RCS - 2024

NEHRU ARTS AND SCIENCE COLLEGE

(An Autonomous Institution affiliated to Bharathiar University)
(Reaccredited with "A+" Grade by NAAC, ISO 9001:2015 & 14001:2004 Certified
Recognized by UGC with 2(f) &12(B), Under Star College Scheme by DBT, Govt. of India)
Nehru Gardens, Thirumalayampalayam, Coimbatore - 641 105, Tamil Nadu.

Moulding True Citizen

REGULATIONS, CURRICULUM & SYLLABUS

PMB

M. Sc., MICROBIOLOGY

Effective from 2024 – 2025

REGULATIONS

NEHRU ARTS AND SCIENCE COLLEGE

(AUTONOMOUS)

REGULATIONS FOR POSTGRADUATE DEGREE COURSES

Choice Based Credit System blended with Outcome based Education

Regulations with effect from the Academic Year 2022-2023

Definition

a) Programme – A course of study leading to the award of a degree in a discipline. (E.g.: M. Sc. / M. Com.)

b) Branch – Discipline of study (e.g. M.Sc. Microbiology)

c) Curriculum – The various courses (subjects) a student must study in a particular branch.

d) Course – The theory & practical subject offered under each curriculum.

e) Credit – A unit of measurement based on the duration of the contact hours, content and quality of the subject matter.

1. PG Curriculum

The PG Curriculum follows CBCS pattern and the medium of instruction is English.

2. Eligibility for Admission to the Course

A candidate who has passed the Degree Examination as main subject of study of this University or an examination of some other University accepted by the Syndicate as equivalent thereto shall be eligible for admission to the Master Degree of this College.

3. Duration of the Programme

This Course of Study shall be based on Semester System. This Course shall consist of four Semesters covering a total of two Academic years. For this purpose, each academic year shall be divided into two Semesters; the first and third Semesters; July to November and the second and the fourth Semesters; December to April. The Practical Examinations shall be conducted at the end of odd / even Semester. Each semester have 90 working days consists of 5 teaching hours per working day. Thus, each semester has 450 teaching hours and the whole programme has **1800 teaching hours**.

4. Choice Based Credit System (CBCS)

All Postgraduate Programmes offered by the University shall be under Choice Based Credit System (CBCS). Choice based credit system is introduced with the aim of offering flexibility in the choice of courses to the students.

Objectives of the Choice Based Credit System :

- To facilitate the students to have greater flexibility in their choice of courses.
- To revamp the curriculum, to impart entrepreneurial skills and placement potentials qualities.
- To incorporate need based knowledge in tune with the location and neighborhood of the institution.
- To allocate credit points to each paper of the study based on the weightage of the contact hours, content and quality.
- To extend opportunities to fast learners in order to earn Extra credit from advanced as well as additional courses.
- To maintain the total credit points of each programme on par with international standards.

5. Outcome Based Education (OBE)

OBE is an **educational** theory that bases each part of an **educational** system around goals (**outcomes**). By the end of the **educational** experience, each student should have achieved the goal.

Objectives of Outcome based curriculum :

- The programme outcomes and Programme specific outcomes are clearly identified and unambiguously specified regarding the content, context and competence.
- The expected outcome should be defined by setting bench marks for each level of the programme. Benchmark should tackle and define specifically, the goals of the curriculum and verify ways to access whether the students have reached these goals at the level of study;
- OBE is driven by assessments that focus on well defined learning outcomes and not by other factors such as what is taught, the duration taken by the student to achieve the outcomes or which path the students take to achieve their targets. In OBE, assessment techniques must be with clear description of expected performance.

Definitions

Outcome : An outcome of an educational Programme is what the student should be able to do at the end of a Programme/ course/ instructional unit.

Levels of Outcomes

- Programme Outcomes: POs are statements that describe what the students graduating from any of the educational Programmes should be able to do.
- Programme Specific Outcomes: PSOs are statements that describe what the graduates of a specific educational Programme should be able to do.
- Course Outcomes: COs are statements that describe what students should be able to do at the end of a course

Learning Outcomes : It describes levels of achievement that can be attained across the domains of learning. Here **K1** representing Remember; **K2** -Understanding; **K3** - Apply; **K4** - Analyze; **K5**- Evaluate, **K6** – Create are used to measure the levels of achievement in learning.

6. CBCS Curriculum

6.1. Part A : Core Components:

Core Courses : Each programme has a group of core courses. The syllabus of the core courses will facilitate the students in the acquisition of the basic concepts of their respective disciplines, besides getting exposure to the recent developments. This exposure will suitably guide the students towards their vertical mobility in their higher studies. Core courses will last till the fourth semester. **It is mandatory for all PG students to complete an online course under SWAYAM / NPTEL platform between 2nd and 3rd semester.**

6.2. Part B: Optional Courses - Advanced Learner's Courses : (ALC)

Students are offered the opportunity to undertake optional papers, additional to their compulsory papers, in order to gain additional credit that would boost their grades. These are not mandatory. The course will be a self study nature and the concerned departments will offer guidance. Other Advanced Learner's Courses shall be decided during the conduct of Board of Studies. The Examination will be of Open Book Examination model.

7. Requirement to appear for the examinations

Attendance Requirements for the Students appearing for ESE

- The guidelines of attendance requirement issued by Bharathiar University are adopted by the College. Attendance shall be considered semester- wise (not annually).
- A candidate shall be permitted to appear for the Semester Examinations in any semester, if he / she secures not less than 75% of attendance in the total number of working days during the semester and if his / her progress has been satisfactory, and his / her conduct has been satisfactory.

- Those who have obtained below 75% and above 65% of attendance shall pay condonation fee and shall write the examination in the same semester with due permission from the Principal.
- Those who have below 65% and above 50% of attendance are not eligible to write the examination in current semester subjects but are permitted to continue their studies in the next semester provided that this is the first time that the candidate earned attendance between 50% and 65%. Else the candidates have to discontinue the course and re-join in the same semester subjects in the next year with proper approval of the Principal. However, the candidates are eligible to write arrear subjects if any.
- Those who have below 50% of attendance have to redo the semester.

8. Restrictions to appear for the examinations

a) Any candidate having arrear paper(s) shall have the option to appear in any arrear paper along with the regular semester papers.

b) Candidates who fail in any of the course of PG degree examinations shall complete the course concerned **within 5 years** from the date of admission to the said programme, and if they fail to do so, they shall take the examination in the texts / revised syllabus prescribed for the immediate next batch of candidates. If there is no change in the texts / syllabus they shall appear for the examination in that course with the syllabus in vogue until there is a change in the texts or syllabus. In the event of removal of that course consequent to change of regulation and / or curriculum after 5 year period, the candidates shall have to take up an equivalent course in the revised syllabus as suggested by the Chairman of the concerned board of studies and fulfill the requirements as per the regulation curriculum for the award of the degree.

9. Medium of Instruction and examinations

The medium of Instruction and the medium of Examination is English.

10. Distribution

The following are the distribution of marks for examination & evaluation pattern. Distribution of Marks between End Semester Exam (Theory) and Internal Assessment is 75:25. The following table gives the distribution.

PG - PROGRAMMES (CBCS)

Table 16: Total credit points and tenure of study for M.A., M.Com, M. Sc. and MSW

Part	Courses	Semesters	Credit Points	Marks / Grade
III	Components Core / Electives / Internship / Project / Online course	I to IV	94	2350

11. Additional Credits

Students are given the opportunity to undertake optional papers, additional to their compulsory papers, in order to gain additional credit that would boost their grades. These are not mandatory. Students can earn to a maximum of 15 credits.

S. No.	Subject	Credit / Course	Total Credits
1.	Presentation of Research papers in International Conferences	1	1
2.	Publication of Research Papers in reputed Journals	1	1
3.	Advanced Learners Course	2	4
4.	MOOC Courses / Swayam prescribed by the Departments	2	4
5.	Visits Abroad for Participation in International Academics events	1	1
6.	Representation - Sports / Social Activities / Co curricular / Extracurricular Activities at University / District / State / National / International levels	1	2
7.	Swachh Bharath Summer Internship Programme	2	2
		Total	**15**

12. Continuous Internal Assessment (CIA)

Three CIA's shall be conducted at regular Intervals. CIA I and II shall be a 2 hours written test for a maximum of 50 marks each and CIA III shall be conducted as Model Examination for ESE.

13. OBE Evaluation - Assignment / Seminar / Role play, etc.

Three OBE Assessment parameters are decided for each course to evaluate the achievement of course outcomes which shall be assessed by the concerned course teacher. The marks allotted to this component will be awarded based on the performance of the candidate. The Rubrics for awarding the marks shall be maintained by the Course Teacher concerned.

