale.J.W. (2016). *Molecular genetics of Bacteria*, 5th ed. Wiley Blackwell. New Jersey.

Web References:

1. https://www.wikilectures.eu>.
2. https://link.springer.com
3. https://opentextbc.ca>biology>
4. https://www2.le.ac.UK>vgec>topics>
5. https://study.com>academy

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	3	3	2	2	2	3	3	3	3	2	3
CO2	3	3	3	3	2	2	3	2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	2	3	3	2	3	2	3	3
CO4	3	3	2	3	3	2	3	3	3	3	3	3	3	3	2
CO5	3	3	3	3	3	2	3	3	2	3	2	3	3	3	3

Semester	19IMICC54: Soil, Agricultural &Environmental Microbiology	L	P	C
V		5	-	5

Learning Objective (LO):

LO	To gain an understanding the role of microorganisms and their applications in soil, agriculture and environment.

Course Outcomes (CO)

After completion of course students will be able to:

CO1:	Understand the interactions of microorganisms in soil.
CO2:	Gain knowledge about biogeochemical cycles.
CO3:	Understand plant diseases and their management.
CO4:	Explain the significance of air Microflora and airborne diseases.
CO5:	Gain knowledge about water pollution and waste water treatments.

Unit – 1: Soil Properties And Microbial Interactions

Soil Microbiology – Soil as an environment for Microorganisms. Classification of soil, Physical and Chemical properties of soil. Rhizosphere and Phyllosphere. Microbial interactions – Mutualism, Commensalism, Amensalism, Synergism, Parasitism, Predation and competition.

Unit – 2: Biological N_2 Fixation

Biological N_2 fixation - Nitrogenase enzyme, *Nif* genes. Symbiotic Nitrogen fixation (*Rhizobium*). Non- symbiotic N_2 fixation (*Azotobacter*). N_2 fixation in Cyanobacteria. Mycorrhiza – Ecto, Endo & Ectendo. VAM, BGA – Inoculum production and use. Biogeochemical cycles - Role of microbes in biogeochemical cycles - Carbon, Nitrogen, Phosphorus and Sulphur.

Unit – 3: Plant Diseases and Control

Plant diseases - Bacterial- Blight of rice and Citrus canker. Fungal - Rust of Wheat and smut of sugarcane. Viral – TMV and CMV. Crop protection - Physical and Chemical control of plant diseases. Biopesticides -

Bacterial, Viral and Entomopathogenic fungi, recombinant forms of bugs, recombinant pesticides.

Unit – 4: Aero Microbiology & Bioremediation

Aero microbiology - Microorganisms in air - Distribution and sources of airborne organisms – Signification of air microflora – Air sampling techniques and air sanitation. Air borne diseases – Methods of measuring Microorganisms in air. Bioremediation - Microbial control of environmental pollutions and phytoremediation. Biodegradation - Oil spills and Xenobiotics.

Unit – 5: Water Pollution and treatment

Aquatic microbiology - Distribution and sources of waterborne organisms. Water pollution- Indicator organisms. Water sampling techniques. Water borne diseases and water purification techniques. Waste water treatments – Primary, Secondary and Tertiary treatments.

Current Streams of Thought

(Not for final Examination only for discussion)

Biofertilizers - advantages over chemical fertilizers - Debate on Modern agricultural practices and its impact on the agro - food safety and health issues– medicine – pros and cons of Organic farming - Concepts of sustainable agriculture (LEISA) Integrated pest management.- Biocontrol methods of controlling weeds - metagenomic approach in soil and environmental microbiology – air quality index –air borne pathogens- survival rate of virus and other pathogens in fomites –safety measures- steps to increase air quality.

Text Books:

1. Dubey, R.C. and Maheswari, D.K. (2013). *A Text Book of Microbiology*. S.Chand and Co. Ltd. New Delhi.
2. Varjani, S. Agarwal, A.K. Gnansounou, E. and Gurunathan, B. (2018). *Bioremediation*: *Applications for Environmental Protection and Management*. Springer. New York.
3. Chatterji. A.K. (2011).*Introduction to Environmental Biotechnology* 3rd ed. Prentic- Hall India private. Ltd. New Delhi.

Supplementary Books:

1. Kirchman, D.L. (2018). *Processes in Microbial Ecology* , 2nd ed.

2. Arceivala, S.J. and Asolekar, S.R. (2017). *Wastewater Treatment for Pollution Control and Reuse*.
3. Arceivala, J. (2017). *Wastewater treatment for pollution control by soil.* 3rd ed. Tata McGraw - Hill Publishing Company Limited. New Delhi.

Web References:

1. www.onlinebiologynotes.com
2. https:///www.biotecharticles.com.
3. https://en.m.wikipedia.org>wiki>water.

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO2	3	3	3	3	3	2	3	3	3	3	3	2	3	2	3
CO3	3	3	3	3	3	3	3	3	2	3	3	3	2	3	3
CO4	3	3	3	3	3	2	3	3	2	3	3	2	2	2	3
CO5	3	3	3	3	3	2	3	3	2	3	3	3	3	3	3

Semester	19IMICP55: PRACTICAL - 4	L	P	C
V	(Immunology, Medical Microbiology, Microbial Genetics And Molecular Biology, Soil, Agriculture & Environmental Microbiology)	-	12	6

Learning Objective (LO):

LO	To learn the basic laboratory skills in immunology, techniques for the identification of bacteria & fungi, basic molecular biology experiments and Methods for isolation of microbes from soil and water.

Course Outcomes (CO)

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

CO1:	Analyze blood grouping and other serological tests.
CO2:	Identify and describe various human pathogenic bacteria and fungi.
CO3:	Analyze mutation studies and other genetic experiments.
CO4:	Apply methods for the isolation of important soil microbes.
CO5:	Analyze water pollution levels.

Practicals:

1) Blood group & typing.
2) WIDAL test.
3) RPR test.
4) Immunodiffusion.
5) Biochemical Identification of Bacterial Pathogens. Indole, MR-VP, Citrate, Urease, Catalase, Oxidase and TSI tests for
    a. *Staphylococcus aureus*
    b. *Escherichia coli*
    c. *Salmonella typhi*
    d. *Pseudomonas aeruginosa*
6) Examination of Fungi by LPCB.
7) Normal Saline / Lugol's iodine preparation for parasitic ova / cyst examination.
8) Observation of Negri bodies

9) Isolation of antibiotic resistant microbes.

10) Induction of mutation in bacteria

11) Preparation of Competent cells for transformation

12) Isolation of microbial genomic DNA.

13) Isolation of plasmid DNA

14) Agarose gel electrophoresis.

15) Isolation of Symbiotic Nitrogen fixing Bacteria from root nodule - *Rhizobium.*

16) Isolation of Phosphate Solubilizers/ Ammonifiers/ Denitrifiers.

17) Assessement of water Quality – MPN Technique.

18) Estimation of Dissolved Oxygen (DO).

19) Estimation of BOD.

20) Estimation of COD.

References:

1. Maheshwari, D. K. and Dubey. R.C. (2012). *Practical microbiology*. Revised edition. S. Chand and Co. New Delhi.

2. Rajan, S and Selvi Christy. R. (2010). *Experimental procedures in life sciences*.1st ed. Anjanaa Book House. Chennai.

3. Cappuccino, J.G. and Sherman, N. (2014). *Microbiology - A laboratory Manual*.10th ed. Pearson. New York.

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	2	3	2	3	3	3	3	3	3
CO2	-	3	3	3	2	2	3	3	3	3	3	2	2	2	2
CO3	3	3	3	3	3	3	3	3	2	3	2	3	3	3	3
CO4	3	3	3	3	3	2	3	3	2	3	3	3	3	3	3
CO5	3	3	3	3	3	2	3	3	2	3	3	3	3	3	3

Semester	19IMICV50: Value Education	L	T	P	C
V		2	-	-	2

Learning Objective (LO):

LO1	This paper focuses on Value Educations among the young minds.
LO2	To nurture the rational ethics among the students community.
LO3	To understand the importance of Human Freedom as responsibility.
LO4	To taught about Lifestyle, Equality and Fraternity.
LO5	To include the ethical values to the students and develop the ethical culture.

Course Outcomes (CO)

After completion of course students will be able to:

CO1:	The students may lead a life in ethical way and also able to take ethical based rational decision in their life.
CO2:	Better understanding of moral consciousness of day to day life.

Unit – I

Value education – Meaning – Nature and Purpose

Importance of Value Education

Unit – II

Basic Features of Rational Ethics- Moral consciousness and conscience

Love – the ultimate moral norm

Unit – III

Morality and Freedom - Human Freedom and Moral Responsibility- God, Religion and Morality

Sanction for Moral Life.

Unit – IV

Social Ethics: Value of life and human beings

Liberty. Equality and Fraternity

Unit – V

Ethical Issues Today: Religious Ethics- Family Ethics- Political Ethics - Business Ethics- Ethics and Culture.

Text Books

1. Heroled Titus, *Ethics for Today*. New Delhi: Eurasia Publishing House, 1964.
2. Madan, G.R., *Indian Social Problems*, New Delhi: Allied Publishers, 1966.

Supplementary Readings

1. Sharma, R.N., *Principles of Sociology*, Meerut: Educational Publishers, 1968
2. Willam, K., *Ethics* , Delhi: Prentice Hall of India,1999
3. Arumugam, N., *Value based Education*, Madras: Saras, 2012

Outcome Mapping

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	-	-	-	-	-	-	1	-	-	-	1	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	1	-	-	-	-
CO3	-	-	1	-	-	1	-	-	-	-	-	-	-	1	-
CO4	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	2	-	-	-	-	-	-	-	1	-	-

Semester	19IMICC61: Industrial Microbiology	L	P	C
VI		5	-	5

Learning Objective (LO):

LO	To learn the general concepts of industrial microbiology and to acquire knowledge about the fermentor design and methods of industrial fermentation.

Course Outcomes (CO)

By the end of the course the students will able to:

CO1:	Develop skills associated with screening of industrially important strains.
CO2:	Develop media for various industrial fermentation.
CO3:	Understand the principles of fermentor design and types of fermentation.
CO4:	Explain about microbial production of foods.
CO5:	Gain the knowledge about the downstream processing.

Unit – 1: Screening And Strain Improvement

General concepts of industrial microbiology - Industrially important microorganisms – Screening, Isolation, Preservation and strain improvement, Fermentation economics. Principles of exploitation of microorganisms and their products.

Unit – 2: Fermentation Processes

Development of inoculum for various fermentation processes, Upstream processing - Media for industrial fermentation – Raw materials used in media production - Formulation - Sterilization.

Unit – 3: Fermentation Types

Fermentation equipment and its uses, Types of fermentation- Single, Batch, Continues, Dual (or) Multiple, Surface submerged fermentation. Immobilization methods – Advantages and Disadvantages.

Unit – 4: Fermented Food

Microbial production of foods – Bread, Cheese, Vinegar. Fermented beverages – Beer, Wine. Amino acids – Glutamic acid, Lysine. Enzymes – Amylase, protease, Cellulose and Antibiotics – Penicillin, Streptomycin. Vitamins – Riboflavin and Cyanogobalamin.

Unit – 5: Downstream Processing

Downstream processing - Recovery of Intracellular and Extracellular products - Cell disruption, Protein, Centrifugation, Culture filtration, Drying – Crystallization.

Current Streams of Thought

(Not for final Examination only for discussion)

Field trip to beverage and pharmaceutical industries - Quiz program related to the fermentor types - Seminar on downstream processing - Recycling and disposal of industrial wastes through microbes - Debate on strain improvement to increase the yield of products.

Text Books:

1. Cassida, J.E. (2007).*Industrial Microbiology*. New Age International.
2. Peppler, H.J. and Pearlman, D. (2014). *Microbial Technology*.vol.1 and 2nd e/d, Elsevier press.

Supplementary Books:

1. Stanbury I.F.Whittakar, A. and Hall S.J. (2016). *Principles of fermentation technology*, 3rd Editon, Pergamon press.
2. Prescott and Gunn,S.,(2009). *Industrial Microbiology*.Agrobios publications.
3. Belter, P.A.Cussler, E.L. and Hu, W.S. (2011).*Downstream processing for biotechnology*. John wiley and Sons, N.Y.

Web References:

1. www.biologydiscession.com
2. https://www.generalmicroscience.com
3. https://www.chemengoonline.com
4. https://www.biotechnologyforums.com

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	1	3	2	3	3	3	3	2
CO4	3	3	3	3	3	2	3	3	3	3	2	2	3	3	3
CO5	3	3	3	3	2	3	3	3	2	3	2	2	3	3	2

Semester	19IMICC62: Genetic Engineering	L	P	C
VI		5	-	5

Learning Objective (LO):

LO	To gain knowledge in basic steps in gene cloning, cloning vectors, gene transfer techniques and also to understand hazards and safety aspects of genetic engineering.

Course Outcomes (CO)

By the end of the course the student will be able to:

CO1:	Understand the basic steps in gene cloning enzymes involved in gene cloning.
CO2:	Get knowledge about cloning vectors.
CO3:	Compare the different methods of gene transfer.
CO4:	Describe methods for screening of recombinants.
CO5:	Appreciate the hazards and safety aspects of genetic engineering.

Unit – 1: Gene Cloning

Basic steps in cloning. Cloning strategies, genomic & cDNA cloning. Enzymes used in cloning -Restriction Endonucleases – Types, properties and uses. Nomenclature and mechanism of action of Type II Restriction Endonucleases, Ligases, methylation dependent restriction enzymes and Other enzymes involved in gene cloning.

Unit – 2: Cloning Vectors

Cloning vectors - Properties. Plasmid (pBR 322), Phage λ, ssDNA phages, M13 phage. Brief account of Cosmids, BACs, YACs, Viral vectors Shuttle vectors. Expression vectors.

Unit – 3: Gene Transfer Methods

Methods of gene transfer – Host cells for gene cloning, Transformation, Conjugation, Transduction, Agrobacterium mediated transfer, Gene gun, Microinjection, Lipofection, Electroporation.

Unit – 4: Screening Of Recombinants

Screening of recombinants - Insertional inactivation (antibiotic resistance, blue white selection) colony hybridization, immunological screening. Blotting techniques - Southern, Northern, Western.

Unit – 5: Techniques

PCR - Basic principle & applications.RAPD,RFLP. DNA sequencing - Chemical & Enzymatic methods. NGS. Site - directed mutagenesis – (Brief account only). Hazards & Safety aspects of genetic engineering.

Current Streams of Thought

(Not for final Examination only for discussion)

Review on prospects and future on GMOs - Controversy about production of genetically modified food discussion/ debate - Review and debate on impact of genetically engineered microbes and crops on biodiversity.

Text Books:

1. Brown, T.A. (2016).*Gene Cloning and DNAanalysis.* 7th edition. By American Society for Microbiology press.
2. Glick &Pasteneuk. (2017).*Molecular Biotechnology*: Principles and Applications of Recombinant DNA 5/e.

Supplementary Books:

1. Desmond, S. T. Nicholl. (2010). *An Introduction to Genetic Engineering*. Cambridge University Press.
2. Manorma Singh. (2008).*Molecular Biology of Genetics*. Discovery Publishing House.
3. Peter J Russell. (2016).*Genetics: A Molecular Approach*. 3rd edition Benjamin - Cummings Publishing Company.
4. Bernard R. Glick and Jack J.Pasternak. (2017). *Molecular Biotechnology*. (2017). 7th edition by American Society for Microbiology press.

Web References:

1. www.onlinebiologynotes.com
2. www.biologydiscussion.com
3. www.biotechnologynotes.com
4. https://www.genome.gov.

5. https://www.biotecharticles.com

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	2	3	2	3	3	3	1

Semester	19IMICC63: IPR, Biosafety & Bioethics	L	P	C
VI		5	-	5

Learning Objective (LO):

LO	To learn the basic concepts of Intellectual Property Rights, patents and awareness about Bio safety and ethics.

ourse Outcomes (CO):

Upon successful completion of the course, the students will be able to:

CO1:	Understand the concepts, criteria and importance of IPR and patents.
CO2:	Understand agreements, treaties and recent amendments.
CO3:	Explain logics and concepts of patents.
CO4:	Follow Biosafety practices in a Laboratory.
CO5:	Understand the principles of bioethics.

Unit – 1: IPR - Types And Functions

Introduction to Intellectual Property - IPR Definition - Types: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, IP as a factor in R&D; IPs of relevance to Microbiology / Biotechnology and few Case Studies WTO - Definition - Functions - Forms of IPR Protection.