14. Distribution of Marks

Table 17 : Distribution of marks for External and Internal for theory papers of PG courses

Total Marks	External		Internal	Overall Passing Minimum for Total Marks (Internal + External)
	Max. Marks	Passing Minimum for External alone	Max. Marks	
100	75	38	25	50
75	55	28	20	38
50	40	20	10	25

Table 18 : Distribution of Internal marks for theory papers of PG courses

S. No.	For Theory - PG courses	Distribution of Marks		
01.	CIA I	5	4	2
02.	CIA II	5	4	2
03.	CIA III	6	5	4
04.	OBE Evaluation – Tool 01	3	2	1
05.	OBE Evaluation – Tool 02	3	2	1
06.	OBE Evaluation – Tool 03	3	3	-
	TOTAL MARKS	**25**	**20**	**10**

Table 19 : Distribution of marks for External and Internal for Practical papers of PG Courses

Total Marks	External		Internal	Overall Passing Minimum for total marks (Internal + External)
	Max. Marks	Passing Minimum for External alone	Max. Marks	
100	60	30	40	50
75	45	23	30	38
50	30	15	20	25

Table 20 : Distribution of Internal marks for PG practical papers

S. No.	For PG Practical Courses	Distribution of Marks		
01.	Laboratory Performance - Assessment Tool 01*	5	4	3
02.	Laboratory Performance - Assessment Tool 02*	5	4	3
03.	Laboratory Performance - Assessment Tool 03*	5	4	3
04.	Test 1 : During Mid semester	10	7	4
05.	Test 2 : As model test at the end of the semester	10	7	4
06.	Observation Note Book	5	4	3
Total Marks		**40**	**30**	**20**

Table 21 : Distribution of External marks for PG practical papers

S. No.	For - UG practical courses	Distribution of Marks		
1.	Experiment-I	20	15	10
2.	Experiment-II	20	15	10
3.	Record	10	10	5
4.	Viva Voce	10	5	5
	TOTAL MARKS	**60**	**45**	**30**

Table 22 : Distribution of marks for Project and Viva Voce examinations and Continuous Internal Assessments and passing minimum marks for the Project / Industrial Training courses of PG programmes

Total Marks	External		Internal	Overall Passing Minimum for Total Marks (Internal + External)
	Max. Marks	Passing Minimum for External alone	Max. Marks	
250	150	75	100	125
200	120	60	80	100
150	90	45	60	75
100	60	30	40	50

Table 23 : Distribution of marks for the Continuous Internal assessment in PG Project / Industrial Training Courses

S. No.	For - PG Project courses	Distribution of Marks			
1.	Review-I	20	15	10	10
2.	Review-II	20	15	10	10
3.	Review-III	20	15	10	10
4.	Document, Preparation and Implementation	25	20	15	10
5.	Research Paper Publication in Journals**	15	15	15	-
	TOTAL MARKS	**100**	**80**	**60**	**40**

**Wherever it is not possible, an equivalent Assessment tool shall be prescribed by the Board Chairperson.

Table 24 : Distribution of marks for the External Examination in PG Project / Industrial Training courses

S. No.	For - PG Project courses	Distribution of Marks			
1.	Record Work and Presentation	100	80	60	40
2.	Viva Voce	50	40	30	20
	TOTAL MARKS	**150**	**120**	**90**	**60**

15. Passing Minimum:

A candidate who secures **not less than 50%** in the End Semester Examination and 50% marks in the External examination and Continuous Internal Assessment put together in any courses shall be declared to have passed the examination in the subject (Theory and Practical). Thus the minimum pass mark is 38 out of 75 in ESE and 50 marks out of 100 (CIA+ESE).

A candidate who passes the examination in all the courses shall be declared to have passed, the whole examination. Thus to obtain PG degree, a student should pass in all the courses prescribed in the concerned programme and also he / she should earn 94 credits.

16. Grade:

Table 25 : Classification of Grade for PG Students based on the Percentage of marks

Range of Marks	Grade Point	Letter Grade	Description
90 – 100	9.0 – 10.0	O	OUTSTANDING
80 – 89	8.0 – 8.9	D+	EXCELLENT
75 – 79	7.5 – 7.9	D	DISTINCTION
70 – 74	7.0 – 7.4	A+	VERY GOOD
60 – 69	6.0 – 6.9	A	GOOD
50 – 59	5.0 – 5.9	B	AVERAGE
00 – 49	0.0	C	RE-APPEAR
ABSENT	0.0	AA	ABSENT

17. Grade Point Average (GPA)

Grade point average (GPA) is calculated for each part taking into account all the courses studied. Calculation of grade point average semester-wise and part-wise is as follows:

$$\text{GPA} = \frac{\text{Sum of the multiplication of grade points by the credits of the courses}}{\text{Sum of the credits of the courses in a semester}}$$

$$\textbf{GPA} = \frac{\sum_i (C_i * G_i)}{\sum_i C_i}$$

Where C_i = Credit earned for course i in any semester.

G_i = Grade points obtained for course i in any semester.

18. Cumulative Grade Point Average (CGPA)

For the entire program CGPA is calculated in the following manner.

$$\textbf{CGPA} = \frac{\sum_n \sum_i C_{ni} * G_{ni}}{\sum_n \sum_i C_{ni}}$$

$$\text{CGPA} = \frac{\text{Sum of the multiplication of grade points by the credits of the entire programme under each part}}{\text{Sum of the Credits of the Courses of the entire programme under each part}}$$

19. Classification of CGPA

A candidate who has passed all the examinations under different parts is eligible for the following part wise computed final grades based on the range of CGPA.

Table 26 : Classification of performance of PG Students based on the Cumulative Grade Points Average

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

a) A candidate who has passed all the subjects examinations in the first appearance within the prescribed duration of the PG programmes and secured a CGPA of 9 to 10 and equivalent grades “O” or “O+” in Core and Electives subjects shall be placed in the category of “First Class – Exemplary”.

b) A candidate who has passed all the subjects examinations in the first appearance within the prescribed duration of the PG programmes and secured a CGPA of 7.5 to 9 and equivalent grades “D” or “D+” or “D++” in Core and Electives subjects shall be placed in the category of “First Class with Distinction”.

c) A candidate who has passed all the subjects examinations of the PG programmes and secured a CGPA of 6 to 7.5 and equivalent grades “A” or “A+” or “A++” shall be declared to have passed in “First Class”.

d) A candidate who has passed all the subjects examination of the PG programmes and secured a CGPA of 5.0 to 6 and equivalent grades “B” or “B+” shall be declared to have passed in “Second Class”.

20. Ranking

A candidate who qualifies for the PG Degree programme passing all the Examinations in the first attempt, within the minimum period prescribed for the programme from the date of admission to the programme and secures First or Second Class shall be eligible for ranking and such ranking will be confined to 10% of the total number of candidates qualified in that particular subject to a maximum of 10 ranks. However the Programmes will be considered for ranking only when there are minimum of 10 students completing that Programme. The improved marks will not be taken into consideration for ranking.

21. Improvement of Marks in the subjects already passed

Candidates desirous of improving the marks awarded in a passed subject in their first attempt shall reappear in the subsequent semester only. The improved marks shall be considered for classification but not for ranking. When there is no improvement, there shall not be any change in the original marks already awarded.

22. Conferment of the Degree

No candidate shall be eligible for conferment of the Degree unless he / she has undergone the prescribed programme of Study for a period of not less than four Semesters in the Institution or has been exempted there from in the manner prescribed and has passed the Examinations as have been prescribed.

23. Question Paper Pattern

A: Question Paper Pattern

Time: 3 Hours **Max Marks: 75**

Knowledge Level	Q. No.	Section	Marks	Description
K1, K2, K3	1 – 10	A(Answer all the questions)	10 x 1 = 10	MCQ
K2, K3	11 – 15	B (Either or pattern)	5 x 5 = 25	Short Answers
K3, K4	16 – 21	C (Answer 3 out of 6)	3 x 10 = 30	Descriptive/ Detailed
K4, K5	22	D (Compulsory Question)	1 x 10= 10	Application Based/ HOTS

B. Question Paper Pattern

Time: 3 Hours **Max Marks: 55**

Knowledge Level	Q. No.	Section	Marks	Description
K1, K2, K3	1 – 10	A(Answer all the questions)	10 x 1 = 10	MCQ
K2, K3	11 – 15	B (Either or pattern)	5 x 4 = 20	Short Answers
K3, K4	16 – 21	C (Answer 3 out of 6)	3 x 6 = 18	Descriptive/ Detailed
K4, K5	22	D (Compulsory Question)	1 x 7 = 7	Application Based/ HOTS

C. Question Paper Pattern –Advanced Learners Course

Time: 3 Hours **Max Marks: 50**

Knowledge Level	Q. No.	Section	Marks	Description
K2, K3	1 – 5	A (Answer all the Questions)	5 × 4 = 20	Short Answers
K3 , K4	6 – 10	B (Either or pattern)	5 × 6 = 30	Descriptive/ Detailed

NOTE: The questions should be numbered continuously running through the Sections A, B and C.

Questions should be evenly distributed among the unit in the syllabus in all the sections of the question paper. While framing questions with internal choice the questions must be identified as (a) or (b). (e.g. 11. a or b). Further, the internal choice must be from the same unit.

The Controller of the Examinations shall arrange for the setting of question papers on the basis the syllabus and the pattern of question paper duly certified by the Chairpersons of the respective Board of Studies.

24. Revision of Regulations and Curriculum

The above Regulation and Scheme of Examinations will be in vogue without any change for a minimum period of three years from the date of approval of the Regulations. The Board may revise / amend / change the Regulations and Scheme of Examinations, if found necessary.

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CURRICULUM

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PG MICROBIOLOGY PROGRAMME OUTCOMES

PO1	**Critical Thinking**	Expertise knowledge in the core areas with wide range of problems solving, environmental factors and administrative placement.
PO2	**Usage of Technology**	Acquire eligibility, competency to be placed in various Microbiological industries.
PO3	**Effective Communication**	Student will communicate scientific concept, experimental result, skills through effective understanding of scientific literature.
PO4	**Environment and Sustainability**	Experiencing the impact of scientific information pertinent to unfamiliar problems through literature survey, experiments, able to apply Research Intelligence in investigations and innovations
PO5	**Individual andTeam Work**	Function effectively understanding of group dynamics, recognise opportunities and contribute positively to collaborative - multidisciplinary domains, demonstrate a capacity for self-management and.
PO6	**Ethics and Values**	Develop knowledge in ethical thinking, quantitative analytical skills and its application to the issues in society.
PO7	**Social Interactions**	Acquire knowledge on harmful and beneficial role played by microbes in human health.
PO8	**Life Long Learning**	Comprehend the role of recent technologies in microbiological applications & research data management.

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Department: Microbiology

PROGRAM EDUCATIONAL OBJECTIVES

After 2 years of the programme, the graduates are expected to attain

PEO1	Offer a sound exposure to students about the theory and practical of microbiology for attaining academic excellence in the field of microbiology.
PEO2	Equip students with adequate research knowledge, techniques for successful career in the field of academics, research, industries and for to pursue higher education.
PEO3	Advance the research skills to conduct research in the thrust areas of Microbiology to benefit the society. The student shall be able to analyze and interpret scientific data to solve technical, conceptual and abstract scientific problems.
PEO4	Make students able to integrate various aspects of microbiology to achieve holistic and societal development.
PEO5	Inculcate entrepreneurship among the students so as to start their own ventures in the field of microbiology and shall be able to develop networking and entrepreneurship skills and establish links with industry and alumni.

PROGRAMME SPECIFIC OUTCOME

M. Sc. (Microbiology)

On completion of M. Sc. (Microbiology), students are able to understand the concept of:

PSO 1	Advanced techniques related to screening, Isolation and Identification of microorganisms from various sources
PSO 2	Microorganisms and their relationship with the environment and their genetic Principles with essential mechanism of biological processes.
PSO 3	Acquiring knowledge in Biomolecules and its clinical applications
PSO 4	The techniques related to Collection, Transport and Processing Clinical Specimens and identification of pathogens and prevention, treatment of infectious Diseases
PSO 5	Acquiring knowledge in relation to skill-based techniques with reference to recombination

SCHEME

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SCHEME OF EXAMINATION

M. Sc. MICROBIOLOGY

Programme Code: PMB

(Applicable to the students admitted during the academic year 2024– 2025 onwards)

Semester	Course Code	Name of the Course	Ins. Hrs/ week	Examinations				Credit
				Dur / Hrs	CIA	ESE	Total Marks	
I	23PGMBC101	Paper I – Essentials of Microbiology	5	3	25	75	100	4
	23PGMBC102	Paper II – Microbial Physiology and Metabolism	5	3	25	75	100	4
	23PGMBC103	Paper III – Analytical Microbiology	5	3	25	75	100	4
	23PGMBC104	Paper IV – Environmental and Agricultural Microbiology	5	3	25	75	100	4
	23PGMBE101 23PGMBE102 23PGMBE103	Elective Paper – I	5	3	25	75	100	4
	24PGMBQ101	Practical I – Analytical Microbiology Practical	5	9	40	60	100	4
	Sub Total		**30**				**600**	**24**
II	23PGMBC205	Paper V – Microbial Genetics and Molecular Biology	5	3	25	75	100	4
	23PGMBC206	Paper VI – Immunology	5	3	25	75	100	4
	23PGMBC207	Paper VII – Microbial Food Technology	5	3	25	75	100	4
	23PGMBC208	Paper VIII – Bioprocess Technology	5	3	25	75	100	4
	23PGMBE201 23PGMBE202 23PGMBE203	Elective Paper – II	5	3	25	75	100	4
	23PGMBQ202	Practical II – Food Microbiology and Immunology Practical	5	9	40	60	100	4
	Sub Total		**30**				**600**	**24**
III	23PGMBC309	Paper IX– Virology and Mycology	5	3	25	75	100	4
	23PGMBC310	Paper X – Microbial Biotechnology and IPR	5	3	25	75	100	4
	23PGMBC311	Paper XI – Biostatistics and Research Methodology	5	3	25	75	100	4
	23PGMBC312	Paper XII – Techniques in Plant and Animal Tissue Culture	5	3	25	75	100	4
	23PGMBE301 23PGMBE302 23PGMBE303	Elective Paper – III	5	3	25	75	100	4
	24PGMBONLC	Online Course through SWAYAM**	-	-	-	-	100	4

	24PGMBQ303	Practical III – Virology, Mycology and Microbial Biotechnology Practical	5	9	40	60	100	4
	23PGMBT301	*Internship Training	-	-	50	-	50	2
	Sub Total		**30**				**750**	**30**
IV	23PGMBC413	Paper XIII – Medical Microbiology	5	3	25	75	100	4
	23PGMBV401	**Project and Viva Voce*	20	-	80	120	200	8
	24PGMBQ404	Practical IV – Medical Microbiology Practical	5	9	40	60	100	4
			30				**400**	**16**
	Total						**2350**	**94**

LIST OF ELECTIVE PAPERS:

Elective Papers	Course code	Group	Name of the Course
Elective Paper I / Semester I	23PGMBE101	**A**	Principles of Quality Assurance in Food
	23PGMBE102	**B**	Diagnostic Microbiology
	23PGMBE103	**C**	Fundamentals of Plant tissue Culture
Elective Paper II / Semester II	23PGMBE201	**A**	Principles of Quality Assurance in Pharmaceuticals
	23PGMBE202	**B**	Techniques in Parasitology
	23PGMBE203	**C**	Fundamentals of Animal tissue Culture
Elective Paper III / Semester III	23PGMBE301	**A**	Total Quality Management (TQM)
	23PGMBE302	**B**	Human Anatomy and Physiology
	23PGMBE303	**C**	Computational Biology, Microbial Genomics and Proteomics

Part	Courses	Semesters	Credit/Points	Marks/Grade
III	Components Core / Elective Papers/ Online course	I to IV	86	2150
III	Research Project	IV	8	200
Total			**94**	**2350**
Optional	i) Advanced Learners Course (ALC) – self study	I – IV	Extra credit – 8 (2 / Paper / Sem.)	400@

@- NOT INCLUDED IN TOTAL MARKS & CGPA CALCULATION

List of Advanced Learners Course (Self Study)

S. No.	Course Code	Name of the Course
1	23PMBSS01	Cellular Organization
2	23PMBSS02	Cell Communication and Cell Signalling
3	23PMBSS03	Developmental Biology
4	23PMBSS04	Inheritance Biology
5	23PMBSS05	Evolution and Behaviour

Question Paper Pattern - Advanced Learners Course

Time:3 Hours Max Marks:100

Knowledge Level		Section	Marks	Description
K2, K3	1-5	A (Either or Pattern)	5×8=40	Short Answer/Define
K3/K4	6-15	B (Answer 5 Out of 10)	5×12=60	Descriptive Detailed

* **Internship Training:**

Industrial Training has to be undergone during II semester vacation period (15 days). Mark shall be given based on training report and presentation.

***Research Project and Viva-Voce Guidelines**

1) Project is pertain to the field of Microbiology
2) Two review meetings should be conducted at regular intervals in the presence of HoD and respective guide.