Unit – 2: Agreements And Treaties

Agreements and Treaties - History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & Recent Amendments.

Unit – 3: Types And Applications Of Patents

Basics of Patents and Concept of Prior Art IPR & edits. Introduction to Patents; Types of Patent Applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and Complete; Process of Patenting, Indian and International Agencies Involved in IPR & Patenting, Global Scenario of Patents and India's Position, Patenting of biological material, GLP, GMP.

Unit – 4: Biosafety

Biosafety – Introduction. Different levels of biosafety. Guidelines for Recombinant DNA Research Activities in Microorganisms. Good Laboratory Practices (GLP). Containments – Types. Basic Laboratory and Maximum Containment microbiology Laboratory research.

Unit – 5: Bioethics

Bioethics - Definition – Principles of Bio ethics – General Issues Related to Environmental release of Genetically Modified Microorganisms. Ethical Issues Related to the use of Animal as Models for Microbial Diseases - Animal ethics Norms in India - Licensing of Animal House - Ethical Clearance Norms for Conducting Studies on Human Subjects. Ethical Issues Related to Research in Embryonic Stem Cell research.

Current Streams of Thought

(Not for final Examination only for discussion)

Ethical concerns in human gene therapy - Ethical issues at the beginning of life, Ethical issues at the end of life. Daily news and research paper on IPR.

Interactive sessions depicting the role of GLP

Text Books:

1. John Bryant (2005). *Bioethics for Scientists*. John Wiley and Sons.
2. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007.

Supplementary Books:

1. BAREACT.(2007).*Indian Patent Act 1970 Acts & Rules.* Universal Law Publishing Co. Pvt. Ltd.,
2. Christian Lenk, Nils Hoppe, Roberto Andorno. (2007). *Ethics and Law of Intellectual Property: Current Problems in Politics*, Science and Technology, Ashgate Publisher (p) Ltd.
3. Felix Thiele, Richard E. Ashcroft. (2005). *Bioethics in a Small World*. Springer.
4. Glick, B.R., and Pasternak. (2009).*Molecular Biotechnology.* 4th Edition, J.J., ASM Press, Washington, DC.

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	2	2	2	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	2	2	3	2	2	2	3	3
CO3	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	2	2	3	2	2	2	3	3
CO5	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3

Semester	19IMICC64: Food & Dairy Microbiology	L	P	C
VI		5	-	5

Learning Objective (LO):

LO	To emphasize the beneficial role of microorganisms in fermented food, contamination, spoilage, preservation of foods and to gain knowledge about food safety and foodborne diseases.

Course Outcomes (CO):

Upon successful completion of the course, the students will be able to:

CO1:	Understand the types of microorganisms in food.
CO2:	Gain knowledge about fermented food.
CO3:	Acquire knowledge about contaminations and spoilage of various food products.
CO4:	Explain food borne diseases.
CO5:	Demonstrate food preservation methods.

Unit – 1: Types Of Microorganisms In Food

Importance of food microbiology - Types of microorganisms in food - Source of contamination (Primary Sources) - Factors influencing microbial growth of food (extrinsic and intrinsic) Regulations in food industry-FSSAI, INFOSAN. FDA, WHO, ISI, EPA.

Unit – 2: Fermented Foods And Enzymes

Food fermentations: Cheese, Bread, Wine, Beer. Fermented vegetables and cereals - Methods and organisms used. Food from microorganisms - Single Cell Protein. Application of enzymes in food production. Fermented Dairy products (Butter milk, Yoghurt, kefir, Kumis, Ice cream and other products).

Unit – 3: Food Spoilage And Preservation

Contamination, Spoilage and preservation of Cereals and Cereals products - Sugar and sugar products - Vegetables and fruits - Meat and meat products - Fish and the Sea foods - Egg and poultry – Dairy.

Unit – 4: Food Borne Diseases

Food borne diseases, intoxication and food poisoning - *Staphylococcus, Clostridium, Vibrio cholerae, Escherichia coli*, *Salmonella*, *Listeria*, Hepatitis, Polio myelitis, Amoebiosis, Giardiasis and Mycotoxins. Enteropathogens. Sea food Toxicants.

Unit – 5: Food Preservation

Food preservation: Principles - Methods of preservation - Physical and chemical methods, Food hygiene, Food sanitation & control. Hazard analysis, Critical control Points and Personnel hygiene, HACCP

Current Streams of Thought

(Not for final Examination only for discussion)

Quiz on Prebiotics, Probiotics and synbiotics; advantage of probiotics, Field trip to food, dairy and beverage industries. Analysis of microbiological quality of milk and other food products - Algal and mycotoxin detection in food samples.- Government regulatory practices and policies FDA,EPA,ISI. Daily news and research papers on food borne outbreaks and food preservation

Text Books:

1. Adams, M.R. and M.O Moss. (2008).*Food Microbiology.*The Royal Society of Chemistry, Cambridge.
2. Doyle, M.P. (2005). *Handbook of Hygiene Control in the Food Industry*. 1nd Edn. Woodhead Publishing.
3. Frazier, W.C and Westhoff, D.C.(2013). *Food Microbiology*. TATA McGraw Hill Publishing Company Ltd. New Delhi.

Supplementary Books:

1. Jay, J.M.(2013). *Modern Food Microbiology*. 7th Edn. CBS Publishers and Distributors, New Delhi.
2. Stanbury, P.F., Whittaker, A. and Hall, S.J., (2009). *Principles of fermentation technology.* 2nd edition, Pergamon press.

Web References:

1. http://site.iugaza.edu.ps/mwhindi/files/ebooksclub.org__Principles_of_Fermentation_Technology.pdf
2. https://www.sciencedirect.com/topics/food-science/food-fermentation

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	2	2	3	3	3	2	2	2
CO4	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3

Semester	19IMICP65: PRACTICAL – 5	L	P	C
VI	(Industrial Microbiology, Genetic Engineering, IPR, Bio Safety & Bioethics, Food & Dairy Microbiology)	-	12	6

Learning Objective (LO):

LO	To acquire skills to produce industrially important products through fermentation, genetic engineering techniques and to analyze the spoilage causing microbes in different foods.

Course Outcomes (CO):

After the completion of course, the students will be able to:

CO1:	Produce industrially important products through fermentation.
CO2:	Perform genetic engineering techniques.
CO3:	Identify spoilage organisms from different food samples.
CO4:	Perform sterility checking.
CO5:	Isolate lactic acid bacteria from different sources.

Practicals:

1. Wine production
2. Crowded plate techniques
3. Immobilization technique (Sodium alginate method).
4. Restriction digestion.
5. PCR
6. Western Blotting (Demo).
7. Essential Bio safety equipment.
8. Health and Medical surveillance
   - Personal Protection
   - Waste Handling
9. Study of spoiled of Vegetables & Fruits.
10. Examination of Unspoiled canned foods for sterility and quality.
11. Study of spoiled Sea foods.

12. Study of spoiled of Eggs.
13. Effect of sodium chloride on the growth of food.
14. Effect of sucrose on the growth of food Microflora.
15. Bread making.
16. Direct Microscopic counting of bacteria in Milk& Curd.
17. Isolation of lactic acid bacteria from curd.

References:

1. Kannan, N.(2002).*Laboratory manual in General Microbiology*
2. Merck. (2000).*Microbiology Manual* .12th edition
3. Cappuccino& Natalie Sherman.(2014).*Microbiology A laboratory Manual*.10th edition
4. Rajan, S., &Selvi Christy. R.(2010).*Experimental procedures in life sciences*.1st edition.

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3	3	2	3	2	3
CO2	3	3	3	3	3	2	2	2	2	3	3	2	3	2	3
CO3	3	3	3	3	3	3	2	2	2	3	3	2	3	2	3
CO4	3	3	3	3	3	3	2	2	2	3	3	2	3	2	3
CO5	3	3	3	3	3	3	3	3	3	3	3	2	3	2	3

Semester	19IMICF60: Experiential Learning	L	P	C
VI		-	4	2

Students are provided with an opportunity to learn about the application of microbiology in various industries by visiting, food and dairy industries, biofertilizer production units, blood banks, clinical laboratories, and different industries.

Semester	19IMICC71: General Microbiology	L	P	C
VII		4	-	4

Learning Objective (LO):

LO	To learn about the general characteristics of different types of bacteria, bacterial respiration and to understand microbial diversity in extreme environments.

Course Outcomes (CO):

Upon successful completion of the course, the students will be able to:

CO1:	Gain knowledge about the Classification of microorganisms.
CO2:	Appreciate the principles and applications of microscopes.
CO3:	Understand the structural features of bacteria, Protozoa, Algae, Fungi and Viruses.
CO4:	Understand the metabolism of microorganisms.
CO5:	Understand the microbial diversity in extreme environments

Unit – 1: History of Microbiology & Classification of Microorganisms

Introduction, History and scope of Microbiology. Recent developments Spontaneous generation – Biogenesis. Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Elie Metchinkoff, Edward Jenner and Fleming. Classification - Haeckel's three kingdom concept, Whittaker's Five-kingdom concept. Classification of Bacteria (Bergey's Manual), Fungi, Algae and Virus.

Unit – 2: Microscopy And Staining Methods

Microscopy**:** Simple, Compound, Dark Field, Phase contrast, Fluorescence and Electron microscopes. (SEM & TEM), Confocal microscopy – Principles and their applications. Staining techniques: Nature of dyes, Simple, Differential and negative and spore staining. Culture methods: Culture media and Nutritional types, Growth curve.

Unit – 3: General Characteristics And Structure Of Bacterial Cell

General characteristics and nature of Archaebacteria, Eubacteria, Cyanobacteria, Mycoplasmas, Rickettsiae, Chlamydias, Spirochaetes, Actinomycetes, Protozoa, Algae, Fungi and Viruses. Cell walls of Gram negative and Gram positive bacteria, Cell wall synthesis, Capsule types, S-layers. Composition and Function. Structure and function of flagella and Pili, Endospore types, structure and functions. Reserve food materials – Polyhydroxy butyrate- Polyphosphate granules- Oil droplets – Cyanophycin granules and Sulphur inclusions. Fungi: Cell wall – Chemical composition and functions.

Unit – 4: Microbial Metabolism

Aerobic respiration- nutritional requirements of Bacteria. Nutritional Types. Glycolysis, ED, TCA, Oxidative and substrate level Phosphorylation, glyoxylate pathway, Gluconeogenesis. Fermentation of carbohydrates - homo and heterolactic fermentations. Photosynthesis - Phototrophy, oxygenic and anoxygenic Photosynthesis.

Unit – 5: Extremophiles

Introduction to microbial biodiversity - distribution, abundance, ecological niche. Survival at extreme environments - Thermophiles, Alkalophiles, Acidophiles and Halophiles. Bioluminescence – Mechanism - Advantages. Space Microbiology aims and objectives of space research.

Text Books:

1. Dubey, R.C. and Maheswari, D.K. (2011). *A Textbook of Microbiology.* S. Chand and Company Ltd., New Delhi.
2. Ananthanarayan. R. and Paniker C.K. (2009).*Text Book of Microbiology.* Orient Longman.
3. Pelczar, Chan &Kreig (2009). Microbiology 5th edition. Tata McGraw Hill, New Delhi.
4. Stanier, R.Y., Ingraham, J.L., Wheels, M.L. and Painter, P.R. (1999). General Microbiology, Mac Millan Educational Limited, London.

Supplementary Books:

1. Willey, Joanne M. (2014). *Prescott's Microbiology*. 9th Edition: McGraw - Hill Education - London.

2. Jawetz, Melnick, &Adelberg's (2013). *Medical Microbiology*. 26th Edition. McGraw - Hill**.**

Web References:

1. https://www.microscopy.co.za/what-is-microscopy
2. https://biologydictionary.net/aerobic-respiration/
3. https://www.livescience.com/51720-photosynthesis.html
4. https://en.wikipedia.org/wiki/Bioluminescence
5. https://biologywise.com/characteristics-of-archaebacteria

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	3	3	2	1	1	3	3	3	2	2	2
CO2	2	3	3	3	1	1	3	1	1	3	3	1	2	3	2
CO3	3	3	3	3	3	3	3	1	1	3	3	1	2	3	2
CO4	3	3	3	3	3	3	3	3	1	3	3	1	2	3	2
CO5	3	3	3	3	3	3	3	3	1	3	3	1	2	3	2

Semester	19IMICC72: Pharmaceutical Chemistry & Pharmaceutical Microbiology	L	P	C
VII		4	-	4

Learning Objective (LO):

LO	To learn about the basic principles of pharmaceutical chemistry and pharmaceutical microbiology

Course Outcomes (CO):

Upon successful completion of the course, the students will be able to:

CO1:	Gain a strong knowledge on Volumetric Analysis.
CO2:	Acquire knowledge about photometric methods and Microbial transformations.
CO3:	Apply the Concepts of pharmaceuticals and biopharmaceuticals.
CO4:	Understand about the bacterial mechanism and action of antibiotics.
CO5:	Apply the Quality Assurance, good laboratory practices in microbiology laboratory.

Unit – 1: Basic Chemistry

Volumetric Analysis – Definition of Mole, Equivalent, Molarity, Normality, Equivalent of Acids, Bases, Oxidising & Reducing agents – Primary and Secondary Standards. Calculations involved in the preparations, Dilutions, Assay and standardization of volumetric solutions. Conversion of Molarity to Normality and vice versa.

Unit – 2: Photometric Methods & Microbial Transformations

Photometric methods – Ultraviolet and Visible Spectrometry: Principle, Electronic transitions, Beer – Lambert's Law, Instrumentation and Pharmaceutical Applications. Spectro fluorimetry - Principle, Mechanism of fluorescence &Phosphorescence. Factors affecting fluorescence intensity. Quenching instrumentation & applications of fluorescence in pharmacy.

Microbial Transformations – Introduction, Methods of transformation, Types of transformation, Oxidation, Reduction, Hydrolysis, Isomerization, hydroxylation. Production of steroids by microbial transformation.

Unit – 3: Biopharmaceuticals

Sources- biopharmaceuticals in production and research, Cytokines, Hormones, Blood products, Therapeutic enzymes (Asparaginase, Streptokinase, β- Lactamase), Antibiotics (Aminoglycosides, Tetracyclines) Synthetic antimicrobial agents - Chloramphenicol, Sulphonamides and Quinolinone antimicrobial agents, Antifungal antibiotics, Antitumor substances, Chemical disinfectants, Antiseptics and Preservatives. Vaccines - New vaccine technology, DNA vaccines, Synthetic peptide vaccines, Multivalent subunit vaccines, vaccine clinical trials. Biosensors in pharmaceuticals. Application of microbial enzymes in pharmaceuticals.

Unit – 4: Mechanism And Action Of Antimicrobial Agents

Mechanism and action of antibiotics (Inhibitors of cell wall synthesis, Nucleic acid and protein synthesis). Molecular principles of drug targeting. Bacterial resistance to antibiotics. Mode of action of bacterial killing by Quinolinones. Mode of action of non – antibiotic antimicrobial agents. Penetrating defenses (Cellular permeability barrier, Cellular transport system and Drug diffusion). Microbial contamination and spoilage of pharmaceutical products (Parenteral and Non parenteral, Ophthalmic preparations and Implants).

Unit – 5: Quality Assurance And Validation

Quality Assurance and Validation - Regulatory aspects of Quality Control (QC), Quality Assurance (QA), Quality Management (QM), Current Good Manufacturing Practices (CGMP), Good Laboratory Practices (GLP) and CMP in Pharma Industry. ISO9000, WHO, USFDA certification. Microbial Limit test of pharma products. Sterility testing, Pyrogen testing and LAL test of Sterile pharma products. Sterilization - heat, D - value, Z - value and Survival curve, Radioactive, Gaseous and Filtration. Chemical and biological indicators. Designing layout for microbiology laboratory and Safety in microbiology laboratory. Market planning.

Current Streams of Thought

(Not for final Examination only for discussion)

Current developments related to drug delivery systems in gene therapy - Discussion on addressing antimicrobial resistance - Antimicrobial drug - Methodologies for testing (in-vivo, in - vitro infectivity models) - Good bacterium is bad news for atherosclerosis (updated quiz) - New drug target for emerging viral diseases.

Text Books:

1. Cassida, J.E. (2007).*Industrial Microbiology*. New Age International.
2. Agarwal, A.K.& Pradeep Parihar.(2006). *Industrial Microbiology*. Published by Student Edition, Behind Nasrani Cinema, Chopasani Road, Jodhpur.
3. Patel, A. H. (2005). *Industrial Microbiology*. Laxmi Publications, New Delhi; Second edition.
4. Douglas A,Skoog, Donald M. James. F. Hall Stanley R. Crouch. (2013).*Fundamentalsof AnalyticalChemistry*. 9th edition, Brooks/Cole Cengage learning; ISBN; 9780495558286.