Review	Maximum Marks
Review I (Last week of December)	15
Review II (Last week of January)	15
Review III (Last week of February)	15
Document preparation and Implementation (First week of March)	15
Paper Publication**	20
Total	**80**

**Wherever it is not possible, an equivalent Assessment tool shall be prescribed by the Board Chairperson.

Dissertation evaluation	80 Marks
Viva-Voce	40 Marks
Total	**120**

Chairman
Board of Studies in Microbiology
Nehru Arts and Science College
Coimbatore

SYLLABUS

SEMESTER – I

Course Code	Title		
23PGMBC101	Paper I – Essentials of Microbiology		
Semester: I	Credits: 4	CIA: 25 Marks	ESE: 75 Marks

Course Objective	To Provide the student with basic knowledge of microorganisms and describe the general properties & characteristics of bacteria.
Course Category	Skill Development
Development Needs	Global
Course Description	This course describes about the history of Microbiology biology of microorganisms, identification of microbes and control of microbes

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand the development of microbiology.	Presentations and lectures	Assignment
CO 2	Acquaintance on study of microbial diversity using different methods and systematics of bacteria.	Interactive lecture	Seminar
CO 3	Identify unique structures, capabilities and functions of microorganisms.	Presentation	Assignment
CO 4	Discuss physiochemical features for growth.	Presentation	Seminar / Assignment
CO 5	Familiarize how to control microorganisms.	Presentation and lectures	Seminar

Offered by	**Microbiology**

Course Content	Instructional Hours / Week: 5

Unit	Description	Text Book	Chapters
I	**Historical Development:** Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Joseph Lister, John Tyndal. History and Scope of Microbiology. Spontaneous generation conflict – Germ Theory of disease.	1	1
		Instructional Hours	**12**
Suggested Learning Methods: Video lectures and discussion			
II	**Microbial Taxonomy:** Domains and Kingdom of life – Bacterial Nomenclature – Various criteria used in bacterial classification: Whittaker's Five kingdom classification. Morphological, physiological, metabolic, serological, ecological and genetic analysis. Outline of Bergey's Manual of systematic bacteriology – Numerical taxonomy – 16S rRNA based classification.	2	2
		Instructional Hours	**12**
Suggested Learning Methods: Video lectures			
III	**Morphology and Fine Structures:** Overview of bacterial cell structure (size, shape, arrangement of membrane and cell wall), cytoplasmic inclusions, mesosomes, flagella and motility, slime, capsule, pili, and endospore. Media – types and preparation.	2	4
		Instructional Hours	**18**
Suggested Learning Methods: Video lecture			

IV	Population growth and its measurement, effect of environmental conditions on growth (pH, temperature, aeration). Continuous and batch culture, cultures and anaerobic cultures. Staining - Simple**,** Gram, Capsule, Spore, Flagellar, Nuclear, Acid fast, Hanging drop technique, albert staining, KOH, LPCB, Giemsa (Parasite Staining).	2	5,6
		Instructional Hours	**18**
Suggested Learning Methods: Video lecture and Group Discussion			
V	**Control of growth of Microbes:** Sterilization, disinfection, antiseptic, sanitizer, germicide, antimicrobial agent, physical methods of sterilization- dry-heat, moist-heat, filtration, radiation, chemical controls- dye alcohols, halogen, formaldehyde, phenols its derivatives, ethylene oxide, detergents.	3	7
		Instructional Hours	**15**
Suggested Learning Methods: Group discussion and Video lecture			
		Total Hours	**75**

Text Books	1. Prescott,Harley, and Klein's, **Microbiology**, 7th Edition, McGraw Hill Education,2008. 2. Dubey R.C., A **Text Book of Microbiology**, S. Chand & Company Ltd., 2013. 3. Jeffrey C. Pommerville, **Fundamentals of Microbiology**, 10th Edition, Jones &Barlett, 2014.
Reference Books	1. Alcamo, E. **Fundamentals of Microbiology**, 6th Edition. Jones and Bartlett Publishers,New Delhi. 2001 **2.** Brooks, G.F., E. Jawetz, J.L. Melnick and E.A. Adelberg. **Medical Microbiology.** 3. 26thEdition, New York: McGraw Hill Medical. 2013. 4. Patricia, M.T. Bailey and Scott's **Diagnostic Microbiology**,13th Edition, Mosby, Inc.Publishers, China. 2014.
Web. URLs	https://microbiologyinfo.com/

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO 3	PSO4	PSO5
CO1	H	H	H	L	M	M	L	M	M	H	H	M	M
CO2	M	M	M	M	H	M	M	M	H	H	H	M	H
CO3	H	L	M	H	M	M	L	H	M	H	H	M	M
CO4	M	H	L	M	L	L	H	M	H	M	H	H	M
CO5	M	M	H	H	M	H	M	H	H	H	M	H	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. Thulasi Sivaraman	Dr. M. Thangavel

Course Code	Title		
23PGMBC102	Paper II - Microbial Physiology and Metabolism		
Semester: I	Credits: 4	CIA: 25 Marks	ESE: 75 Marks

Course Objective	This course provide the students basics of microbial physiology and know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement
Course Category	Employability
Development Needs	Global
Course Description	Students will be able to explain the processes used by microorganisms for their replication, survival, and interaction with their environment, hosts, and host populations.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand the concept of cell structure and functions.	Lecture	Assignment
CO 2	Describe the microbial growth factors.	Lectures/ Video lessons	Seminar
CO 3	Know various types of bacteria involved in photosynthesis and its mechanisms.	Lectures / Video Lessons	Assignment
CO 4	Explain the mechanisms carbohydrate metabolism.	Lectures/ Video lessons	Assignment
CO 5	Develop knowledge on the development on spore and spore structure.	Lectures and Videos	Seminar

Offered by	**Microbiology**

Course Content	Instructional Hours / Week : 5

Unit	Description	Text Book	Chapters
I	**Cell structure and Function:** Cell structure and function Biosynthesis of peptidoglycan - outer membrane, teichoic acid – Exopolysaccharides; cytoplasmic membrane, pili, fimbriae, S-layer. Transport mechanisms – active, passive, facilitated diffusions – uni, sym, antiports. Electron carries.	1	3-5
		Instructional Hours	**15**
Suggested Learning Methods: Video Lectures			
II	**Microbial Growth**: Microbial growth 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 – starvation – adaptative mechanisms in thermophilic, alkalophilic, osmophilic and psychrophilic.	3	9, 16-18
		Instructional Hours	**15**
Suggested Learning Methods: Demonstration and Presentation			
III	**Microbial pigments:** Microbial pigments Autotrophs - cyanobacteria - photosynthetic bacteria and green algae – heterotrophs – bacteria, fungi, myxotrophs. Brief account of photosynthetic and accessory pigments – chlorophyll – fluorescences, phosphoroscenses - bacteriochlorophyll – rhodpsin – carotenoids – phycobiliproteins.	2	12
		Instructional Hours	15

Suggested Learning Methods: Presentations and Video lectures			
IV	**Carbon metabolism:** Carbohydrates – anabolism – autotrophy – oxygenic – anoxygenic Photosynthesis – autotrophic generation of ATP; fixation of CO2 – Calvin cycle – C3 – C4 pathways. Respiratory metabolism – Embden Mayer Hoff pathway – Enter Doudroff pathway – glyoxalate pathway – Krebs cycle – oxidative and substrate level phosphorylation – reverse TCA cycle – gluconeogenesis – Fermentation of carbohydrates – homo and heterolactic fermentations	3	13, 14
		Instructional Hours	15
Suggested Learning Methods: Videos and demonstration			
V	**Bacterial and Fungal Spore:** Structure, function and Cell division – endospore – structure – properties – germination. Microbial development, sporulation and morphogenesis. Hyphae vs yeast forms and their significance. Multicellular organization of selected microbes. Dormancy.	1	13
		Instructional Hours	15
Suggested Learning Methods : Seminars and Group learning			
		Total Hours	**75**

Text Books	1. Byung Hong Kim, Geoffrey Michael Gadd, **Bacterial Physiology and Metabolism**, Cambridge University Press, 2008. 2. Alber G. Moat, John W. Foster, Michael P. Spector, **Microbial** 3. **Physiology**, Wiley & Sons, 2002. 4. Jain J.L., **Fundamentals of Biochemistry**, S. Chand and Company, 2004.
Reference Books	1. Caldwell. D.R. **Microbial Physiology and Metabolism**, Wm C. Brown Publisher.1995. 2. Stainier R.Y. Ingraham,J.L. Wheolis, H.H. and Painter. P,R.**Microbiology**.1986David Freifelder. **Physical Biochemistry**. (2nd Edition) 3. Prescott, L.M J.P. Harley and C.A. Klein. **Microbiology,** 2nd Edition Wm, C. Brown publishers. 1995. 4. Marion G. Macey. Flow **Cytometry Principles and Applications**. 5. Wilson Keith and Walker John, Principles **and Techniques of Biochemistry and Molecular Biology**, 6th Edition. Cambridge University Press, New York, 2005.
Web. URLs	https://www.easybiologyclass.com/carbohydrates-simple-lecture-notes

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	L	L	H	H	M	H	H	M	L	L	H
CO2	H	H	M	L	H	H	M	H	L	M	L	L	H
CO3	H	H	M	M	H	L	M	H	L	L	H	M	H
CO4	H	H	M	M	H	H	L	H	H	M	H	M	M
CO5	H	H	M	M	H	H	L	H	M	M	H	H	M

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. B. David Jayaseelan	Dr. M. Thangavel

Course Code	Title		
23PGMBC103	Paper III - Analytical Microbiology		
Semester: I	Credits: 4	CIA: 25 Marks	ESE: 75 Marks
Course Objective	To make the students to gain knowledge on techniques commonly performed in microbial laboratory		
Course Category	Employability		
Development Needs	Global		
Course Description	The course serves as an introduction to chromatographic analysis, basic principles of mass spectrometry, and reviews different choices of methods and instruments.		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Gain knowledge about microscopy history and principles.	Lecture	Assignment
CO 2	Describe the colorimetric principles by specific methods.	Lectures/ Video lessons	Seminar
CO 3	Develop knowledge on centrifugation basic principles and applications.	Lectures / Video Lessons	Assignment
CO 4	Understand the principles and application of chromatography.	Lectures/ Video lessons	Assignment
CO 5	Explain the electrophoresis principle, types, and applications.	Lectures and Videos	Seminar

Offered by	Microbiology

Course Content	Instructional Hours / Week: 5

Unit	Description	Text Book	Chapters
I	**Historical Development:** Microscopy: history and principles of microscopy, properties of light, magnification power, resolution, limit, resolving. Bright field - Dark Field - Phase contrast Fluorescence microscope confocal microscopy, atomic force microscope Electron Microscope - Specimen preparation -TEM and SEM.	2	4
	Instructional Hours		15
Suggested Learning Methods: Video Lectures			
II	**Spectrophotometry:** Principles, Instrumentation and Applications of Colorimetry and Spectrophotometer – UV visible, IR spectroscopy, FT-IR, NMR, Principles, theory and applications of Flame photometry and spectrofluorometry.	1	5
	Instructional Hours		15
Suggested Learning Methods: Demonstration and Presentation			
III	**Centrifugation:** Basic principles of centrifugation, differential and density gradient: zonal and isopycnic centrifugation. Sedimentation coefficient, factors affecting sedimentation coefficient. Ultracentrifuges: analytical and preparative with application. Rotors: types and applications.	1	3
	Instructional Hours		15
Suggested Learning Methods: Presentations and Video lectures			

IV	**Chromatography:** Principles, Instrumentation, Types and Detection methods – Ion exchange, Column, Paper Chromatography, TLC, HPLC, GC, GCMS, GCMSMS, LCMS, LCMSMS. Chromatography Applications.	1	4
		Instructional Hours	**15**
Suggested Learning Methods: Videos and demonstration			
V	**Electrophoresis:** Principles, Instrumentation, Types. Staining and Detection methods – Isoelectrophoresis – isoelectric focusing – Applications MALDI-TOF, 2D gel electrophoresis Native PAGE and SDS-PAGE.	1	4
		Instructional Hours	**15**
Suggested Learning Methods: Seminars and Group learning			
		Total Hours	**75**

Text Books	1. Rodney Boyer. **Biochemistry Laboratory Modern theory and techniques** 2rd Edition, Pearson Education, 2012 edition 2. Keith Wilson and John Walker. **Principles and Techniques in Practical Biochemistry**, 7th Edition, Cambridge University Press, 2000.
Reference Books	1. Kathleen Talaro and Arthur Talaro. **Foundation in Microbiology**. WCB Publishers. 1993. 2. David Freifelder. **Physical Biochemistry**. (2nd Edition) 3. 3. Prescott, L.M J.P. Harley and C.A. Klein. **Microbiology,** 2nd Edition Wm, C. Brown publishers. 1995. 4. Marion G. Macey. Flow **Cytometry Principles and Applications**. 5. Wilson Keith and Walker John, Principles **and Techniques of Biochemistry and Molecular Biology**, 6th Edition. Cambridge University Press, New York, 2005
Web. URLs	1. https://www.saylor.org/site/wp-content/uploads/2012/07/Chapter121.pdf 2. http://gnu.inflibnet.ac.in:8080/jspui/bitstream/123456789/1262/1/colorimetry.pdf.

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	H	H	L	L	H	H	M	H	H	M	L	L	H
CO2	H	H	M	L	H	H	M	H	L	M	L	L	H
CO3	H	H	M	M	H	L	M	H	L	L	H	M	H
CO4	H	H	M	M	H	H	L	H	H	M	H	M	M
CO5	H	H	M	M	H	H	L	H	M	M	H	H	M

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. K. E. Vivekanandan	Dr. M. Thangavel

Course Code	Title		
23PGMBC104	Paper IV - Environmental and Agricultural Microbiology		
Semester: I	Credits: 4	CIA: 25 Marks	ESE: 75 Marks
Course Objective	To gain understanding the role of microbes in soil physiology, as well as air pollution and its sources and causes, as well as environmental contamination and toxicology, environmental health, monitoring, technology, geology, and management		
Course Category	Skill Development		
Development Needs	Global		
Course Description	Acquire knowledge about different microbes from air, soil and water Pollution and their water borne diseases, biogeocycles. And the use of biofertilizer and chemical fertilizer.		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Acquire the knowledge of different microbes from air, air sanitization and air sampling by using various techniques.	Lecture	Assignment
CO 2	Know the Microorganisms responsible for water pollution especially Water-borne pathogenic microorganisms and their transmission.	Lectures/ Video lessons	Seminar
CO 3	Understand the factors influencing presence of and activities of microorganisms in water.	Lectures / Video Lessons	Assignment
CO 4	Understand various biogeochemical cycles – Carbon, Nitrogen, Phosphorus cycles etc. and microbes involved.	Lectures/ Video lessons	Assignment
CO 5	Understanding the use of Biofertilizers is being emphasized along with chemical fertilizers and organic manures.	Lectures and Videos	Seminar

Offered by	Microbiology

Course Content	Instructional Hours / Week: 5

Unit	Description	Text Book	Chapters
I	**Aerobiology**-Microbial contamination of air-Biological indicators of air pollution. Air sampling Devices. Significance of air Microflora, Air sanitation- methods and applications. Room sanitation in Hospitals, Industries and Pharmaceuticals etc. Outline of Airborne diseases and preventive measures. Effect of Air pollution on plants and Humans.	2	15
	Instructional Hours		**15**
Suggested Learning Methods: Video Lectures			
II	**Water Microbiology-** Water Pollution and Waterborne Pathogens- Assessment of water quality (Microbial) Bacteriological examination of water MPN - Indicator organisms. Bacteriological analysis of drinking water and other quantitation techniques; drinking water purification. Total Microbial Count – *E. coli.* Waste water- Sources, types, composition and characteristics (DO, BOD, COD). Microbiology of waste water. Sewage treatment.	1	2
	Instructional Hours		**15**
Suggested Learning Methods: Demonstration and Presentation			
III	**Soil Microbiology**-Structure, Types, Physical and Chemical Properties-Soil microbes (Types and Enumeration). Soil as a	1	9-11

	source of industrial strains. Biogeochemical cycling-Nitrogen, Carbon, Phosphorous, Sulphur, Iron cycles and its importance alkalophilic, osmophilic and psychrophilic		
		Instructional Hours	15
Suggested Learning Methods: Presentations and Video lectures			
IV	**Microbial interactions:** Positive and Negative interactions. Microbial flora of soil. Plant – Microbe interactions: -. Nitrogen fixation- Symbiotic and non-symbiotic, physiology and genetics of nitrogen fixation. Mycorrhizae, Rhizosphere and Phylloplane microorganisms. Animal-Microbe Interactions - Rumen microflora, Nematophagous fungi, Bioluminescent bacteria, Termite nutrition	2	48
		Instructional Hours	15
Suggested Learning Methods: Videos and demonstration			
V	**Applications of microbes in agriculture:** Biofertilizers. Mass production of biofertilizers. Bio pesticides- bacterial, fungal and viral. Advantages and disadvantages of biopesticides over the chemical counterparts. GM crops and its significance.	2	14,15, 37 & 45
		Instructional Hours	15
Suggested Learning Methods: Seminars and Group learning			
		Total Hours	**75**

Text Books	1. Subba Rao N.S. **Soil microbiology**, 4th Edition Oxford and PHB publishers. 2020. 2. Vijay Ramesh. K. **Environmental Microbiology.** 2019.
Reference Books	1. Gupta P.K. **Biotechnology and genomics,** Rastogi Publications. 2013. 2. Larry. L. Barton, **Microbial Ecology**, Atlas and Bartha. 1st Edition. 2011. 3. Singh DP& SK Dwivedi. **Environmental Microbiology and Biotechnology.** 1st Edition, New Age International (P) Ltd., Publishers, New Delhi. 2005. 4. Joseph C Daniel. **Environment Aspects of Microbiology.**1st Edition, Bright sun Publications, Chennai. 1999.
Web. URLs	1. https://drive.google.com/file/d/1R7kCrPX14ejScvHuEAxIs3a1N9NC1EdO/view?usp=sharing 2. https://drive.google.com/file/d/1kz/Q4K6Ta8pHneJxzdRcuqFG7UOhWq9y/view?usp=sharin

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	L	L	H	H	M	H	H	M	L	L	H
CO2	H	H	M	L	H	H	M	H	L	M	L	L	H
CO3	H	H	M	M	H	L	M	H	L	L	H	M	H
CO4	H	H	M	M	H	H	L	H	H	M	H	M	M
CO5	H	H	M	M	H	H	L	H	M	M	H	H	M

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. S. Esath Natheer	Dr. M. Thangavel

Course Code	Title		
23PGMBE101	Elective Paper I – Group A – Principles of Quality Assurance in Food		
Semester: I	Credits: 4	CIA: 25 Marks	ESE: 75 Marks

Course Objective	To make the students to gain knowledge on techniques commonly performed in afood industry
Course Category	Employability
Development Needs	Global
Course Description	Typical QA and QC programs, such as the good manufacturing practices (GMP) and the hazard analysis and critical control points (HACCP), together with the new regulations related to the Food Safety Modernization Act (FSMA).