Supplementary Books:

1. Jain,N.K.*Pharmaceutical Microbiology*. Second edition. (2005). publication: VALLABH Prakasahan, Delhi- ISBN: 81-85731-25-X VPBN-50.
2. DOUGLAS.J.Pisan, David.S.Mantus.(2008).*FDA regulatory affairs.* 2nd Ed Informa health care, New York. ISBN: 9781420073546.

Web references:

1. Pharmacology; action and Uses of Drugs by Maurice VejuxTyrode.
2. Pharmaceuticals Management for Underserved Populations by Johns Hopkins University.
3. http://202.74.245.22:8080/xmlui/bitstream/handle/123456789/1014/Chapter%2012-Sterilization-and-sterility-assurance.pdf?sequence=14
4. https://cdsco.gov.in
5. https://www.fda.gov/cder

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	3	3	3	2	2	3	2	3	3	3	3
CO2	3	3	3	3	2	1	3	2	3	3	2	3	3	2	3
CO3	3	3	3	3	3	3	3	2	2	3	2	3	3	2	3
CO4	3	3	3	3	3	2	3	3	2	3	3	3	3	2	3
CO5	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3

Semester	19IMICC73: Immunology &Immuno Technology	L	P	C
VII		4	-	4

Learning Objective (LO)

LO	To gain an understanding of basic concepts of cells and components of the immune system and immune diagnostic techniques

Course Outcomes (CO)

Upon successful completion of the course, the students will be able to:

CO1:	**Understand the functional organization of the immune system.**
CO2:	Evaluate the interactions between Antigen and Antibodies.
CO3:	Analyze the basis of Immunological disorders.
CO4:	Appreciate the guidelines and methods for sample collection and processing.
CO5:	Understand serological methods for diagnosis of infections.

Unit – 1: Immunity And Immune System

Basic concepts and terminologies in immunology. Haematopoiesis. Types of immunity. Central and Peripheral Lymphoid Organs: structure and functions. Cells of the immune system. Phagocytosis, Maturation and differentiation of T - cell and B - cell T cell and B cell receptor and function.

Unit – 2: Antigen and Antibody Reactions

Antigens: Types, Properties, Haptens, Epitopes, Adjuvants, Auto antigens, Blood group antigens. Immunoglobulin structure, Types, Properties and Function. Theories of antibody production - Clonal selection theory, Antibody diversity. Factors governing Antigen – Antibody interactions - Affinity, Avidity, Valency, Cross reactivity. Hybridoma Technology and Monoclonal Antibodies. Interferons (IFN), Interleukins and its types.

Unit – 3: Immune Disorders

Complement system, Major Histocompatibility Complex- Class I and Class II, MHC structure and function. Transplantation immunity – Organ transplantation and HLA tissue typing. Autoimmune Disorders and immunology of Infectious Disease- Immunity to infection, Hypersensitivity reactions, Immunological tolerance, Immunosuppression, Immunodeficiency disorders. Tumors: Type of tumor antigens, Immune response to tumors,.

Unit – 4: Sample Collection, Processing, Vaccines and Immunotechnology

Guidelines for the collection, Transport, Processing and analysis of clinical specimens Vaccines-Killed and Attenuated, Recombinant, DNA and peptide vaccines, Edible vaccines. Application of immunotechniques- Flow cytometry, Immunoelectron microscopy, Immunohistochemistry and Bioplex array

Unit – 5: Serology

Serology - Serological methods for diagnosis purpose – Agglutination, Immuno diffusion, Widal, VDRL, RPR, ASO, CRP test, Precipitation, Latex Agglutination Test, CFT, ELISA and its types, RIA, CLIA

Current Streams of Thought

(Not for final Examination only for discussion)

Foreign body reaction to biometerials - Immunological biosensors- Review on prospects and future of immunosensors - Quiz: Abzymes, properdin, complement, aggressions - Review and debate on chemotherapy v/s immunotherapy.

Text Books:

1. John P. Harley. (2007).*Microbiology Lab Manual*. 7th edition McGraw Hill Medical publication division.
2. Ramnik sood. (2009).*Laboratary Technology [Methods and interpretation]*. 6thEd. J.P.Bros, New Delhi.
3. Owen, J., Punt, J and Strandford, S. “Kuby. (2012).*Immunology.* 7th Ed., W. H. Freeman Publication, New York, USA.

Supplementary Books:

1. P.J.Delves, SJ.Martin, DR.IM.Roitt.(2011).*Roitt's Essential Immunology*. Blackwell Scientific Publications, Oxford.
2. Rao, C.V. (2008).*Immunology*, Narosa Publishing House, India.
3. T.J.Kindt, RA.Goldsby, BA.Osborne, Janis Kuby. (2008). *Cuby Immunology* III Edn. Panimabook company limited. New Delhi.

Web references:

1. http://www-immuno.path.cam.ac.uk/-immuno/part1.html
2. http://www.Iclark.edu/-reiness/immuno/lectures.html
3. http://www.hhmi.org/biointeractive/immunology/lectures.html
4. http://www.immuneweb.xxmc.edu.cn/immunology/immunology.html

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO4	3	3	3	3	3	2	3	3	2	3	3	3	3	3	3
CO5	3	3	3	3	3	2	3	3	2	3	3	3	3	3	3

Semester	19IMICP74: Practical - 6	L	P	C
VII	(General Microbiology, Pharmaceutical Chemistry & Pharmaceutical Microbiology, Immunology & Immunotechnology)	-	12	6

Learning Objective (LO)

LO	To acquire practical skills in basic microbiological techniques, sterility testing and microbial contamination of pharmaceutical products and to examine Antigen – Antibody reactions by immunological tests.

Course Outcomes (CO)

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

CO1:	Understand the sterilization methods and media preparation.
CO2:	Enumerate bacterial and yeast cells
CO3:	Detect microbial contaminations in pharmaceutical products.
CO4:	Determine antimicrobial activity of chemical compounds.
CO5:	Perform various immunological experiments.

Practicals:

1. Different methods of sterilization.
2. Preparation of Media.
3. Bacterial growth curve – Turbidity measurement.
4. Pure culture techniques.
5. Measurement of microbial cell size – Micrometry.
6. Enumeration of bacterial / yeast cells-viable count (Plate count) Total count (Haemocytometer count).
7. Motility determination - Hanging drop method, soft agar method.
8. Staining methods: Simple, Negative, Acid fast, Gram staining, Spore, Capsule, Metachromatic granular staining, Lactophenol Cotton Blue staining,

9. Fungal slide culture.
10. Sterility testing by *Bacillus sterothermophillus*
11. Sampling of pharmaceuticals for microbial contamination and load
12. Determination of phenol coefficient of chemical compounds
13. Blood group typing - slide method and tube method

14. Identification of leukocytes from blood smear.
15. Precipitation method- Immunodiffusion and Immuno-electrophoresis
16. Latex Agglutination test
17. ELISA
18. Urine Pregnancy test.

References:

1. Kannan, N. (2002). *Laboratory manual in General Microbiology*.
2. Cappuccino and Natalie Sherman.(2014).*Microbiology A laboratory Manual*.10th edition.

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3

Semester	19IMICC81: Bioprocess Technology	L	P	C
VIII		4	-	4

Learning Objective (LO):

LO	To gain knowledge on the principles of fermentation, microbial production of therapeutic compounds and nanoparticles.

Course Outcomes (CO)

On completion of the course students will be able to:

CO1:	Develop an understanding of various aspects of bioprocess technology.
CO2:	Understand the principles of fermentor design and types.
CO3:	Gain knowledge about mass transfer in bioreactors.
CO4:	Evaluate nanotechnology and microbial production of therapeutic compounds.
CO5:	Understand various downstream processing techniques.

Unit – 1: Fermentation Process

An introduction to fermentation process - The range of fermentation process, Chronological development - Component parts of fermentation process - Types of fermentation. Immobilization – Types.

Unit – 2: Fermentors

Fermentor design - Body construction, Individual parts, Fermentors - Stirred tank, Bubble column, Air lift, Tower Fermentors, CSTR. Computers in bioprocess control. Bioprocess control - Control of pH, Foam, pressure, Temperature - Computer application in fermentation technology.

Unit – 3: Mass Transfer and Types

Sterilization of Bioreactors, air and nutrients, Mass transfer in bioreactor. Gas liquid exchange - Mass transfer - Heat transfer - O_2 transfer -

Stirring and mixing - Newtonian, Non Newtonian fluids – Effect of viscosity Scale up, Scale down.

Unit – 4: Production ff Therapeutic Compounds

Microbial production of therapeutic compounds (Antibiotics) - Bioplastics (PHB & PHA) - Biopolymer (Xanthan) – Nanotechnology - Biological synthesis of nanoparticles - Types of nanoparticles - Characterization studies (UV - Visible spectroscopy, FTIR, SEM, TEM, XRD analysis) - Advantages and disadvantages of microbial synthesis of nanoparticles.

Unit – 5: Downstream Processing

Downstream processing - Recovery of intracellular and extracellular products - Biomass separation by centrifugation, Filtration, Flocculation and other recent developments, Cell disintegration - Physical, Chemical and Enzymatic methods. Extraction - Solvent, Two phase, Liquid extraction, Whole broth, Aqueous multiphase extraction - Purification by different methods. Concentration by precipitation, Ultra filtration, Reverse osmosis. Drying and Crystallization.

Current Streams of Thought

(Not for final Examination only for discussion)

Field trip to beverage and pharmacutical industries - Review and debate on Nanoparticles v/s antibiotics - Synergestic action of Nanoparticles and antibiotics - Quiz program related to the fermentor types - Seminar on downstream processing.

Text Books:

1. Michael.J, Wailes, Neil, L.Morgan, John S, Rockey, Gary Higton,A. (2015).*Industrial Microbiology*. *An Introduction* 2nd edition, Sinavous Association, Inosundeland.
2. Patel A H.(2015).*IndustrialMicrobiology* 2/e. Laxmi Publications-New Delhi.
3. W. Clarke. (2016).*Biotechnology: Industrial Microbiology A Textbook*. 1/ed.
4. Cassida,J.E. (2007).*Industrial Microbiology*. New Age International.

5. Peppler, H.J, and Pearlman, D. (2014). *Microbial technology*.vol.11 and 2/e, Elsevier press.

Supplementary Books:

1. Stanbury I.F., Whittakar, A and Hall S.J.(2016). *Principlesoffermentationtechnology*. 3rdEditon, Pergamon press.
2. Prescott and Gunn, S.(2009). *IndustrialMicrobiology*.agrobios publications.
3. Anuj Kumar Rana. (2015).*Downstream*processing*forbiotechnology*. Global Vision Publishing House.

Web references:

1. https://en.wikipedia.org/wiki/Fermentation
2. https://nptel.ac.in/courses/102106022/
3. http://www.understandingnano.com/nanoparticle-synthesis.html
4. http://cdn.intechweb.org/pdfs/13555.pdf

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	2	3	3	2	3
CO4	3	3	3	3	3	3	2	2	3	3	3	3	3	3	2
CO5	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3

Semester	19IMICC82: Bacteriology & Virology	L	P	C
VIII		4	-	4

Learning Objective (LO):

LO	To learn about host - parasite relationship, bacterial and viral diseases, drugs, vaccines and antiviral agents.

Course Outcomes (CO):

Upon successful completion of the course, the students will be able to:

CO1:	Understand host parasite relationships.
CO2:	Evaluate the causes, prevention and management of diseases caused by Gram positive bacteria.
CO3:	Analyze the causes, prevention and management of diseases caused by Gram negative bacteria.
CO4:	Understand properties and classification of Viruses.
CO5:	Gain an insight into viruses and the life cycle and pathogenicity, prevention and treatment of viral diseases.

Unit – 1: Bacteriology

Bacteriology: Indigenous normal microbial flora of human body. Infection – Types, Sources, Mode of transmission etiology, epidemiology. Host parasite relationships - Nonspecific host immune mechanisms. Rules for collection and transportation of clinical specimens for microbiological diagnosis. Nosocomial infection – prevention and treatments. Hospital waste disposal.

Unit – 2: Medically Important Gram Positive Bacteria

Morphology, Classification, Cultural characteristics, Pathogenicity, Laboratory diagnosis, Prevention, Control and treatment of diseases caused by *Staphylococcus aureus, Streptococcus pyogenes, pneumococci, Corynebacterium diphtheriae,*

Mycobacterium tuberculosis, leprae, Clostridium tetani, perfringens and Bacillus anthracis,

Unit – 3: Medically Important Gram Negative Bacteria

Gram negative Bacteria causing human infection – *Vibrio cholerae, Escherichia coli, Proteus vulgaris, Klebsiella pneumoniae, Salmonella typhi & para typhi, Shigella dysentriae, Brucella abortus, Pseudomonas aeruginosa, Yersinia pestis. Neisseriae [Gonococci & Meningococci], Gram negative Anaerobes, Spirochetes, Rickettsia, Chlamydia, Mycoplasma* and *Ureoplasma.* Zoonotic diseases and their control.

Unit – 4: Properties And Classification Of Viruses

Introduction to virology - Properties, Nomenclature, Classification, Morphology and Cultivation. General methods in diagnosis and serology, viroids, prions, satellite RNAs and virusoids. Newly emerging viruses - Corona virus, SARS virus, Swine flu and Dengue virus.

Unit – 5: Viral Diseases

Life cycle, Pathogenicity, diagnosis, prevention and treatment of DNA & RNA viruses - Pox viruses, Herpes viruses, Adeno viruses, Papova virus, Polio virus, Hepatitis viruses (A – E), Picorna, Orthomyxo, Paramyxo, Toga and other arthropod borne viruses, Rhabdo, Rota and HIV, Ebola virus, Zikavirus, Rabies virus, Oncogenic viruses. Viroids, Prions, Satellite RNAs, Virusoids. Viral vaccines and Antiviral agents.

Current Streams of Thought

(Not for final Examination only for discussion)

Role of cell signaling and quorum sensing in microbial diseases - Keeping track of recent outbreaks of bacterial and viral diseases through daily news and research paper - Awareness program on personal hygiene, vaccination, contagious and emerging microbial diseases - Application of CRISPR / Cas 9 (deciphering mechanisms of HIV1 persistence) - Potential of engineered Antibody for HIV 1 therapy and cure. Small RNAs - to treat HIV - 1 infection by gene therapy.

Text Books:

1. Ananthanarayan.R. and Paniker C.K.J Text book of Microbiology, orient Longman,2013
2. Ram Reddy, Essentials of Virology, 2017.

3. Baijayanthi Mala Mishra, Text book of Medical Virology, CBS Publisher and Distributor Pvt. Limited, 2018.
4. Paul Hyman &Srephen T. Abedon, Viruses of microorganisms, Caister academic Press, 2018.

Supplementary Books:

1. Paul G Western, MV Michael Valentine. (2016).*Essentials of Bacteriology*. Wentworth press.
2. Paul Hyman & Stephen T. Adedon, Coasster. (2018).*Viruses of Microorganisms.* Academic Press.

Web references:

1. http:// www.virology.net/garryfavwebaids.html
2. http:// www. virology.net/garryfavwebaids.html≠genaids
3. http:// www.bact.wisc.edu/bact330
4. http:// www.bact.wise.edu/microtextbook/
5. http:// www.textbook of bacteriology.net/

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3

Semester	19IMICC83: Mycology & Parasitology	L	P	C
VIII		4	-	4

Learning Objective (LO):

LO	To acquire knowledge of fungal and parasitic diseases, etiology, diagnosis and treatment.

Course Outcomes (CO):

After the course the student will be able to:

CO1:	Gain knowledge about mycology and classification of fungi.
CO2:	Understand the etiology diagnosis and management of the different fungal infections.
CO3:	Evaluate the Life cycle and pathogenicity of the most important parasitic protozoa.
CO4:	Analyze life cycle and pathogenicity of helminthes**.**
CO5:	Understand common lab techniques used in the identification of parasites.

Unit – 1: Mycology

Historical introduction to mycology - Morphology – Taxonomy - Classification of fungi - Isolation and Identification of fungi from clinical specimens. Mycotoxins and Mycetism. Antifungal agents - Testing methods and quality control.