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Develop knowledge on food hazards.	Lecture / Flipped Classroom	Assignment
CO 2	Improve management of quality assurance in food industry.	Tutorial	Seminar
CO 3	Create step by step operating procedures and work on instructions.	Lectures / Video Lessons	Quiz
CO 4	Understand food safety and good manufacturing practices.	Tutorial / Case Studies	Seminar
CO 5	Gain knowledge on food safety microbial standards and applications.	Lecture / Industrial Visit	Quiz

Offered by	**Microbiology**

Course Content	**Instructional Hours / Week: 5**

Unit	Description	Text Book	Chapters
I	**Food Safety and Hazards in Food:** Definition, Biological hazards in foods - Pathogenic bacteria, viruses, parasites. Chemical hazards in foods - Permitted food additives, naturally occurring harmful compounds, Unavoidable contaminants, Agricultural residues, Industrial contaminants, Chemical residues, Prohibited chemicals, Food allergens. Physical hazards in foods - Broken glass, Plastic, Metal pieces, Wood pieces, Stones, Personal articles.	1	2
	Instructional Hours		**15**
Suggested Learning Methods: You tube videos			
II	**Quality Assurance**: Theories and Applications, Functions of a Quality Assurance Program, Careers in Quality Assurance, QA Responsibilities and Operational Interactions, Need for and Roles of QA, Organization of a QA Program, QA Personnel, QA Audits, Product Quality Audits.	2	3
	Instructional Hours		**15**
Suggested Learning Methods: Interactions / Group Discussions			
III	**Manufacturing Audits - Control of Processing Operations**: Objectives, elements, education, training, Process control documentation, Unit Operations in the Food Industry - Materials Handling, cleaning, separation, disintegration,	2	6

	pumping, mixing, heating, cooling, evaporating, drying, packaging.		
		Instructional Hours	**15**
Suggested Learning Methods: Industrial Visit			
IV	**Good Manufacturing Practice Audits**: Food Plant Sanitary Practices, Value of a Planned Sanitation Program, Quality Assurance and Sanitation, Food Plant Sanitation Management, Employee Hygiene and Sanitary Handling of Food, Sanitation and Housekeeping, Pest Control in Food Processing Plants, Sanitation Laws and Regulations, The Sanitation/GMP Audit.	2	7
		Instructional Hours	**15**
Suggested Learning Methods: Group Discussion			
V	**HACCP:** Concept, importance, advantages, guidelines, training, program development, principles, Implementation and maintenance of HACCP program, regulatory aspects of HACCP, sanitation and the HACCP concept.	2	9
		Instructional Hours	**15**
Suggested Learning Methods: Group Discussion / Industrial Visit			
		Total Hours	**75**

Text Books	1. Inteaz Alli. Food Quality Assurance: Principles and Practices, CRC Press, 2003. 2. Andres Vasconcellos J., Quality Assurance for the Food Industry: A PracticalApproach. CRC Press, 2003.
Reference Books	1. Jay JM, Loessner MJ, Golden DA. **Modern Food Microbiology**, 7th Edition. Springer,2005. 2. Rosamund M. Baird, Norman A. Hodges and Sephen P. Denyer. **Handbook ofMicrobiological Quality Control**, CRC Press, 2000.
Web. URLs	1. https://www.academia.edu/41208822/Food_Quality_Management_Notes 2. http://foodtechnotes.com/category/quality-control-and-quality-assurance-and-tqm/.

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	H	H	M	H	H	H	H	M	H	H	L	L	H
CO2	H	H	M	M	H	H	H	H	H	H	L	L	H
CO3	H	H	H	H	H	H	M	M	M	M	M	L	H
CO4	H	H	M	H	H	H	H	H	M	M	H	M	H
CO5	H	H	M	M	H	H	M	H	M	M	H	M	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr .K. E. Vivekanandan	Dr. M. Thangavel

Course Code	Title		
23PGMBE102	Elective Paper I – Group B – Diagnostic Microbiology		
Semester: I	Credits: 4	CIA: 25 Marks	ESE: 75 Marks

Course Objective	To assimilate Knowledge across diagnostic procedures in microbiology
Course Category	Skill Development, Employability and Entrepreneurship
Development Needs	Global/Local/Regional
Course Outcomes	This is a skill-oriented course that will help the student to acqui8re the practical skills that will enable them to get employment in hospitals or to start their own laboratories and become an entrepreneur

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Develop Knowledge and awareness of the basic principles and concepts of infections	Chalk & talk	Seminar
CO 2	Acquire knowledge on the diagnostic skills of bacterial identification	Videos	Assignment
CO 3	Understand the fungi and the diagnostic skills of fungal infections	Videos	Assignment
CO 4	Provide diagnostic skills to identify Viral infections	Practical	Quiz
CO 5	Apply the knowledge on the diagnostic skills of parasitic infections	Charts Model and Practical	Seminar and group discussion

Offered by Microbiology

Course Content — **Instructional Hours / Week: 5**

Unit	Description	Text Book	Chapters
I	Infection – Definition, Types, Sources and Mode of transmission- Selection, collection and transport of specimens – Blood, Urine, Sputum, CSF, Pus & Faeces – transport media and storage.	1,5,6	15
		Instructional Hours	**15**
Suggested Learning Methods: **Video and Experiments**			
II	Microscopic examination of specimen for Bacterial pathogens – simple, differential staining and motility. Identification of organisms - Biochemical reaction – Sugar fermentation test antimicrobial susceptibility testing	1,5,6	**20**
		Instructional Hours	**20**
Suggested Learning Methods: Video and Experiments			
III	Laboratory methods in basic Mycology – Collection and transport of clinical specimens – Direct Microscopic examination, KOH method, culture media and incubation, Serological tests for fungi – Antifungal susceptibility testing.	3	**10**
		Instructional Hours	**12**
Suggested Learning Methods: Demonstration			
IV	General Structure, Properties and Classification, Spread of viral infections and diagnosis of Viral infections- Hepatitis and HIV- ELISA, IFT,	3	**15**
		Instructional Hours	**13**

Suggested Learning Methods: Experiments and Demonstration			
V	Laboratory methods for parasitic infections – Diagnostic techniques for gastrointestinal and urino-genital specimen. Parasitic diseases- *Entamoeba histolytica, Taenia solium, Enterobius,* and *Plasmodium vivax,*	2	15
		Instructional Hours	**15**
Suggested Learning Methods: Experiments and Demonstration			
		Total Hours	**75**

Text Books	1. 1.Textbook of Microbiology, Ananthanarayanan and Jayaram Panicker 2. Text book of Medical Parasitology - Jayaram Panicker 3. Clinical Mycology – Eliasw.J. Michael.R 4. Textbook of Medical Microbiology- Geo.F. and Brooks.S
Reference Books	1. Bailey and Scotts - Diagnostic Microbiology, Mosby, Inc, 2. Medical Microbiology – Jawetz 3. Virology, Textbook of Microbiology, Ananthanarayanan and Jayaram Panicker
Web. URLs	https://microbiologysociety.org/members-outreach-resources/links.html

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Quiz	Assignment	Seminar	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	H	H	H	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	H	H	H	H	H	H
CO3	M	M	M	M	M	M	M	M	M	M	M	M	M
CO4	M	M	M	M	M	M	M	M	M	M	M	M	M
CO5	L	L	L	L	L	L	L	L	L	L	L	L	L

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. K. E. Vivekanandan	Dr. M. Thangavel

Course Code	Title		
23PGMBE103	Elective Paper I – Group C – Fundamentals of Plant Tissue Culture		
Semester: I	Credits: 4	CIA: 25 Marks	ESE: 75 Marks

Course Objective	To learn the basics of plant tissue culture for rapid clonal propagation *in vitro*
Course Category	Skill Development
Development Needs	Global
Course Description	Principles and culture techniques of cells, callus, organs, pollen, anthers, embryos, and protoplasts. The applications in clonal propagation and research in breeding, physiology, and pathology.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand on basic development of plant tissue culture.	Lecture	Assignment
CO 2	Gain knowledge on the setup of laboratory and sterilization techniques.	Flipped Classroom	Seminar
CO 3	Acquire knowledge on media used for culture techniques and their preparation.	Lectures / Videos	Quiz
CO 4	Understand the different concepts of tissue culture.	Case Studies	Assignment
CO 5	Learn the techniques for production of plants through *in vitro* condition.	Lecture / Demonstration	Seminar