Unit – 2: Fungal Diseases

Superficial mycosis - Tinea, Piedra- Dimorphic fungi causing systemic mycosis - Blastomycosis and Histoplasmosis - Cutaneous mycosis – Dermatophytosis. Subcutaneous mycosis - Sporotrichosis, Mycetoma, Rhinosporidiosis. Opportunistic mycosis- Candidiasis, Cryptococcosis and Aspergillosis.

Unit – 3: Parasites – Protozoan Diseases

Introduction and classification of parasites, Transmission life cycle, Lab diagnosis and treatment for the following Protozoa - Intestinal amoebae - *Entamoeba histolytica, E.coli.* Free living *Amoebae – Naegleria fowleri, Acanthamoeba spp.*

Intestinal and Genital flagellates – *Giardia lamblia, Trichomonas vaginalis.* Blood and tissue flagellates - *Leishmania donovani, Trypanosoma brucei, Haemosporina* - Malarial parasite. Coccidian – *Toxoplasma gondii, Cryptosporidium parvum.*

Unit – 4: Parasites – Helminths

Infection of helminthes -*Taenia solium, T.saginata, Fasciola hepatica, Paragonimus westermani* and *Schistosoma haematobium, Ascaris lumbricoides, Ancyclostoma duodenale, Trichuris trichiura, Enterobius vermicularis,* and *Wuchereria bancrofti.*

Unit – 5: Laboratory Techniques In Parasitology

Laboratory techniques in Parasitology - Examination of faeces - Direct and concentration methods - Blood smear examination - Cultivation of protozoan parasites, serology and PCR techniques. Antiparasitic drugs.

Current Streams of Thought

(Not for final Examination only for discussion)

Mold infections; Determination of identity of medically important fungi; and diseases (eg - modern techniques like PCH and MALDI - TOF for fungal diagnosis and differentiation); fungal biofilms; fungal toxins - Health and economic significance - Organoids - new models for host - helminth interactions - Awareness program on contagious fungal and parasitic diseases - antiworm medication and personal hygine.

Text Books:

1. Jagdishchander. (2017). *Text book of Medical Mycology*, 4th edition, Taypee Publisher.
2. Gopinathhait. (2017).*A Text book of Mycology*, New central book agency (NCBA).
3. JayaramPaniker, .C. K. (2013). *Paniker'sTextbook of Medical Parasitology*, 7th edition, Jaypee Brothers Medical Publishers (P) Ltd.

Supplementary Books:

1. Errolraiss H. Jeanshadorry, G. Mashallyon. (2014).*Fundamental Medical Mycology*, Weiley Blackwell.
2. Russel F. Cheadle and Ruth Leventhal. (2011).*Medical Parasitology*.

Web References:

1. http://dmoz.org/Science/Biology/Microbiolg y//
2. http://cal.vet.upenn.edu/parasite/links.html
3. http://www.biosci.ohio-state.edu/-zoology/parasite/home.html
4. http:// www.cellsalive.com/ecoli.html
5. http:// www. Pitt.edu/-super1/lecture/lec4771/

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	2	2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	1	2	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	1	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Semester	19IMICP84: Practical - 7	L	P	C
VIII	(Bioprocess Technology, Bacteriology & Virology, Mycology & Parasitology)	-	12	6

Learning Objective (LO):

LO	To acquire skills for the production and recovery of products from microorganisms and steps to identify pathogens from clinical samples.

Course Outcomes (CO)

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

CO1:	Produce microbial metabolites by fermentation.
CO2:	Identify pathogens from clinical samples.
CO3:	Identify the fungi from clinical samples.
CO4:	Identify the Parasites, eggs & Larvae from Processed samples

Practicals:

1. Screening of antibiotic producing microorganisms from soil.
2. Screening of enzyme producing microorganisms.
3. Solid state fermentation and Submerged fermentation.
4. Production of alcoholic beverages.
5. Production of Citric acid.
6. Production of enzymes – Protease / Amylase / Lipase
7. Purification of enzymes.
8. Immobilization techniques.
9. Identification of pathogenic microorganisms from a given samples
    a. Pus
    b. Blood
    c. Urine
    d. Stool
    e. Sputum

10. Egg inoculation techniques
11. Spotters of Viral inclusions and CPE – stained smears.
12. Skin/nail scrapings for fungi isolation.
13. Lactophenol Cotton Blue mount for identification of fungi.
14. Cultivation fungi from clinical specimens.
15. Germ tube test for yeast.
16. Sugar assimilation test for yeast.
17. Isolation of ova / cyst from faeces
18. Spotters of Anopheles, Glossina, Ticks, Mites, Sand fly.
19. Blood smear examination of malarial parasites.

References:

1. Kannan, N. Laboratory manual in General Microbiology (2002).
2. Sundararajan, T. Microbiology laboratory manual. 2nd edition (2007).
3. Rajan, S., & Selvi Christy. R., Experimental procedures in life sciences.1st edition (2010).

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	2	3	1	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3

Semester	19IMICC91: Molecular Biology & Recombinant Dna Technology	L	P	C
IX		4	-	4

Learning Objective (LO):

LO	To gain knowledge about the basic principles of molecular biology and advanced gene manipulation techniques.

Course Outcomes (CO)

On completion of the course the students will be able to:

CO1:	Understand DNA structure and Protein interactions.
CO2:	Appreciate the hierarchical organization of DNA and DNA replication.
CO3:	Gain an insight into the mechanism of transcription and translation and regulation of gene expression.
CO4:	Evaluate the strategies in gene cloning.
CO5:	Appreciate the applications of rDNA technology.

Unit – 1: Structure and Properties of DNA/ RNA

Concept of molecular biology - DNA Structure: Chemistry of DNA, Forms of DNA, Physical properties of Double stranded DNA and DNA topology. DNA – Protein interactions. RNA – types and structure.

Unit – 2: Organization of DNA and Replication

Organization of DNA into chromosomes: Packaging of DNA and organization of chromosome in bacterial cells, Packaging of DNA in Eukaryotic nucleosome and Chromatin condensation. DNA Replication in Prokaryotes and Eukaryotes. Types of DNA polymerase, replication of nucleic acid in viruses. Inhibitors of DNA replication. DNA damage and repair.

Unit – 3: Transcription and Translation

Transcription, Translation, Regulation of gene expression in prokaryotes: Operon concept - Positive regulation (*E. coli ara* operon) and Negative regulation (*E. coli* - *lac* operon). Regulation by attenuation – *his* and *trp* operons. Anti terminators. RNAi, Regulation of gene expression in Eukaryotes- Transcriptional, Translational and Processing level, control mechanism.

Unit – 4: Gene Cloning Process

Concept and Importance of genetic engineering, General strategies and steps involved in gene cloning. Extraction and Purification of DNA from bacteria, plant and animal cells. mRNA and cDNA preparation, Cloning vectors: – types – Bacteriophage vectors- Host systems.

Unit – 5: Transgenesis and rDNA Applications

Transgenic plants, Transgenic animals. Knock out mice. Gene therapy. Recombinant products - Recombinant hormones, Recombinant vaccines. Genetic engineering guidelines, Containment levels. Indian guidelines. Applications of Genomics and Proteomics.

Current Streams of Thought

(Not for final Examination only for discussion)

Review on prospects and future on GMOs - Controversy about production of genetically modified food discussion/ debate - Genome editing techniques (in embryo) - seminar on Biomedical tattoo - Review and debate on impact of genetically engineered microbes and crops on biodiversity.

Text Books:

1. An introduction to genetic engineering. 2010. Desmond S.T Nicholl, Cambridge University Press.
2. Molecular biology of Genetics.2008.ManoramaSingh,Discovery Publishing House.
3. Introduction to genetics: A molecular approach, T.A. Brown, Garland Science, 2011.

Supplementary Books:

4. James. D. Watson, Tania A. Baker, Stephen P. Bell and Alexander Gann 2013, Molecular biology of the gene,7th edition, Pearson publication.

5. Watson JD, Hopkins NH, Roberts JW, Steitz JA, Weiner AM. 2013. Molecular Biology of the gene, 7th edition, Benjamin/Cummings publishing company.
6. Molecular Biology of the Gene (7th Edition, J.D.Watson, Tania A. Baker, Stephen P. Bell , Michael Levine, Richard Losick) Benjamin/Cummings Publ. Co., Inc., California, 2013.
7. Genes XI (9th Edition) Benjamin Lewin, Jones & Bartlett Learning, 2008.

Web References:

1. https://link.springer.com
2. https://opentextbc.ca>biology>
3. https://www.scienceabc.com
4. https://www2.le.ac.UK>vgec>topics>
5. https://study.com>academy
6. https://www.sciencedaily.com

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	2	3	2	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Semester	19IMICC92: Biofuel & Bioenergy	L	P	C
IX		4	-	4

Learning Objective (LO):

LO	To understand the basic principles of Biofuels, Bioenergy and their applications.

Course Outcomes (CO)

On the completion of course the students will able to:

CO1:	Acquire knowledge about classification of biofuels.
CO2:	Evaluate the utilization of alternative feed stock for biogas and biofuel production.
CO3:	Analyze renewable and non – renewable energy sources and energy management.
CO4:	Develop an understanding of utilization of biomass for energy production.
CO5:	Understand bioelectricity generation from microbes.

Unit – 1: Classification and types of biofuels

Introduction, Classification of biofuels - liquid and gaseous. Gaseous biofuel, biogas and biohydrogen. Liquid biofuels - Bio ethanol, Bio diesel. Bio gas plants - Types – Construction details - Loading of biogas plants - Biogas requirement for various use - Biogas applications - Dual fuel engine.

Unit – 2: Applications of biofuels

Alternative feedstock for biofuels. Effective use of Agricultural, Horticultural, Forest and fishery wastes and byproducts as an alternative feed stock for biogas plants – Bio digested slurry - Manurial value - Enrichment - Pelletization.

Unit – 3: Biomass briquetting and alcohol production

Biomass briquetting - Coir pith groundnut shell etc., Alcohol from Sweet sorghum, Tapioca, Sweet potato -Producer gas - Aqua gas, Pyrolytic gas from biomass such as Maize cob, Groundnut husk, Cotton stalk, Briquettes.

Unit – 4: Bioenergy and utilization

Energy - Renewable and non - Renewable energy - Energy plantations - Latex producing plants - Nuclear energy - Energy management and use.

Unit – 5: Bioenergy production

Utilization of biomass for energy production. Fast growing biomass species as energy source - Solid, Liquid, Gaseous energy production from biomass and its use. Hydrogen Production, Utilization - Biofuel cells, Bioelectricity generation from microbes.

Current Streams of Thought

(Not for final Examination only for discussion)

Assignment related to Biofuels and biogas from different raw materials - Mini project in various research topics - Group discussion about the wide applications of biofuels - Field visit to bioenergy/ biogas/ biofuel industry.

Text Books:

1. Ozcan Konur Bioenergy and Biofuels1st Edition 2018. CRC Press.
2. Anju Dahiya Bioenergy: Biomass to Biofuels. 2014 Academic press.
3. FW Bai, CG Liu, H Huang, G T Tsao, Biotechnology in China III: Biofuels and Bioenergy: 3 (Advances in Biochemical Engineering/Biotechnology) 2014, Springer press.
4. Vaughn C. Nelson, Kenneth L. Starcher. Introduction to Bioenergy 2016 CRC Press.

Supplementary Books:

5. V. K. Gupta, M. Tuohy, C. P Kubicek, J Saddler, Feng Xu, Bioenergy Research: Advances and Applications, 2014, Elsevier press.

Web References:

1. https://study.com>academy
2. www.bioconstruct.com
3. https://onlinelibrary.willey.com
4. www.ieabioenergy.com , https;//energypedia.info

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1:	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3
CO2:	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3:	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3
CO4:	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5:	2	3	3	3	3	3	3	2	3	3	3	3	3	3	3

Semester	19IMICC93: Microbial Inoculants & Mushroom Technology	L	P	C
IX		4	-	4

Learning Objective (LO):

LO	To learn about the production and distribution of biofertilizers and to understand about mushroom cultivation techniques.

Course Outcomes (CO)

After the completion of the course the students will be able to:

CO1:	Appreciate the importance of microbial inoculants and biofertilizers in agriculture.
CO2:	Understand the cultivation and production methods for biofertilizers.
CO3:	Differentiate types of mushrooms cultivated around the world.
CO4:	Understand the cultivation of different types of mushroom.

Unit – 1: Introduction and Fungal Biofertilizers

Introduction to biofertilizers, types, advantages and application. Fungal Biofertilizers - Ectomycorrhizal association with pines: Vescicular Arbuscular Mycorrizal Association (VAM) – *Glomus* sp:

Unit – 2: Bacterial Biofertilizers

Bacterial Biofertilizers - Free living forms: *Azotobacter, Azospirillum*: Symbiotic forms: *Rhizobium* - Legume Association: *Pseudomanas*, Nonlegume association.

Unit – 3: BGA and Actinomycetes biofertilizers

Cyanobacterial Biofertilizers - *Nostoc, Anabaena, Gloeocaps* and *Scytonema*. Symbiotic association with *Azolla*; Actimomycetes as Biofertilizers - Actinomycetes associations - *Frankia* sp.

Unit – 4: Mushroom and types

Edible and non-edible mushroom (Historical account, most commonly cultivated mushrooms in the world, Distribution and production in various countries). Poisonous mushroom, identification and effect on human health.

Unit – 5: Mushroom Cultivation

Cultivation of button mushroom - Morphology raising a pure culture & Spawn preparation. Preparation of compost & Cultivation *of Agaricus bisporus, Pleurotus flabelltus* harvest. Cultivation of oyster and paddy straw mushroom - Preparation of pure culture & Spawn cultivation methods, Harvest.

Current Streams of Thought

(Not for final Examination only for discussion)

Mushroom research and development in improving yield and reducing contamination wastage; present status of mushroom industry in India - Novel technologies for high priced mushroom cultivation, preservation - global medicinal values of various mushrooms – importance of various biofertilizers; ill effects of chemical fertilizers (All aspects). Steps to promote biofertilizer usage among farmers. Meeting of local entrepreneurs involved in mushroom and biofertilizer production.

Text Books:

1. S Biswas, M. Datta and S.V. Ngachan Mushrooms: A Manual for Cultivation, 2012, PHI Learning Private Limited.
2. Dhar and Kaul, Biology and Cultivation or Edible Mushrooms, 2007, Westville Publishing House.
3. Mahendra Rai, Handbook of Microbial Biofertilizers, 2008, CRC Press.

Supplementary Books:

4. Rao, N.S., 2007. Biofertilizers in Agriculture. Oxford & IBH Publishing Co., Pvt., Ltd., Bombay.
5. Totawat, K.L., Somani, L.L., Sharma, R.A. and Maloo, S.R., 2008. Biofertilizers Technology. Agrotech Publishing Academy. Udaipur, Rajasthan.

Web References:

1. http://www.csir.res.in/ruralsectors/button-mushroom-cultivation
2. https://www.crcpress.com/Handbook-of-Microbial-Biofertilizers/Rai/p/book/9781560222705
3. http://www.fungaldiversity.org/fdp/sfdp/FD38-2.pdf
4. https://www.jstor.org/stable/4354403

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	2	1	3	3	3	3	3	2	3
CO3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3

Semester	19IMICC94: Bioinstrumentation & Research Methodology	L	P	C
IX		4	-	4

Learning Objective (LO):

LO	To learn the fundamentals of research methodology, working principles and applications of instruments used in biology.

Course Outcomes (CO)

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

CO1:	Appreciate the working principles and applications of Microscopy.
CO2:	Understand principles and applications of spectroscopy, centrifugation.
CO3:	Evaluate the various types & applications of chromatography and electrophoresis.
CO4:	Understand the methodology of doing research.
CO5:	Understand the mechanics of thesis writing.

Unit – 1: Microscopy

Light Microscopy - Microscopic optics, Components of microscopes. Basic principles and types of Bright field, Dark field, Phase contrast. Fluorescence, Polarization and Confocal microscopes and their applications. Immunofluorescence – Flow Cytometer – Immuno Electron Microscope - In situ hybridization. Electron Microscopy - Principle, Techniques and applications of Transmission Electron Microscope (TEM) and Scanning Electron Microscope (SEM).

Unit – 2: Spectroscopy, Centrifugation & Radioactivity

Spectroscopic methods - UV-Visible, Atomic Absorption and Atomic Emission Spectroscopy. Centrifugation - Principles and types centrifugation Radioactive Analysis: Principles of radioactivity, GM counter & LS counter.

Unit – 3: Chromatography &Electrophoresis

Theory, principles and applications of Paper, Thin layer, Gel filtration, Ion exchange, Affinity, GC and HPLC methods. Electrophoresis - Principle, types and methods. Horizontal, Vertical, PAGE, Agarose electrophoresis, Blotting techniques and its Applications. Pulse Field Gel Electrophoresis (PFGE) - Principle and applications. Gel Documentation and molecular weight analysis.

Unit – 4: Research Methodology

Research Methodology - Meaning and importance. Statement, Constraints, Review of literature - Review and synopsis presentation. Types of research, Research tools, Qualities of a good researcher. Research process, Research designs - Experimental and non-experimental. Preparation of research report. Guidelines for preparing an article. Impact factor, Citation index, h-index, i-10 index, Scopus, Web of science. Computers in biological research.

Unit – 5: Guidelines For Thesis Writing

Thesis writing - Defining research problem, Research design, General format, Literature survey, Primary source - Articles, Reviews, Abstract, Current contents (both text and CCOD), Reference card, Data analysis, Data interpretation, Report writing, Proof correction.

Current Streams of Thought

(Not for final Examination only for discussion)

Seminar/ assignment on thesis writing- Keeping track of advances in instrumentation techniques - Statistical methods used in biology - Current developments in instrumentation techniques through internet, webinars and discussions - Quiz about the principle and application of instruments used in biology.

Text Books:

1. Baltz Demain,R.H., A.L., and Davies, J.E. (2010). *Manual of Industrial Microbiology & Biotechnology.*ASM Press.
2. Murphy, D.B., and Davidson, M.W. (2012) *Fundamentals of Light Microscopy and Electronic Imaging,* Wiley-Blackwell.

3. Kothari, C.R, (2013). *Research methodology Methods and Techniques,* New Age International Pvt. Ltd Publishers., New Delhi.

Supplementary Books:

1. John, G., Webster. (2008). *Bioinstrumentation.* University of Wisconsin, John Wiley & Sons, Inc.
2. Anderson, J., Durosn, B.H., and Poole, M. (2011). *Thesis and assignment writing*, Wiley Eastern Ltd., New Delhi.

Web References:

1. https://libguides.wits.ac.za/c.php?g=693518&p=4914913
2. https://explorable.com/defining-a-research-problem
3. https://www.sciencedirect.com/book/9780127843094/spectroscopic-methods-of-analysis
4. https://en.wikipedia.org/wiki/Bioinstrumentation
5. http://www.asmscience.org/content/book/10.1128/9781555816827

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	2	3	3	3	3	3	2
CO2	3	3	3	3	3	3	3	2	3	3	3	3	2	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3

Semester	19IMICP95: PRACTICAL - 8	L	P	C
IX	(Molecular Biology & Recombinant Dna Technology, Biofuel & Bioenergy, Microbial Inoculants And Mushroom Technology, Bioinstrumentation & Research Methodology)	-	12	6

Learning Objective (LO):

LO	To acquire skills to perform techniques in recombinant DNA technology, biomass briquetting, biogas production, biofertilizers, mushroom cultivation and chromatography techniques.

Course Outcomes (CO)

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

CO1:	Isolate genomic and plasmid DNA and undertake Molecular biology experiments.
CO2:	Quantify biogas and analyze biogas slurry.
CO3:	Cultivate Mushrooms.
CO4:	Undertake biomass briquetting uses coir pith, groundnut cake and bagasse.

Practicals:

1. Genomic DNA Isolation.
2. Plasmid DNA Isolation.
3. Restriction digestion.
4. Transformation.
5. Conjugation.
6. PCR
7. RAPD Fingerprinting.

8. Southern and Northern Blotting.
9. Quantification of biogas from different feedstock.
10. Analysis of nutritive value of biogas slurry.
11. Biomass briquetting – Coir pith, Groundnut cake, Bagasse.
12. Cultivation of button mushroom.
13. Cultivation of Oyster mushroom.
14. Production of microbial inoculants.
15. Cultivation of *Azolla.*
16. Separation of microbial cells using centrifugation
17. Production of buffer solutions and pH Measurements.
18. Protein estimation by spectrophotometric method.
19. Paper Chromatography.
20. Thin Layer Chromatography.
21. Preparation of molar solutions.

References:

1. Merck. (2000). *Microbiology Manual.*12th edition.
2. Cappuccino. and Natalie Sherman. (2014).*Microbiology A laboratory Manual.*10th edition.
3. Oelkers, P. (2016)10th*Molecular biology lab manual laboratory manual.*10thedition.
4. Sundararajan, T. (2007) *Microbiology laboratory manual*.2nd edition.

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	2	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	3	3	3	3	3	2

Semester	19IPSC090- Constitution Of India	L	P	C
IX		2	-	2

Learning Objective (LO):

LO	To understand the basic features of Indian Constitution. To grasp about the basic Rights & duties of Indian Citizenry To ponder over the form of Indian Political System. To have broad understanding about the pivotal provisions related with liberty, Equality and fraternity.

Course Outcomes (CO)

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

CO1:	Imbibed about the basic features of Indian Political System.
CO2:	Enlighten with the rights & duties of Indian Citizens.
CO3:	Understand the significance of rule of law.
CO4:	Inculcated with basic liberties.

Unit – 1: Introduction

Meaning of the Constructional law and Constitutionalism – Historical Perspective of the Constitution of India – Salient features Characteristics of the Constitution of India

.**Unit – 2: Rights and Duties**

Scheme of the Fundamental Rights – The scheme of the Fundamental Duties and its legal status – The Directive Principles of State Policy-Its importance and implementation

Unit – 3: Centre State Relationship

Federal Structure and distribution of legislative and financial powers between the union and the states- Parliamentary form of Government in India – The Constitution powers and status of the president of India.

Unit – 4: Amendments and Provisions

The Historical perspectives of the constitutional amendments in India – Emergency Provision: National Emergency, President Rule. Financial Emergency

Unit – 5: Institutions

Judiciary –Judiciary Activism – Amending Procedures- Recent Trends – Rights to Information- Lokpal and LokAyukta

Text Books:

1. Bipan Chandra, Mridula Mukherjee, Adility Makherjee 2016., India after Independence 1947-2000, Penguin Publishers, New Delhi.
2. Durga Das Basu,2018., Introduction to the Constitution of India Prentice Hall, New Delhi.
3. Jogendra Yadav 2000, Transforming India: Dynamics of Democracy, Oxford University Press New Delhi

Supplementary Readings:

1. The Constitution of India 1950 (Bare Act), Government Publications.
2. Busi S.N Ambedkar B.R 2015 Framing of Indian Constitution.
3. Jain M.P 2014 Indian Constitution Law Lexis Nexis.
4. Paul R.Brass 1999 The politics of India Since Independence Cambridge University Press.
5. Granvila Austin 2006 The Indian Constitution: Cornerstone of a Nation, Oxford University Press, New Delhi.

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO2		3	3		2					2			3	3	
CO3		3	2		3	2							3		

Semester	19IMICCX1: Medical Diagnostic Technology	L	P	C
X		4	-	4

Learning Objective (LO):

LO	To learn the diagnostic methods and sample collection to diagnose the disease.

Course Outcomes (CO)

After completion of course students will be able to:

CO1:	Understand laboratory safety precautions, quality assurance and disposal of waste.
CO2:	Understand pathological analysis of clinical specimens.
CO3:	Know about blood grouping and analysis.
CO4:	Perform tissue fixation and staining.

Unit – 1: Laboratory Safety

Organization of laboratory and safety precautions in laboratory and personal cleanliness and care with regards to infected materials and chemical burns. Quality assurance and disposal of wastes. Maintenance of clinical laboratory instruments. Regulatory agencies NABL.

Unit – 2: Analysis of clinical specimens

Sample collection, preservation and transportation of various clinical pathology samples. Pathological analysis of clinical specimens

Unit – 3: Analysis of Blood

Collection and analysis of Blood, Blood cells, Separation of serum, plasma, complete, differential blood counts, platelet count, Determination of ESR, PCV. Blood grouping systems, Rh typing, Blood bank operation.

Unit – 4: Tissue Fixation and Staining

Tissue reception, labeling, fixation for different tissue and section cutting. Preparation of paraffin blocks. Handling and care of microtome sharpening of razors, and section cutting. Preparation of common stains. H & E, Congo red, methyl violet, Leishman stain, Giemsa, VG, PAS, PASM etc. and staining techniques.

Unit – 5: Biochemical Analysis & Serology

Liver, Renal functions and their assessment blood urea estimation, serum uric acid, total protein, albumin, globulin, glucose, cholesterol, bilirubin, estimation. Serological tests - agglutination and precipitation reactions

Current Streams of Thought

(Not for final Examination only for discussion)

APPT, FDP estimation; conventional and rapid methods of isolation and identification of microbes - Record keeping, indexing of slides and mounting museum specimens - Lab visit - Blood bank visit - Keeping track of advances in diagonostic techniques through internet, webinar and discussions.

Text Books:

1. Bros, J.P. (2012). *Satish Gupte, - Short Text book of medical laboratory for technicians*, New Delhi.

Supplementary Books:

1. Todd. and Sanford. (2011). *Clinical Diagnosis by laboratory method*. Nabu Press.
2. Orchard, G. (2011) *Histopathology (Fundamentals of Biomedical Science)*. OUP Oxford.
3. Culling - *Histopathology techniques.*
4. Bain, Dacie and Lewis. (2011). *Practical Haematology*. Elsevier.
5. Ramani Sood. (2009). *Laboratory Technology (Methods andinterpretations*) J.P.Bros, New Delhi. 6th edition.

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	2	3	3	3	3	3	2
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	2	3	3	2	3	2	3	3	2
CO4	3	3	3	2	3	3	3	2	3	3	3	3	3	3	3

Semester	19IMICCX2: Applied Microbiology	L	P	C
X		4	-	4

Learning Objective (LO):

LO	To learn the applications of microbiology in diverse fields.

Course Outcomes (CO)

After completion of course students will be able to:

CO1:	Understand the nature of soil microbial interactions.
CO2:	Gain knowledge about Interactions between plant and microbes.
CO3:	Analyze the cause of various plant diseases and the principles of organic farming.
CO4:	Understand the impact of air and water contamination and evaluate air and water quality.
CO5:	Understand waste types and Bioremediation.

Unit – 1: Microbial Diversity in Soil

Nature of soil - Soil as micro environment. Soil organic matters and humus, Soil and surface environment, Soil pores and movement of gases for microbial activity, Microbes in soil surface and different zones of soil. Decomposition of plant and animal residues by microorganisms in soil.

Unit – 2: Microbial Interactions in Soil

Interactions between plants and microbes – Phyllosphere, Mycorrhizae (Ecto, ,Endo, Ectendo & VAM), Rhizosphere – Symbiotic association in root nodules. Biofertilizers – *Rhizobium*, *Azotobacter, Azospirillum* and *Azolla*. Phosphate solubilising Bacteria. Soil anaerobes - Methanogens in rice field.

Unit – 3: Plant Diseases and Organic Farming

Plant diseases – Bacterial – Brown spot of rice and wilt of potato. Fungal – Leaf Blight of Potato and Red Rot of sugarcane. Viral diseases in cotton, Tomato, Potato, Tungro disease of Rice, Sugarcane Mosaic Virus. Organic farming - Management of nutrient weed, Insect pest and Diseases. Advantages, Limitations and Implications of Organic Farming.

Unit – 4: Air and Water Microbiology

Aero microbiology - A brief account on droplets, droplet nuclei, Aerosols - Air borne microbes and disease. Assessment of air quality. Water microbiology - Water microbial communities - Hydrosphere - Ecology of fresh water, Composition and Activity of fresh water, Microbial communities.

Unit – 5: Waste and Waste Management

Types of waste – Solid and liquid wastes. Treatment of solid waste – Composting, Vermicomposting, Saccharification and Gasification. Production of biogas from waste. Bioremediation – Principles and metabolic pathway for the biodegradation of Xenobiotics - and Hydrocarbons.

Current Streams of Thought

(Not for final Examination only for discussion)

Discussions on biodegradable plastics and super bug - Role of Microalgae and aquatic plants - to decrease radioactive pollution - Emerging plant disease/ pathogens - Applications of GIS and RS in environmental monitoring.

Text Books:

1. Mishra R.R., (2014). Soil Microbiology. CBS Publishers and Distributors, New Delhi.
2. Soil Microbiology 2018 by Prof. N.S. Subba Rao, Fourth Edition, Oxford and Ibh publishing CO.PVT, LTD., New Delhi.
3. Vijaya Ramesh K.E. 2013 Environmental Microbiology MJP publishers Chennai.

Supplementary Books:

4. Modern soil Microbiology, Drik J, Elas V, Trevors JT, Wellington, EMH (2017) Marcel Dekker INC, New York.
5. Microbial Ecology: (2005) Fundamentals and applications, Ronals M, Atlas, fourth edition, Animprint of Addison Wesley Longongman. Inc, California.
6. Shirish H. Sonawane, Y. PydiSetty, T. Bala Narsaiah, S. Srinu Naik 2017. Innovative Te
7. chnologies for the Treatment of Industrial Wastewater: A Sustainable Approach. Apple Academic Press.

Web References:

1. geography.name>the-nature-of the soil
2. https://www.mocroscopemaster.com
3. www.biologydiscussion.com
4. Vikaspedia.in>crop-production>organic
5. www.yourarticlelibrary.com

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1:	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2:	3	3	3	3	2	3	3	3	3	3	3	3	2	3	3
CO3:	3	3	3	3	3	2	3	3	2	3	3	2	3	3	3
CO4:	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO5:	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Semester	19IMICPX3: Practical - 9 (Medical Diagnostic Technology & Applied Microbiology)	L	P	C
X		-	12	6

Learning Objective (LO):

LO	To learn the medical diagnostic techniques, methods to enumerate soil microorganisms, Aeromicrobiology and Water microbiology.

Course Outcomes (CO)

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

CO1:	Enumerate soil microorganisms.
CO2:	Identify free – living nitrogen fixing bacteria and symbiotic N_2 fixing bacteria from soil.
CO3:	Screen phosphate solubilizers from soil.
CO4:	Enumerate airborne microorganisms.
CO5:	Perform diagnostic techniques in microbiology.

Practicals:

1. Different methods of blood collection and preparation of anticoagulant bottles.
2. Cross matching major, minor.
3. Antibiotic Sensitivity Test – MIC, MBC.
4. Anti - Streptolysin “O” test.
5. CRP
6. HB, TC, DC and ESR
7. Analyses of clinical samples urine/sputum
8. Fixing and staining of tissues for pathological examination.
9. Enumeration of microorganism from air- Settle plate technique.
10. Isolation and enumeration of bacteria from soil by serial dilution methods.
11. Isolation and enumeration of Fungi from soil by serial dilution methods.

12. Isolation of free - Living Nitrogen Fixing Bacteria from soil - *Azotobacter.*
13. Cultivation of *Azolla.*
14. Isolation of entomopathogenic fungi
15. Microscopic demonstration of VAM fungi
16. Vermicomposting
17. Isolation of dye degrading organisms

References:

1. Kannan, N. Laboratory manual in General Microbiology (2002).
2. Sundararajan, T. Microbiology laboratory manual. 2nd edition (2007).
3. Rajan, S., & Selvi Christy. R., Experimental procedures in life sciences.1st edition (2010).

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1:	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2:	3	3	3	3	3	3	3	3	3	3	3	2	3	2	3
CO3:	3	3	3	3	3	2	3	2	3	3	2	3	3	3	3
CO4:	3	3	3	3	3	3	3	3	2	3	3	3	3	2	3
CO5:	3	3	3	3	3	3	2	3	3	3	2	3	2	3	3

DEPARTMENT ELECTIVES

Semester	19IMICE15: Techniques In Microbiology	L	P	C
I		3	-	3

Learning Objective (LO):

LO	To learn about working principles of instruments and its applications in biology

Course Outcomes (CO)

After successful end of the course student will be able to:

CO1:	Understand the basic principles, types and application of microscopes.
CO2:	Develop skills on samples preparation by using analytical methods.
CO3:	Gain knowledge about types of instruments and its applications in Microbiology.

Unit – 1: Microbiological Techniques

Media preparation - Pure culture methods (streak plate, spread plate, pour plate, stab culture, slant culture) Staining techniques.

Unit – 2: Spectrophotometer

Calorimetry, Spectroscopic methods – UV - Visible spectrophotometer, Flame photometry, Biosensor.

Unit – 3: Centrifugation

Centrifugation - Principles and types - Low speed, High speed, Ultra centrifuge, differential centrifuge – density gradient centrifugation – application of centrifuge.