Offered by | **Microbiology**

Course Content	Instructional Hours / Week : 5

Unit	Description	Text Book	Chapters
I	**Introduction to Plant tissue culture:** Origin and development, history, scope and applications, culture room and vessels, medium constitution and functions of each element, growth regulators; Setting up of primary culture.	1	1
		Instructional Hours	**15**
Suggested Learning Methods: Demonstration			
II	**Laboratory design and sterilization techniques:** Washing and storage facilities, Media preparation room, Transfer area, Culture room, Data collection area and specialized facilities and Transplantation area. Sterilization techniques – Dry heat, flame, moist heat, filter, surface sterilization.	2	2
		Instructional Hours	**15**
Suggested Learning Methods: Group Learning			
III	**Tissue Culture Media and Preparation:** Media composition, Types of media, Media preparation, Selection of new media, sterilizing the culture vessels and media, Aseptic culture technique	2 1	3 & 4 3
		Instructional Hours	**15**
Suggested Learning Methods: Hands on training			
IV	**Concepts of tissue culture:** Totipotency, differentiation, dedifferentiation and redifferentiation. Micropropagation; Raising of virus free and pest resistant plants, methods. Somatic embryogenesis:	3	5

	Factors and molecular aspects.		
		Instructional Hours	**15**
Suggested Learning Methods : You tube videos			
V	**Initiation of plant tissue culture:** Induction and growth parameters; Culture initiation, Callus culture, Formation, cloning, suspension culture, regeneration. Micropropagation through various explants (Leaf, Stem, Axillary bud, Tuber, Corms and Bulbills).	2	6
		Instructional Hours	**15**
Suggested Learning Methods : Laboratory practice			
		Total Hours	**75**
Text Books	Smith, R.H. Plant Tissue culture techniques and experiments, Academic Press. 2013. Razdan, M.K. Introduction to plant tissue culture. Science publishers, inc, USA, 2nd edition. 2002. Bhojwani, S.S. and M.K. Razdan. Plant tissue culture: Theory and Practice, Elseiver Science, 1st Edition, New York. 1996.		
Reference Books	Guptha, P.K. **Elements of Biotechnology**. Rastogi Publications, 2016 Slater, A., Scott, N. and Fowler, M. Plant Biotechnology: The Genetic Manipulation of Plants, Oxford, 2008.		
Web. URLs	https://nptel.ac.in/courses/102/103/102103016/ https://www.mooc-list.com/tags/biotechnology https://www.coursera.org/courses?query=biotechnology		

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	H	H	M	H	H	H	M	H	L	L	L	L	H
CO2	H	H	M	H	H	H	L	H	L	L	L	L	H
CO3	M	H	L	H	H	H	L	H	H	L	L	L	H
CO4	H	H	L	H	H	L	L	H	L	L	L	L	H
CO5	H	H	L	L	H	H	L	H	L	M	L	L	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. K. E. Vivekanandan	Dr. M. Thangavel

Course Code	Title		
24PGMBQ101	Practical I: Analytical Microbiology Practical		
Semester: I	Credits: 4	CIA: 40 Marks	ESE: 60 Marks

Course Objective	To develop skills to isolate and identify the microorganisms
Course Category	Skill Development / Employability
Development Needs	Global
Course Description	Gain knowledge on sterilization techniques and develop skills to isolate and identify the microorganism on the basis of morphology by staining techniques and cultural characteristics.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	To understand about the laboratory guidelines for safety and about different sterilization methods.	Lecture / Hands on training	Behaviour
CO 2	To develop skills to identify the morphology of microorganisms by performing different staining techniques.	Hands on training / Video lectures	Observation and performance
CO 3	To acquire knowledge on media preparation, culture techniques and preservation of microorganisms.	Hands on training	Performance
CO 4	To understand and develop skills on cultivation of anaerobic microorganisms	Hands on training	Performance
CO 5	To demonstrate the working principles of advanced instruments.	Demonstration	Observation

Offered by	Microbiology

Course Content	Instructional Hours / Week: 5

Exp. No.	Experiments
1	Laboratory precautions and safety measures.
2	Methods of Sterilization - Principles and Methods - Physical Methods - Dry heat - Hot Air Oven, Moist heat –Autoclave, Chemical methods - Alcohols, Aldehydes
3	Bacterial Staining - Simple, Grams, Acid fast, Spore, Capsule
4	Isolation of bacteria and fungi from food waste samples
5	Culture media preparation, Liquid and Solid media. Types of media - Simple, Defined, Complex, Enriched, Enrichment, Differential, Selective, transport and Anaerobic media
6	Pure Culture Techniques – Pour plate, Spread plate and Streak plate
7	Enumeration of Bacteria, fungi and Actinomycetes from soil
8	Cultural Characteristics of Microorganisms

9	Measurement of microbial cell load – Turbidometry method
10	Isolation of bacteria from water, vegetables and food samples by Standard Plate Count
11	Cultivation of Anaerobic Bacteria - Robinson's Cooked meat media, Wright's tube method
12	Micrometry
13	Advanced Lab Instrumentation – Thermal cycler, Spectrophotometer, SDS PAGE, Blotting, HPLC, GCMS
14.	Analysis of water – DO, BoD, CoD, TSS, SS, TDS, pH.
Instructional Hours	**75**

Text Books	1. Rajan S and Selvi Christy R. Experimental Procedures in Life Sciences. Anajana Book House, Chennai, 2015. 2. James G Cappuccino and Natalie Sherman. Microbiology – A Laboratory Manual. Pearson Education Limited, 2017.
Reference Books	1. Dubey R C and Maheshwari D K., Practical Microbiology. S Chand and Co. Ltd., New Delhi, 2002. 2. P. Gunasegaran, Laboratory Manual in Microbiology. New Age International. 2007.
Web. URLs	1. https://microbenotes.com/fields-of-microbiology/ 2. https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Boundless)/1%3A_Introduction_to_Microbiology/1.3%3A_The_Science_of_Microbiology/1.3B_Applied_Microbiology

Tools for Assessment (40 Marks)

Laboratory Performance			Test I	Test II	Observation Note Book	Total
Level of Engagement in Lab	Preparation	Result				
5	5	5	10	10	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	H	M	M	H	H	M	M	H	M	M
CO2	H	M	H	H	M	H	M	M	H	H	H	M	M
CO3	M	H	M	M	M	H	L	H	H	M	M	H	M
CO4	L	M	M	H	M	M	H	H	H	M	L	H	H
CO5	L	H	H	M	L	H	L	M	M	M	L	M	L

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. S. Esath Natheer	Dr. M. Thangavel

SEMESTER – II

Course Code	Title		
23PGMBC205	Paper V - Microbial Genetics and Molecular Biology		
Semester: II	Credits: 4	CIA: 25 Marks	ESE: 75 Marks

Course Objective	To make the students to gain knowledge about the structure and function of biologically important molecules. Students will gain inputs of how the DNA, RNA and the molecular events that governs the cell functions.
Course Category	Employability
Development Needs	Global
Course Description	This course develops concept of Microbial genome organization, DNA, RNA, (Prokaryotic and Eukaryotic), Viral Genetics, Mutagenesis, Bacterial plasmids as research tools, transcription and translation in prokaryotes and eukaryotes and application of microbial genetics.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Describe the structure and function of DNA and RNA in a cell	Video Lecture	Assignment
CO 2	Elucidate the biological process in the cell and the regulation	Video Lecture	Seminar
CO 3	The RNA synthesis and the control mechanisms is understood	Video Lessons	Quiz
CO 4	To understand how molecular transformation process happens	Video Lessons	Assignment
CO 5	To understand and comprehend DNA repair and recombination	Presentations	Seminar

Offered by	**Microbiology**

Course Content	Instructional Hours / Week: 5

Unit	Description	Text Book	Chapters
I	**DNA**: Discovery of DNA as a genetic material, Structure, Salient features of double helix, Types of DNA, denaturation, and renaturation, topoisomerases; Organization of DNA Prokaryotes, Viruses, Eukaryotes. RNA Structure	1	10
		Instructional Hours	**15**
Suggested Learning Methods: Group Learning			
II	**Replication:** Bidirectional and Unidirectional replication, semi-conservative, semi-discontinuous replication, Mechanism of DNA replication; Enzymes and Proteins involved in DNA replication -DNA polymerases, DNA Ligase, Primase, telomerase-for replication of linear ends.	3	3
		Instructional Hours	**15**
Suggested Learning Methods: Group learning and Videos			
III	**Transcription:** Definition, Promoter, concept, and strength of promoter. Transcriptional machinery and mechanisms of transcription. Reverse transcription, Principles of transcriptional	1	13

	regulation, regulation at initiation with examples from *lac* and *trp* operons.		
		Instructional Hours	**15**
Suggested Learning Methods: Group learning			
IV	**Transformation:** Discovery, Mechanism of natural competence conjugation- Discovery, Mechanism, Hfr and F^+ strains Transduction-Generalized transduction, specialized transduction. Property and functions of plasmids, types of Plasmids.	2	15
		Instructional Hours	**15**
Suggested Learning Methods: Seminars and Presentation			
V	**DNA repair and recombination:** DNA Mismatch Repair, Double strand, break and repair, Recombination as a molecular biology tool mutations and mutagenesis. Definition and types of mutations; Physical and chemical mutagens; Uses of mutations.	1	18
		Instructional Hours	15
Suggested Learning Methods: Seminars and Group learning			
		Total Hours	**75**