Unit – 4: Chromatography

Chromatography – Principles, types and applications of Paper, Thin layer, column, Ion exchange, GC methods.

Unit – 5: Electrophoresis

Electrophoresis - Principle, types – SDS - PAGE and Agarose gel electrophoresis, Blotting Techniques – Southern, Western and northern blotting, Immunoblotting.

Text Books:

1. Wilson, K., Walker, J. M., Hofmann, A., andClokie, S. (2018). *Wilson and Walker's principles and techniques of biochemistry and molecular biology*.: Cambridge University Press.Cambridge
2. Webster,J.G. (2008). *Bioinstrumentation.* John Wiley & Sons.New Jersey

Supplementary Books:

1. Baltz, R. H., Davies, J. E., andDemain, A. L. (2010). *Manual of industrial microbiology and biotechnology*., DC: ASM Press.Washington
2. Pommerville, J. C. (2013). *Alcamo's fundamentals of microbiology*. Jones & Bartlett Learning.Sudbury, MA

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1:	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2
CO2:	3	3	3	3	1	2	3	3	2	1	3	2	3	2	3
CO3:	3	3	3	3	2	3	3	2	3	3	1	3	3	2	3

Semester	19IMICE16: PHYCOLOGY & MYCOLOGY	L	P	C
I		3	-	3

Learning Objective (LO):

LO	To understand the characteristics, classification and economic importance of algae and fungi.

Course Outcomes (CO)

After successful end of the course student will be able to:

CO1:	Know about the classification & characteristics of Algae and Fungi.
CO2:	Know about the economic importance of Algae & Fungi.
CO3:	Gain knowledge about the Algae and fungal products.

Unit – 1: Classification And Morphology Of Algae

Classification – History of Indian Phycology. Habitat – distribution of algae – Freshwater –Marine. Morphology – plastids, pyrenoids, stigma, flagella, nuclear division, growth. Reproduction – sexual – asexual – life cycle.

Unit – 2: Characteristics Of Algae

General characteristics of Cyanophyta – Dinophyta – Crytophyta - Rhodaphyta – Chrysophyta – Bacillariophyta – Xanthophyta – Phaeophyta – Chlorophyta – Charophyta - Euglenophyta.

Unit – 3: Economic Importance Of Algae

Algal protein –Pigments – FAME – Growth promoting substance from microalgae – extracellular polymeric substance – Toxins. Phycoremediation and algal in Transgenics - Algae in Space.

Unit – 4: Classification Of Fungi

Outline of fungal taxonomy, nomenclature and classification and their types Characteristic features in brief of Ascomycetes, Basidiomycetes and Imperfecti fungi.

Unit – 5: Economic Importance Of Fungi

Useful and harmful aspects of fungi: Fungi as food and natural recycler; manures; antibiotics and medicine; fermented products; organic acids and enzymes; pigment production.

Text Books:

1. Alexopoulos, C. J. Mims, C. W., and Blackwell, M. (2014). *Introductory mycology*. Wiley India Pvt.New Delhi
2. Chander, J.(2018). *Text Book of Medical Mycology*. 4th ed.Mehta Publishers.New Delhi
3. Khan M. (1970).*Algae today*, Dehra Dun. Siva Printers, Dehra Dun
4. Sarabhai, B., & Arora, C. (2002). *Textbook of Algae*. Anmol Publications.New Delhi

Supplementary Books:

1. Hoek, C. V. Mann, D. G. & Jahns, H. M. (2002). *Algae: An introduction to phycology*.Cambridge University Press.Cambridge
2. O'Brien, S. J. (1993). *Bacteria, algae, and protozoa*. Cold Spring Harbor Laboratory Press.Cold Spring Harbor, NY

Web References:

1.https://www.easybiologyclass.com/tag/algae/

2. https://www.biologydiscussion.com/algae/algae-definition-characteristics-and-structure-with-diagram/46727

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1:	3	3	3	3	3	2	3	3	3	3	3	3	3	3	2
CO2:	3	3	3	2	3	3	3	2	3	3	3	2	3	2	3
CO3:	3	3	3	3	3	2	3	2	3	3	1	3	2	3	3

Semester	19IMICE17: Biological Science	L	P	C
I		3	-	3

Learning Objective (LO):

LO	To learn about fundamentals of biological science, classification, characteristics and economic importance of plants, animals and microbes.

Course Outcomes (CO)

After successful end of the course student will be able to:

CO1:	Understand fundamentals of biological science.
CO2:	Understand the Classification & General characteristics of Angiosperm and invertebrates.
CO3:	Gain knowledge about the Significance of Experimental plants and animals.

Unit – 1: Algae And Fungi

Thallophytes: Algae - General characteristics - Economic importance - Types of life cycle - Outline of various classifications. Fungi: General characteristics - Classifications and Economic importance. General characteristics - Economic importance of Bryophytes, Pteridophytes and Gymnosperms.

Unit – 2: Angiosperms

Classification of Angiosperm, Systems of classification - Artificial, Phylogenetic and Natural, Outline of Bentham and Hooker‟s classification.

Unit – 3: Invertebrates

General characteristics and outline classification of invertebrates - Protozoa, Porifera, Coelenterata, Platyhelminthes, Ashelminthes, Mollusk and Echinodermata. Economoic importance of invertebrates - Insect pests of rice, sugarcane, coconut, cotton, vegetables, fruits and stored products. Principles of insect

control: physical, mechanical, chemical, biological and integrated methods of pest control.

Unit – 4: Chordata

Classification of Chordata – Characteristic features - protochordata class – Pisces and Amphibia up to orders. Salient features of Reptilia, Aves and Mammalia - Economic importance of Vertebrates.

Unit – 5: Experimental Plants And Animals

Significance of Experimental plants (Arabidopsis, Neurospora, *Chlamydomonas*) and Animals *(Caenorhabditis elegans*, *Danio rerio* (Zebra fish) and *Galleria bimaculatus*). Importance of in vitro studies with specific to cell lines.

Textbooks

1. Vashishta, PC. Sinha,AK.and Kumar A . (2010).*Pteridophyta*, S Chand. New Delhi
2. Kochhar SL. (2012).*Economic Botany in Tropic*. 4th ed. Macmillan and Co. New Delhi
3. Sambamurty. (2008)**.** A *Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany*. IK International Publishers.Bangaluru
4. Jordon EL and Verma PS. (2010).*Chordata Zoology*, S Chand & Co., New Delhi.

Supplementary books:

1. Pough Harvey F, Christine M .Janis and John B. Heiser. (2002).*Vertebrate Life* (6thed). Pearson Education Inc. New Delhi.
2. Simpson MC. (2006).*Plant Systematics*. Elsevier, Amsterdam.

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1:	3	3	3	3	3	2	3	3	2	3	3	3	2	3	2
CO2:	3	3	3	3	3	3	2	3	3	2	1	3	2	3	3
CO3:	3	3	2	3	3	3	1	3	2	3	2	3	3	2	3

Semester	19IMICE35: Public Health Microbiology	L	P	C
III		3	-	3

Learning Objective (LO):

LO	To acquire the student with basic concept of public health and to understand air, food, water, and hospital acquired infections and their prophylactic measures.

Course Outcomes (CO)

After completion of this course the student can able to

CO1:	Describe the basic concepts of public health hygiene.
CO2:	Investigate the outbreaks of communicable diseases.
CO3:	Give awareness about Prevention of disease and promoting health among populations.

Unit – 1: Importance Of Public Health Microbiology

Introduction to public health: definition, scope, concept and importance of public health microbiology – roles of microbiologist in public health.

Unit – 2: Air Borne Infections

Air borne infections: air and its composition – indoor air – outdoor air – methods of enumeration of microorganisms in air – air sanitation - air borne diseases.

Unit – 3: Water Borne Infections

Water borne infections: Methods of enumeration of microorganisms in water – indicator organism – water treatment, water borne diseases (viral, bacterial, protozoan) – control of water borne diseases.

Unit – 4: Food Borne Infections

Food borne infections: Definition and importance of food hygiene – role of microorganisms in food spoilage and poisoning – food borne diseases – types of food borne diseases.

Unit – 5: Hospital Acquired Infection

Hospital acquired infection: Prophylactic immunization – disposal of infective hospital and laboratory materials – monitoring of sanitation in community – techniques used for the diagnosis of hospital acquired infection.

Text Books:

1. Ghimire P. and Parajuli K. (2005) *A Text Book of Microbiology*, VidhyarthiPustakBhandar Publication, Kathmandu.
2. Brownson, R.C., Baker, E.A. Leet T.L. and Follespie K.N. (2003) *Evidence Based Public Health*, Oxford University Press.Oxford

Supplementary Books:

1. Engelkirk P.G. and Duben, EJ. (2015) *Burton's Microbiology for the Health Sciences*, 10th ed. Wolters Kluwer Health publishing.Netherlands
2. Park K. (2017) *Park's Text Book of Preventive and Social Medicine*. 24th ed.BanarsidasBhanot Publishers. Jabalpur
3. Jay J.M. Loessner M.J. and Golden D.A. (2005) *Modern Food Microbiology*, 7th ed. Springer. New York

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1:	3	3	3	3	3	2	3	3	2	3	3	3	3	2	2
CO2:	3	3	3	3	2	3	2	3	1	2	3	3	2	3	3
CO3:	3	3	3	3	1	3	3	2	3	3	3	2	3	2	1

Semester	19IMICE36: Virology	L	P	C
III		3	-	3

Learning Objective (LO):

LO	To describe the structure and replication strategies of viruses and define the process of virus latency & its control measures

Course Outcomes (CO)

After the completion of the course students would be able to

CO1:	Study the nature of pathogenic viruses.
CO2:	Unravel the mechanisms by which viruses infect cells and cause disease.
CO3:	Impart the knowledge regarding the diagnostics clinical aspects.

Unit – 1: General Concepts

Virus history, Diversity, shapes, sizes and components of genomes. Isolation and purification of viruses and components.

Unit – 2: Virus Infection To Animals And Human

Viral infection: affect on host macromolecules. Viral infection: establishment of the antiviral state. Viruses counter attack mechanisms.

Unit – 3: Classification Of Viruses And Nomenclatures

+ve strand RNA viruses- Picorna viruses. Flavi viruses - West Nile virus and Dengue virus. Corona viruses - SARS pathogenesis –ve strand RNA viruses Para myxoviruses. Ortho myxoviruses: Influenza pathogenesis and Bird flu. Rhabdo viruses: Rabies pathogenesis.

Unit – 4: dsRNA Viruses

Reo viruses. Retroviruses: structure, classification, life cycle; reverse transcription. Retro viruses: HIV, viral pathogenesis and AIDS.

Unit – 5: Small DNA Viruses

Parvo and polyoma viruses. Large DNA viruses: Herpes – adeno and poxviruses. Miscellaneous viruses.

Text Books:

1. Maloy. S.R Cronan. Jr. JE, Freifelder. D. (1994). *Microbial genetics*. Jones and Bartlett publishers.Burlington
2. Flint. S.J, Enquist. L.W, King. R.M, Racaniell. V.R and Shalka. A.M (2000). *Principles of Virology - Molecular Biology, pathogenesis and contro*l. ASM Press, Washington DC.
3. Timbury. M.C. (1997) *Notes on Medical Virology*. 10thed. Churchill Livingston.London

Supplementary Books:

1. Topley,W.C. and Wilson, G.S. (1990).*Topley and Wilson's Principles of Bacteriology, Virology and Immunity*, Edward Arnold, London.
2. Carter,J. and Saunders,V. (2013). *Virology, Principles and Applications*. 2nd ed. John Wiley and Sons limited. England.
3. Saravanan. P. (2006). *Virology*. MJP Publishers.Chennai.

Web References:

1. https://www.news-medical.net/health/What-is-Virology.aspx
2. http://www.virology.ws/

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1:	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3
CO2:	3	3	3	3	3	1	3	2	1	2	2	3	2	3	2
CO3:	3	3	3	3	3	3	3	2	3	3	3	3	1	3	3

Semester	19IMICE37: Rhizosphere Biology	L	P	C
III		3	-	3

Learning Objective (LO):

LO	To gain fundamental knowledge about the biological processes in rhizosphere and their effect on plant growth.

Course Outcomes (CO)

After the completion of the course students will be able to:

CO1:	Gains knowledge about root nodule bacteria from the rhizosphere soil.
CO2:	Understand ecological linkages between soil and rhizosphere microbes.
CO3:	Learnt about Rhizosphere organisms and their beneficial effects on plant growth.

Unit – 1: Rhizosphere Biology

Definition, general features and concepts. Historical backgrounds - Hiltner (1906) to Darrow (1993). Research importance in rhizosphere biology and international Research centers. Techniques used in rhizosphere biology .

Unit – 2: Biosphere

Agroecosystem and soil formation; rhizosphere soil and bulk soil; root soil ratio; root development; rhizodeposition; oligotropic and mesotropic evolution, edaphic and climatic.

Unit – 3: Ecology Of Rhizosphere

Ecology of rhizosphere (antagonism, competition, neutralism and mutualism) Biological interactions: Plants – microflora - microfauna. Microbiome and Metabolomics of rhizosphere; signalling and establishment of rhizosphere.

Unit 4 : Analysis of rhizosphere

Analysis of rhizosphere components and tools. Improvement of plant and soil health. Modification and adaptation strategies of soil – microbes - plant parameters and holobiont paradigm.

Unit – 5: Ecosystem

Contribution of microbial ecosystems in biogeochemical cycles and regulation. Sustainable agriculture for food security, biodiversity conservation, mitigating climate change and energy production.

Text Books:

1. Gupta, V.V.S.P. (2020) *Rhizosphere Biology: Interactions Between Microbes and Plants*. Springer. New York.
2. Reinhardt, D.and Sharma, A.K. (2019) *Methods in Rhizosphere Research*Springer. New York.

Supplementary Books:

1. Cardon, Z. and Whitbeck, J. (2007) The Rhizosphere. Academic Press. Cambridge.

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1:	3	3	3	3	3	3	3	2	3	1	2	3	2	3	1
CO2:	3	3	3	3	3	2	3	1	2	3	3	3	1	3	2
CO3:	3	3	3	3	3	3	2	3	3	1	3	2	3	1	3

Semester	19IMICE56: Microalgal Technology	L	P	C
V		3	-	3

Learning Objective (LO):

LO	To learn about the distribution, Morphology and general characteristics of microalgae & Formulation of algal cultures and its importance

Course Outcomes (CO)

After the completion of the course students will be able to:

CO1:	Learn about the morphology and general characteristics of algae.
CO2:	Describe the commercial production of fuels, microbial enzymes from microalgae.
CO3:	Know about different molecular approaches involved microalgae to enhance its application.

Unit -1: Morphology And Reproduction Of Algae

Habitat – distribution of microalgae – Morphology and General characteristics of microalgae – cyanobacteria – diatom – Freshwater – Marine. Reproduction – sexual – asexual – life cycle.

Unit – 2: Cultivation Of Algae

Mass cultivation - Circular – Tubular column – Raceway pond – Pit method. Mass cultivation of *Chlorella* – *Spirulina* – *Dunaliella*. Algal bloom. Factor influence algal growth – nutrients – temperature – light.

Unit – 3: Microalgal Metabolites

Microalgal protein – peptides – SCP- pigments – carotenoids – phycocyanin – phycoerythrin. Lipids – FAME – Growth promoting substance from microalgae – extracellular polymeric Substance – Toxins.

Unit – 4: Microalgae In Human Welfare

Microalgae -Nutraceuticals; Pharmaceuticals; Biofertilizers; and pollution control. Biofuels – biodiesel, Bioethanol and nanoparticles from microalgae - antimicrobials from microalgae – food colorant.

Unit – 5: Genetics Of Microalgae

Application of synthetic biology in algae. Evolution at morphological and ultra structural level, horizontal gene transfer and evolution of algal chloroplast. Quorum sensing in microalgae - Introns.

Text Books:

1. Van den Hoek C, Mann DG and HM. Jahns. (1996). *Algae, an introduction to phycology*. Cambridge University Press. Cambridge.
2. O'Brien, S. J. (1993). *Bacteria, algae, and protozoa*. Cold Spring Harbor Laboratory Press.Cold Spring Harbor, New york.
3. Stevenson RJ, ML Bothwell, RL and Thorp, J.H.*Algal Ecology - Fresh Water Benthic Ecosystems*. Academic Press. New York.
4. Whitton, B.A. and Potts, M. (1996). *Ecology of Cyanobateria - Their diversity in time and space.*Springer Netherlands.

Supplementary Books:

1. Ismail R, Sanjay K. Gupta, Amritanshu S, Poonam S, Sheena K and Faizal B. (2016). *Microalgae Applications in Waste water Treatment.* Springer, Cham.
2. Pal, R. and Choudhury, A. (2014) *Phytoplankton: Diversity and Ecology*., Springer. New Delhi.

Web references:

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5836383/
2. https://pubs.rsc.org/en/content/articlelanding/2018/se/c7se00236j
3. http://www.hawaii.edu/abrp/biordef.html

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1:	3	3	3	3	3	3	3	3	3	2	2	3	3	1	3
CO2:	3	3	3	3	1	3	2	3	3	2	3	2	1	3	3
CO3:	3	3	3	3	3	3	3	1	3	3	1	3	2	3	1

Semester	19IMICE57: Commercial Biotechnology	L	P	C
V		3	-	3

Learning Objective (LO):

LO	To understand the industrially important microorganisms commercial value and importance of patent and IPR.

Course Outcomes (CO)

After the completion of the course students will be able to:

CO1:	Gain knowledge about the Industrially important microorganisms & uritional requirements.
CO2:	Know about the Commercialization methods of Microbial products.
CO3:	Know about Legal protection & IPR.

Unit – 1: Industrially Important Microorganisms

Biology of industrially important microorganisms - *Streptomyces*, yeasts, *Spirulina* and *Penicillium*. Strain improvement (mutation, rDNA, protoplast, metabolic regulation) Culture preservation - Stock culture collection centres.

Unit – 2: Growth Media

Fermentation media - Desired qualities - media formulation strategies - economic means of providing energy, carbon - nitrogen - vitamin and mineral sources - role of buffers, precursors, inhibitors, inducers and antifoams.

Unit – 3: Commercially Important Products

Alcohol production – beer and wine –organic acids (Vinegar, lactic acid), Production of antibiotics (Penicillin, Streptomycin), Production of amino acids (Tryptophan), Enzymes (Amylase), Vitamins (Vitamin B12), Biotransformation (Steroid). Vaccines – (BCG, Polio) and Insulin.

Unit – 4: Commercialization Methods

Objectives - market potential - economic measures in plant and equipment - media, heating and cooling; productivity of culturing and recovery costs.

Unit – 5: Legal Protection & IPR

Biotechnological regulations IPP, IPR, process of patenting, Indian and international agencies involved in IPR & patenting, Global scenario of patents and India's position, patenting of biological material, GLP, GMP. General Introduction to IPR (Patents, Plant Breeders Rights) – Trade Marks, Industrial Design, Trade Secrets; Copy Right and right related to copy right; Patent – Patent Principle, International Standards and Patent Validity, Recent developments in patent system and patentability of biotechnology invention IPR issues of the Indian context.

Text Books:

1. Raledge, C., Kristiansen, B. (2001). *Basic Biotechnology*, 2nded. Cambridge University Press.Cambridge
2. Crueger, W., Crueger A. (2000). *A text of Industrial Microbiology*, 2nded, Panima Publishing Corp. New Delhi
3. Reed, G. (2004). *Prescott and Dunn's Industrial Microbiology*. 4th ed.CBS Publishers. Chennai.
4. Glaser A.N., Nilaido, H., (2007). *Microbial Biotechnology: Fundamentals of Applied Microbiology.*Cambridge University Press. Cambridge

Supplementary Books:

1. Stanbury, P.F, Whitaker, H., Hall, S.J. (2016). *Principles of Fermentation Technology.*3rd ed. Butterworth-Heinemann. Oxford
2. Young, M. M. (2011). *Comprehensive Biotechnology*.2nd ed.Pergamon. Oxford

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1:	√	√	-	√	√	√	-	-	-	√	√	√	-	-	-
CO2:	-	√	√	√	-	-	√	-	-	√	-	√	√	-	-
CO3:	√	-	√	-	√	√	√	-	-	√	-	√	-	-	-

Semester	19IMICE58: Microbiome Science	L	P	C
V		3	-	3

Learning Objective (LO):

LO	To understand the importance of human and animal Microbiome, microbiome's role in diseases and data analysis using Computational techniques.

Course Outcomes (CO)

After the completion of the course students will be able to:

CO1:	Know about types of Microbiome.
CO2:	Gain knowledge about microbiome data analysis.
CO3:	Acquire knowledge about role of Microbiome in various diseases.

Unit – 1: Types Of Microbiomes

Definition and discovery of the microbiome, Types of Microbiomes - Human microbiome - Gut, Genital, skin, oral, Respiratory microbiomes, Animal, Plant microbiomes, Root Microbiome, Environmental microbiomes, Bacteriabiome, Mycobiome, Phycobiome, Actinobiome, Virome, Phytobiome.

Unit – 2: Metagenomics

Metagenomics - Definition, Metagenomics work flow - sample collection and processing, Metagenomic DNA isolation, 16S, 18SrRNA rRNA gene amplicon sequencing and shotgun metagenomics sequencing methods, Next Generation Sequencing (NGS) methods - Illumina Genome Analyzer (HiSeq/MiSeq), Pyrosequencing.

Unit – 3: Microbiome Data Analysis

QIIME (Quantitative Insights into Microbial Ecology) pipeline, Mothur pipeline, metagenome Seq R package -Sequence data (fastq), Metadata about samples (mapping file), Preprocessing: Operational Taxonomic Units (OTUs)

Picking, Taxonomic Assignment, Phylogenetic Analysis, Downstream analysis and Visualization-knowledge discovery - Alpha, Beta - diversity.

Unit – 4: Functional Analysis Of The Microbiome

Functional analysis of the microbiome from DNA sequence functional analysis, metatranscriptome, metabolome, proteome, and glycome - Metatranscriptomic analysis – nano - LC MSMS, Proteome Discoverer software v1.4, Functional mining of metagenomes, Plant growth promoting genes in metagenome.

Unit – 5: Role Of Microbiome In Diseases

Microbiome distrbutions in healthy individuals; composition of specific body sites microbiome (nose, skin, teeth, urogenital, etc.), microbiome's role in diseases such as inflammatory bowel diseases, colitis, obesity, diabetes; effects of diet on microbiome, Ecological concepts of disease eg. Dysbiosis.

Text Books:

1. Douglas, A.E. (2018). *Fundamentals of Microbiome Science: How Microbes Shape Animal Biology,* Princeton University Press, New Jersey.
2. Bordenstein SR, Theis, KR (2015) *Host Biology in Light of the Microbiome: Ten Principles of Holobionts and Hologenomes*. PLoS Biol 13(8): e1002226.

Supplementary Books:

1. Saleem, M. (2015). *Microbiome Community Ecology Fundamentals and Applications*, Springer. New York.

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1:	3	3	3	3	3	3	3	2	3	1	2	3	1	3	2
CO2:	3	3	3	3	3	2	3	1	2	3	1	2	3	2	3
CO3:	3	3	3	2	3	3	2	3	3	2	3	2	3	2	3

Semester	19IMICE85: Entrepreneurship & Management For Microbiology	L	P	C
VIII		3	-	3

Learning Objective (LO):

LO	To learn the basic concepts related to entrepreneurship within the life science sectors and to acquire knowledge about the production of biofertilizers and compost

Course Outcomes (CO)

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

CO1:	Explain bio entrepreneurship and describe its components and forms.
CO2:	Gain knowledge about institutions and schemes of government of India.
CO3:	Understand the required skills for entrepreneurs.
CO4:	Gain knowledge about composting methods.
CO5:	Explain methods of production of Teaching kits and Diagnostic kits.

Unit – 1: Entrepreneurship

Evolution of the concept of entrepreneur - Entrepreneurship: Definitions-concept of Entrepreneurship, development - need - role of resource, talent and spirit - process of Entrepreneurship to socio-economic gains.

Unit – 2: Institutions And Schemes Of India

Institutions and schemes of government of India- Schemes and programmes. Department of science and technology schemes, Nationalized banks - other financial institutions, etc - SIDBI - NSIC - NABARD - 1DBI - IFCI - 1CICI etc.

Unit – 3: Development Of Skills

Skills for entrepreneurs - communication skills, problem solving skills; Business plan development; Market need - market research, SWOT analysis, identify your competition. Financial plan - obtain financing for your business, insure your business, Marketing - mix- product, distribution, price, promotion, set marketing goals.

Unit – 4: Composting & SCP

Composting - domestic waste, agricultural and industrial waste, vermi - composting. SCP production - Mushroom cultivation.

Unit – 5: Production Of Teaching And Diagnostic Kits

Biofertilizers and Biopesticides. Production of teaching kits (Plasmid DNA isolation, Serum electrophoresis) and Diagnostic kits (WIDAL test kits, ABO blood grouping kits).

Text Books:

1. Patzelt, H. and Brenner,T.(2008)*Handbook of Bio entrepreneurship*. Springer press. New york
2. Rao, N.S., (1995). *Biofertilizer in agriculture and forestry*. Oxford and IBH, New york.

Supplementary Books:

1. Teng, P.S.(2007).*Bioscience Entrepreneurship in Asia: Creating Value with Biology*, , World Scientific Publishing Co Pte Ltd. Singapore
2. Adams,D. and Sparrow,J. (2008)*Enterprise for Life Scientists: Developing Innovation and Entrepreneurship in the Biosciences*. Scion Publishing Ltd. Banbury.
3. Rao, N.S., (2007). Biofertilizers in Agriculture. Oxford & IBH Publishing Co., Pvt., Ltd., Bombay.
4. Totawat, K.L., Somani, L.L., Sharma, R.A. and Maloo, S.R., 2008. *Biofertilizer Technology*. Agrotech Publishing Academy. Udaipur, Rajasthan.

Web References:

1.http://www.rishibiotech.com/bioentrepreneurship

2.https://careerdevelopment.aaas.urg

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1:	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3
CO2:	3	3	2	3	3	3	3	2	3	3	1	3	2	3	2
CO3:	3	3	3	3	3	3	2	3	3	3	3	3	3	2	3
CO4:	3	3	3	2	3	3	3	3	3	3	3	2	3	1	3

Semester	19IMICE86: Bioremediation	L	P	C
VIII		3	-	3

Learning Objective (LO):

LO	To acquire knowledge about principles of bioremediation, process design for biotreatment studies and types of bioremediation

Course Outcomes (CO)

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

CO1:	Understand the principles of bioremediation.
CO2:	Understand the biodegradation process.
CO3:	Evaluate various types of bioreactors.
CO4:	Understand Bioremediation in fresh and marine water system.
CO5:	Understand the degradation of xenobiotics.

Unit – 1: Biology Of Bioremediation

Principles of Bioremediation – Rapid growth and Metabolism- Genetic plasticity – Metabolic pathways for the degradation of xenobiotics, hydrocarbons – Microbial site characterization – Biodegradation potential.

Unit – 2: Biodegradation Process

Bioprocess design, optimization – Microbial removal rates – inherent problems associated with biotreatment studies. Microbiological methodologies – Standard biotreatability protocols – Quantification of biodegradation; Biocleaning -Chernobyl radioactive contaminated area - Phytoremediation.

Unit – 3: Bioremediation And Its Types

Aerobic Bioremediation: Bioremediation of Surface Soils: Fate and transport of contaminants in the Vadose zone – Biodegradation in soil

ecosystems – Types of soil treatment systems – Bioreactors. Subsurface Aerobic Bioremediation: in situ Bioremediation – in situ Bioventing – in situ treatments of Harbor Sediments and Lagoons.

Unit – 4: Applications Of Bioremediation

Bioremediation in fresh water and marine systems: Bench and Pilot Scale studies – in situ Bioreactor treatment of sediments – in situ treatment in marine ecosystem.

Unit – 5: Xenobiotics

Anoxic/Anaerobic Bioremediation: Anoxic/Anaerobic Processes – Fermentation, Degradation of Xenobiotic – Anoxic/Anaerobic bioremediation of hydrocarbons, Phenols, Chlorophenolic compounds, Polycyclic Aromatic Hydrocarbons (PAH), Heterocyclic Compounds, Cyanide, dyes, Radioactive wastes.

Text Books:

1. Pichtel,J.(2014) *Waste Management Practices: Municipal, Hazardous, and Industrial* 2nd ed. CRC Press. Florida
2. Hazardous Wastes and Solid Wastes, Liu, D.H.F and Liptak, B.G (2005), Lewis Publishers, New York.

Supplementary Books:

3. Atlas, R.M and Bartha,R., (2000) *Microbial Ecology*, 4th ed., Addison Wesley Longman Inc. Boston
4. Madigan, M.T.Martinko, J.M.Stahl,D.A. Clark, D.A.(2010)*Brock Biology of Microorganisms*, - 12th ed. Pearson Benjamin Cummings.San Francisco
5. Crawford, R.L.Crawford, D.L. (2009)*Bioremediation: Principles and Applications.*Cambridge University Press.Cambridge

Web References:

1.www.environmentalpollution.in.

2. https://archive.epa.gov

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1:	3	3	3	3	3	3	3	3	2	3	3	3	1	3	3
CO2:	3	3	3	3	3	3	3	3	3	3	3	2	3	3	2
CO3:	3	3	3	3	3	3	2	3	2	3	1	3	2	3	3
CO4:	3	3	3	3	3	3	3	3	3	3	3	1	3	1	3
CO5:	3	3	3	3	3	3	2	3	3	3	3	3	2	3	2

Semester	19IMICE87: Microbial Nanotechnology	L	P	C
VIII		3	-	3

Learning Objective (LO):

LO	To acquire knowledge about biological research with various fields of nanotechnology

Course Outcomes (CO)

To acquire knowledge about biological research with various fields of nanotechnology.

CO1:	Understand the nanotechnology concepts.
CO2:	Gain knowledge about Microbial nanotechnology & its applications.
CO3:	Acquire knowledge about preparation of nano biomaterials.
CO4:	Understand the nano scale applications in biology and medicine.
CO5:	Gain knowledge about implications of Nanotechnology.

Unit – 1: Introduction To Nanotechnology

Characteristic scale for quantum phenomena, nanoparticles, nano - clusters, nanocomposite, nanotubes, nanowires and emergence of bionanotechnology. Characterization of nanoparticles - UV – Vis Spectroscopy, Electron Microscopic – HRTEM & SEM.

Unit – 2: Microbial Nanotechnology

Microbial synthesis of Nanoparticles - Synthesis of nanodrugs – metal nanoparticles and drug delivery vechicles - Nanoshells - Tectodentrimers Nanoparticle drug systems – Diagnostic applications of nanotechnology.

Unit – 3: Preparation Of Nanomaterials

Physical and chemical properties of nanoparticles – types, functions – Silver, Gold and Titanium. Electrochemical properties of Nanoscale

Materials, Intra-molecular bonding, Inter - molecular bonding, Nanocatalysis. Interaction between biomolecules and nanoparticle surfaces.

Unit – 4: Applications Of Nanoscale In Biology And Medicine

Polymeric , Lipid nanoparticels for drug delivery , Micelles in drug delivery . Biosensors – protein in Nanotechnology enabled sensors – Nano - sensors based on Nucleotides and DNA Microarrays – cell Biochips – *in vitro* characterization – *in vivo* Investigations.

Unit – 5: Implications Of Nanotechnology

Health and safety implications from nanoparticles: Health issues – Environmental issues - Need for regulation – societal implications: Possible military applications - potential benefits and risks for developing countries.

Text Books:

1. Parthasarathy, B.K. (2007). *Introduction to Nanotechnology*, IshaPublication.New Delhi

2. Papazoglou, E.S and Parthasarathy,A. (2007). *Bionanotechnology*. Morgan & Claypool Publishers. Williston

Supplementary Books:

1. Rehm, B. (2006). *Microbial Bionanotechnology: Biological Self-assembly Systems and Biopolymer-based Nanostructures*. Horizon Scientific Press. London

2. Reisner,D.E.Bronzino,J.D. (2008). *Bionanotechnology: Global Prospects*. CRC Press. Florida

3. Gazit,E. (2006). *Plenty of Room for Biology at the Bottom: An Introduction to Bionanotechnology.* Imperial College Press.London.

Web References:

1. https://www.ntnu.edu/physics/research/bionano
2. https://nanohub.org/resources/180

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1:	3	3	3	3	3	3	3	3	1	3	3	3	2	3	1
CO2:	3	3	3	3	3	3	2	3	3	2	2	3	3	3	3
CO3:	3	3	3	3	3	3	3	3	2	3	3	1	3	3	2
CO4:	3	3	3	3	3	3	2	3	3	3	2	3	3	3	3
CO5:	3	3	3	3	3	2	3	3	2	3	2	3	1	3	2

Semester	19IMICE96: Microbial Diversity And Extremophiles	L	P	C
IX		3	-	3

Learning Objective (Lo):

LO	The aim of the course will be on the concept of microbial diversity and characteristics of microorganisms in extreme conditions

Course Outcomes (CO)

After completion of course students will be able to:

CO1:	Know about a Microbial Biodiversity.
CO2:	Gain knowledge about Characteristics, classification and applications of Extremophiles.
CO3:	Understand the Alkalophiles and Acidophiles.
CO4:	Understand about the halophilic and basophilic microorganisms and its importance.
CO5:	Get knowledge about Space Microbiology.

Unit – 1: Biodiversity

Biodiversity Introduction to microbial biodiversity - distribution, abundance, ecological niche. Types - Bacterial, Archael and Eucaryol.

Unit – 2: Extremophiles

Characteristics and classification of Archaebacteria. Thermophiles Classification, hyperthermophilic habitats and ecological aspects. Extremely thermophilic Archaebacteria, thermophile, commercial aspects of thermophiles. Applications of thermozymes. Methanogens: Classification, Habitats, applications.

Unit – 3: Alkalophiles And Acidophiles

Alkalophiles and Acidophiles Classification, alkaline environment, soda lakes and deserts, calcium alkalophily Applications. Acidophiles Classification, life at low pH, acidotolerence, applications.

Unit – 4: Halophiles and Basophiles

Halophiles and Basophiles Classification, Dead Sea, discovery basin, cell walls and membranes - Purple membrane, compatible solutes. Osmoadaptation/ halotolerence. Applications of halophiles and their extremozymes. Barophiles: Classification, high-pressure habitats, life under pressure, basophile, death under pressure.

Unit – 5: Space Microbiology

Space Microbiology aims and objectives of Space research. Life detection methods -Evidence of metabolism (Gulliver) - Evidence of photosynthesis (autotrophic and heterotrophic) - ATP production - Phosphate uptake - Sulphur uptake. Martian environment (atmosphere, climate and other details).

Reference Books:

1 Singh,O.V.(2012)*Extremophiles: Sustainable Resources and Biotechnological Implications*, Wiley - Blackwell. New Jersey.

2 Gerday,C.Glansdorff,N. (2007)*Physiology and Biochemistry of Extremophiles*, ASM Press.Newyork

3 Anitori,R.P.(2012)*Extremophiles: Microbiology and Biotechnology,*Caister Academic Press.Norfolk.

4 Breidahl, H.(2001)Extremophiles: Life Extr. Envirn. Chelsea House Publications. Philadelphia

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1:	3	3	3	3	3	3	2	3	3	2	2	3	2	3	3
CO2:	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2
CO3:	3	3	3	3	3	3	3	3	3	2	2	3	2	3	2
CO4:	3	3	3	3	3	3	2	3	3	2	2	3	2	3	3
CO5:	3	3	3	3	3	3	3	2	3	3	3	3	3	3	2

Semester	19IMICE97: Environmental Microbial Technology	L	P	C
IX		3	-	3

Learning Objective (LO):

LO	To provide a fundamental knowledge about the various scopes in environmental studies

Course Outcomes (CO)

After completion of course students will be able to

CO1:	Demonstrate an understanding of key concepts in ecosystems.
CO2:	know the microorganisms responsible for water pollution.
CO3:	Understand the various assessment techniques of air quality.
CO4:	Describe about different sewage treatment methods employed in waste water treatment.
CO5:	Learn about the global environmental problems.

Unit – 1: Ecosystems

Environment and Ecosystems - Definitions, biotic and abiotic environment. Environmental segments. Composition and structure of environment. Concept of biosphere, communities and ecosystems. Ecosystem characteristics structure and function. Food chains, food webs and tropic structures. Ecological pyramids.

Unit – 2: Eutrophication

Eutrophication Water pollution and its control: Need for water management. Sources of water pollution. Measurement of water pollution, Eutrophication: Definition - causes - microbial changes in eutrophic bodies of water induced by various inorganic pollutants. Effects of eutrophication on the quality of water environment - factors influencing eutrophication. Algae in

eutrophication, algal blooms, their effects and toxicity, coloured waters, red tides, and cultural eutrophication. Physico - chemical and biological measures to control eutrophication.

Unit – 3: Aerobiology And Airborne Diseases

Aerobiology - Droplet nuclei, aerosol, assessment of air quality, - solid – liquid -impingement methods - Brief account of air borne transmission of microbes - viruses -bacteria and fungi, their diseases and preventive measures.

Unit – 4: Waste Treatment Methods

Waste treatment techniques - Wastes - types - solid and liquid wastes characterization - solid - liquid; treatments - physical, chemical, biological - aerobic - anaerobic - primary - secondary - tertiary; solid waste treatment - saccharification - gasification - composting. Utilization of solid wastes - food (SCP, mushroom, yeast): fuel (ethanol, methane) fertilizer (composting), liquid waste treatment – trickling filter– activated sludge – oxidation pond - oxidation ditch.

Unit – 5: Bioremediation

Bioremediation & Global environmental problems Microbiology of degradation of xenobiotics in the environment, ecological considerations, decay behavior, bio magnification and degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants and pesticides. Genetically Modified Organisms released and its environmental impact assessment and ethical issues - Ozone depletion, UV - B, greenhouse effect and acid rain, their impact and biotechnological approaches for management.

Reference Books

1. Crawford, R.L. Crawford, D.L. (2009) *Bioremediation: Principles and Applications.* Cambridge University Press. Cambridge
2. Eldowney, S. Hardman D.J. and Waite S. (1993) *Pollution: Ecology and Biotreatment* Longman Scientific Technical.Harlow
3. Glymph,T. (2005) *Wastewater Microbiology: A Handbook for Operators*, Amer Water Works Assn, Mumbai
4. Bhattacharyya,B.C.Banerjee,R. (2007) *Environmental Biotechnology*. Oxford University Press.Oxford

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1:	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2:	3	3	3	3	3	3	3	2	3	3	3	3	2	3	3
CO3:	3	3	3	3	3	3	3	3	2	2	3	3	3	3	2
CO4:	3	3	3	3	3	3	3	2	3	3	3	3	2	3	3
CO5:	3	3	3	3	3	3	3	3	2	3	3	3	3	1	2

Semester	19IMICE98: Vermitechnology	L	P	C
IX		3	-	3

Learning Objective (LO):

LO	To gain knowledge about the basic principles of vermicompost production and its importance in agriculture

Course Outcomes (CO)

After completion of course students will be able to:

CO1:	Gain knowledge about major types of soil.
CO2:	Understand the characteristics of soil.
CO3:	Describe the role of earthworms in soil.
CO4:	To know the production methods for composting.
CO5:	Develop an understanding of utilization of earthworms for vermicompost production.

Unit – 1: Soil Types

General characteristics of soil - structure of the soil - sand, clay, salt, types of soils – role of microorganisms in soil fertility.

Unit – 2: Soil Properties

Physical properties of soil - soil colour, soil moisture, soil temperature, bulk density of soil, chemical properties of soil PH, Electrical conductivity, organic, Nitrogen, Phosphate and potash.

Unit – 3: Earthworm Biology

Soil biota - Earthworms - Ecological classification of earth worms as Epigeics -Introduction to earthworm biology - physical and chemical effects of earth worms on soils - Role of earthworms in soil - classification of earthworms based on ecological strategies- Burrowing activity of earthworms - Drilospheres - Microorganisms and their relationship with earthworms.

Unit – 4: Composting

Composting - anaerobic composting, aerobic composting, types of composting, vermicompost earthworm species used in vermicompost production - endemic species, exotic species.

Unit – 5: Vermiculture

Vermicopost - setting up vermicompost quality N, P, K, C, N, Microbial quality applications — vermiculture - vermiwash — role of vermicompost in organic farming - its quality and advantages over chemical inputs. Earthworms in Bio - reclamation of soil. Problems in vermiculture units - remedial suggestions. Vermicomposting as a tool for solid waste management - a small scale industry and it's economics.

Text Books:

1. Whitley,N. (2015). *The Application of Geology to Agriculture*, PalalaPress.Poland
2. Singh, M.S. andChaudhuri,P. (2014). *Biology and Ecology of Tropical Earthworms*, Discovery Publishing House Pvt. Ltd. New Delhi
3. Satchell, J.E., (2012). *Earthworm ecology: From Darwin to Agriculture*. Chapman and Hall, London.
4. Dash, M.S. (2012). *Charles Darwin's Plough Earthworm Biology, Ecology and Tool for Vermitechnology*, I K International Publishing House. New Delhi.

Supplementary Books:

1. Barrett, T.J. (2018). *Harnessing the Earthworm*, Forgotten Books.London
2. Yadav, S. and Singh,V.K. (2014). *Vermitechnology: Rebuilding of Sustainable Rural Livelihoods,* Nova Science Publishers.New York.

Outcome Mapping:

COURSE OUTCOME	PROGRAMME OUTCOME										PROGRAMME SPECIFIC OUTCOME				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4	PSO5
CO1:	3	3	3	3	3	3	3	3	2	3	3	3	3	3	2
CO2:	3	3	3	3	2	3	2	3	3	3	3	3	2	3	3
CO3:	3	3	3	3	3	3	3	3	2	3	2	3	3	2	3
CO4:	3	3	3	3	3	3	1	3	3	3	3	3	3	3	3
CO5:	3	3	3	3	3	3	2	3	2	3	3	2	3	2	3

ALLIED COURSES OFFERED TO OTHER DEPARTMENTS

Semester	19IMICA01: Microbiology - I	L	P	C
I		4	-	4

Learning Objective (LO):

LO	To learn about the Introduction, Historical development, Staining reactions and Media preparation for the cultivation of microorganisms.

Course Outcomes (CO)

By the end of the course the student will be able to:

CO1:	Understand the history and recent developments in Microbiology.
CO2:	Understand the principle and operation of different types of microscopes and their applications.
CO3:	Understand staining reactions and structure of bacteria.
CO4:	Gain knowledge about different methods of sterilization.
CO5:	Explain the media types and pure culture techniques.

Unit – 1: History Of Microbiology

History and scope of Microbiology. Recent developments - Spontaneous generation - Biogenesis. Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Elie Metchnikoff, Edward Jenner, Lister and Fleming.

Unit – 2: Microscopy

Microscopy: Principles and applications of Simple, Compound, Bright field, Dark field, Phase contrast, Fluorescent and Electron microscope [SEM & TEM].

Unit – 3: Bacterial Structure And Staining

Structure and organization of bacterial cell, Gram positive and Gram negative bacterial cell wall. Principles of staining: Nature of dyes, Types of staining – Simple, Differential, Negative and Spore staining.

Unit – 4: Sterilization Methods

Sterilization methods – Physical (Moist heat, Dry heat, Filtration, Pasteurization, Tyndalization, Radiations) and Chemical methods (Alcohols, Aldehydes, Phenols, Halogens and Hypochlorite).

Unit – 5: Cultivation And Preservation Of Bacteria

Culture and Media preparation – Solid and liquid – types of media -.Semi synthetic, Synthetic, Enriched, Enrichment, Selective and Differential media. Pure culture techniques - Tube dilution - Pour, Spread, Streak plate. Anaerobic culture techniques.

Text Books:

1. Dubey, R.C. and Maheswari, D.K. (2013). A Textbook of Microbiology 3/e, S. Chand and Company Ltd., New Delhi.

2. Ananthanarayan. R. and Paniker C.K.J Text Book of Microbiology, 9th Edition Orient Longman, (2013).

Supplementary Books:

3. Pelczar, Chan & Kreig (2012). Microbiology 5th edition. Tata McGraw Hill, New Delhi.

4. Willey, Joanne M. Prescott's Microbiology. 9th Edition: McGraw - Hill Education 10/e - Europe, 2017.

5. Geeta Sumbali and Mehrotra RS (2009). Principles of Microbiology. First edition, Tata McGraw Hill P. Ltd., New Delhi.

Web References:

1.http://abrc.sinica.edu.tw/icm/app_out/main/theorem_E.php

2. https://www.cliffsnotes.com/study

3.guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology

4. https://vlab.amrita.edu/?sub=3&brch=73&sim=208&cnt=1

ALLIED COURSES OFFERED TO OTHER DEPARTMENTS

Semester	19IMICA02: Microbiology- II	L	P	C
II		4	-	4

Learning Objective (LO):

LO	To acquire fundamental knowledge about the Classification of microorganisms, Structure, differences and antimicrobial chemotherapy.

Course Outcomes (CO)

By the end of the course, the student will be able to:

CO1:	Differentiate prokaryotic and eukaryotic cells.
CO2:	Understand the ultra-structure of the bacteria.
CO3:	Describe the characteristics of Archaebacteria, Eubacteria and Cyanobacteria.
CO4:	Gain knowledge about isolation and preservation of microorganisms.
CO5:	Gain knowledge about the antimicrobial drugs.

Unit – 1: Classification Of Microorganisms

Difference between prokaryotic and eukaryotic microorganisms. Classification of microorganisms - General principles and nomenclature - Haeckel's three kingdom concept, Whittaker's five kingdom concept.

Unit – 2: Ultrastructure Of Bacteria

Microbial cell: Ultrastructure of bacteria, Subcellular structures and cell envelope - Slime, Capsule, Cell wall, Pili, Flagella, Cell inclusions, Biosynthesis of bacterial cell wall, Cell membrane.

Unit – 3: General Characteristics Of Microorganisms

General characteristics and nature of Archaebacteria, Eubacteria, Cyanobacteria, Mycoplasmas, Rickettsiae, Chlamydias, Spirochaetes, Actinomycetes, Protozoa, Algae, Fungi and Viruses.

Unit – 4: Isolation Of Microorganisms

Isolation of different types of Bacteria - Fungi - Actinomycetes - Cyanobacteria - Protozoa. Preservation methods of microbes. Type culture collections.

Unit – 5: Antimicrobial Chemotherapy

Antimicrobial Chemotherapy – Antibiotics – Mode of action antimicrobial resistance, Tests for sensitivity to antimicrobial agents.

Text Books:

1. Pelczar, Chan & Kreig (2012). Microbiology 5th edition. Tata McGraw Hill, New Delhi.
2. Dubey, R.C. and Maheswari, D.K. (2013). A Textbook of Microbiology 3/e, S. Chand and Company Ltd., New Delhi.
3. Ananthanarayan. R. and Paniker C.K.J Text Book of Microbiology, 9th Edition Orient Longman, 2013.

Supplementary Books:

1. Willey, Joanne M. Prescott's Microbiology. 9th Edition: McGraw-Hill Education 10/e - Europe, 2017.
2. Meenakumari. S (2006) Microbial Physiology. 1st Edition, MJP Publishers, A unit of Tamil Nadu Book House, Chennai.

Web References:

1.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1254764/

2.http://microbialcell.com/

3.http://www.biologydiscussion.com/microbiology-2/antimicrobial-drugs-features-and-mechanisms-microbiology/66222

Semester	19IMICP01: Allied Practical – I Microbiology	L	P	C
II		-	6	2

Learning Objective (LO):

LO	To acquire basic laboratory skills like pure culture techniques, Staining techniques and Media preparation

Course Outcomes (CO)

By the end of the course, the student will be able to:

CO1:	Understand the sterilization methods and media preparation.
CO2:	Perform the pure culture techniques.
CO3:	Enumerate bacteria and yeast.
CO4:	Understand the staining methods and slide culture techniques.

Practicals:

1. Different methods of sterilization.
2. Preparation of Media:

   i. Nutrient broth ii. Nutrient agar iii. Plates iv. Slants v. Soft agar vi. Blood agar vii. Selective Media.
3. Determination of growth - Growth curve.
4. Pure culture technique:

   i. Streak plate ii. Spread plate iii. Pour plate methods.
5. Measurement of microbes - Micrometry.
6. Enumeration of bacterial / yeast cells- Viable count (Plate count), Total count (Haemocytometer count).
7. Motility determination

   i. Hanging drop method.
8. Staining methods:

   i. Simple staining ii. Gram's staining iii. Negative staining iv. Spore staining

v. Metachromatic granular staining vi. Lacto phenol cotton blue staining

vii. Fungal slide culture.

Reference Books:

1. Sundararajan, T. Microbiology laboratory manual. 2nd edition (2007).

2. Kannan, N. Laboratory manual in General Microbiology (2002).