Text Books	1. Benjamin A. Pierce, Genetics- **A Conceptual Approach** W.H. Freeman and Company, 5th 2014. 2. Peter J. Russel, Genetics- **A Molecular Approach**. Pearson Education Inc., Third edition, 2010.' 3. Primrose, S.B., R.M Twyman , **Principles of Gene manipulation and Genomics**, Black well Publishing, Seventh edition 2006.
Reference Books	1. James D. Watson, Alexander Gann, Tania A. Baker, Michael Levine, Stephen P.Bell Rishardlosick, **Molecular Biology of Gene,** Cold Spring Harbor Laboratory Press. New York, 7th edition, 2017.\ 2. Primrose S.B.,R.,M Twyman and R.W.Old, Principle of Gene manipulation Sixth edition, Blackwell Science Publishing, 2008. 3. Brown T.A. Gene Cloning and DNA Analysis- An Introduction, Wiley Blackwell publishing, 2016, 7th edition
Web. URLs	1. https://ocw.mit.edu/courses/hst-161-molecular-biology-and-genetics-in-modern-medicine-fall-2007/.

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	H	H	L	H	H	H	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	M	H	M	H	H	H
CO3	H	H	L	M	H	H	H	H	H	H	H	M	H
CO4	H	L	L	L	H	H	H	H	H	H	H	H	H
CO5	H	M	L	M	H	H	H	H	H	H	H	H	M

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. R. Kasimani	Dr. M. Thangavel

Course Code	Title		
23PGMBC206	Paper VI - Immunology		
Semester: II	Credits: 4	CIA: 25 Marks	ESE: 75 Marks

Course Objective	To make the students to gain knowledge on techniques commonly performed in a microbiology laboratory
Course Category	Employability
Development Needs	Global
Course Description	Course covers the study of the molecular and cellular interactions and principles of the immune system. Topics include immune system development, humoral & cell-mediated immunity, disease and treatments involving immunization, immunodeficiency, and autoimmunity.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Gain knowledge about the cells and organs of the immune system	Lecture / Flipped Classroom	Assignment
CO 2	To gain knowledge about the antibody reaction and determination	Tutorial / Videos	Seminar
CO 3	Acquire knowledge about various types of antigens and antibodies	Lectures / Video Lessons	Model Preparation
CO 4	To understand the various types of hypersensitive reactions and allergic reactions	Tutorial / Case Studies	Quiz
CO 5	To understand and explain the basis of immunological tolerance, autoimmunity, and transplantation and to understand and explain the immune system in cancer; tumour immunology and principles of immunotherapy	Lecture / Video Lectures	Assignment

Offered by | **Microbiology**

Course Content	Instructional Hours / Week: 5

Unit	Description	Text Book	Chapters
I	**Cells and Organs of Immune system**: Cells of the immune system- lymphoid cells, mononuclear cells, granulocytic cells, mast cells. T&B -cell maturation, activation, and differentiation. Organs of the immune system	2,3	3,2
		Instructional Hours	**15**
Suggested Learning Methods: Video lectures			
II	**Antigens and Immunoglobulin's:** Factor influence immunogenicity -Haptens- study of antigenicity, Immunoglobulin's-structure, types of biological activities. Antigenic determinants, Monoclonal antibodies.	1,3	11,14
		Instructional Hours	15
Suggested Learning Methods: Demonstration			

III	**Antigen -Antibody reactions:** Agglutination and precipitation, Immunoelectrophoresis, Complement fixation test, Immunofluorescence, ELISA, RIA, Immunoelectron microscopy, Forensic serology, Immunohematology- ABO, RH incompatibility.	1,3	13,6
		Instructional Hours	15
Suggested Learning Methods: Videos			
IV	**Hypersensitive reaction-** Types of hypersensitivity I-V reactions, complement system- classical, lectin pathways, biological consequences. T-cell receptor, cytokines – Structure, functions, and receptors.	3	7,13
		Instructional Hours	15
Suggested Learning Methods:			
V	**Antigen processing and Presentation:** Transplantation immunology- Transplantation antigens, HLA typing. MHC and its types, Histocompatibility. Tumour immunology- treatment of tumours. Immune response to infectious disease	1,3	19,20
		Instructional Hours	15
Suggested Learning Methods: Laboratory practice			
		Total Hours	**75**

Text Books	**1.** Ananthanarayan, R., and Panicker, C.K.J., Text Book of Microbiology. Orient Longman, New Delhi, 2004. **2.** Coleman, R.M., Lombard, M.F., Sicard, R.E., Fundamental Immunology, 4th edition, Wm.C. Publishers. London.2000 3. Goldsby, RA., Barbara, T.J.K., and Osborne, A., Kuby Immunology, 6th edition, W.H Freeman and Company, New York, 2006
Reference Books	1. Coleman, R.M., Lombard, M.F and Sicard, R.E., Fundamentals of immunology, 4th edition, WMC Publications. London, 2000 2. Hyde, R.M. NMS-Immunology. 4th edition, Lippincott Williams and Wilkins Baltimore, 2000. 3. Janeway, Jr. C.A., Walport, P.T.M., and Shlomchick, M.J., Immunobiology-The Immune system in Health and Disease, 5th edition, Churchill Livingstone-Garland Publishing company, New York, 2001
Web. URLs	https://www.roitt.com/

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	L	M	M	M	L	H	H	H	M	H
CO2	H	H	H	L	H	L	L	M	H	M	H	H	M
CO3	H	M	L	M	M	L	H	H	H	H	H	M	H
CO4	H	L	M	M	M	H	L	M	H	H	H	H	H
CO5	H	L	M	M	H	H	H	H	H	H	H	H	M

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. B. David Jayaseelan	Dr. M. Thangavel

Course Code	Title		
23PGMBC207	Core Paper VII: Microbial Food Technology		
Semester: II	Credits: 4	CIA: 25 Marks	ESE: 75 Marks

Course Objective	To gain the knowledge of various types of food spoilage and an understanding the principles of food processing and to improve the food quality for the general public
Course Category	Employability / Entrepreneurship
Development Needs	Global
Course Description	Food borne pathogens caused by spoiled food and methods used to preserve them by physical methods. Also understand the importance of HACCP protocols

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand about the growth factors required for the growth and food spoilage mechanism	Lecture / Chalk and talk	Assignment
CO 2	Gain knowledge about the food borne pathogens	Lectures / Video Lessons	Seminar
CO 3	Analyse about the microbiological examination of food and their preservation techniques	Lectures / Case study	Quiz
CO 4	Know about the use of microorganisms in food industries for public health benefits	Tutorial / Group Discussion	Seminar / Assignment
CO 5	Gain knowledge on production of industrially important compounds	Lecture / Tutorial	Seminar

Offered by	**Microbiology**

Course Content	Instructional Hours / Week: 5

Unit	Description	Text Book	Chapters
I	**The Scope of Food Microbiology:** Microorganism and food, Food preservation, Food safety. **Factors influencing Microbial growth:** Intrinsic factors, Nutrient content, pH, anti-microbial barrier and constituents, Extrinsic factors: relative humidity, temperature, Gaseous atmosphere.	1	1, 3
	Microbiology of primary food commodities: Spoilage, Spoilage of meat, Structure and composition, Spoilage of fresh meat, Spoilage of fish, structure and composition, spoilage of fresh fish.	1	4, 5
		Instructional Hours	**15**
Suggested Learning Methods: Video lectures about the factors influencing growth and spoilage of meat			
II	**Food borne diseases**: Introduction to Foodborne Pathogens, Host invasion, Pathogenesis. Staphylococcal Gastroenteritis, Habitat, distribution, nutritional requirement and growth.	2	7, 22

	Fermented milk products: Dairy products, Milk biota, Cheese, Butter. Health benefits of fermented milk, Anti-cancer effect, probiotics. Botulism, Salmonellosis, Gastroenteritis, Shigellosis and Yersiniosis.	2	26
		Instructional Hours	**15**
Suggested Learning Methods: Prepare a chart distinguishing the pathogens which cause spoilage			
III	**Microbiology of food preservation:** Preservation by use of High temperature, Low temperature, Canning, Drying, Radiation and Food additives. Heat processing - Pasteurization, Appertization**,** Quantifying Thermal Death of microorganism D values, Aseptic packaging methods**.**	1	3, 4
	Methods for the Microbiological Examination of Foods: Indicator organism, Direct examination, Rapid Methods for the Detection of Specific Organisms and Toxins, Laboratory Accreditation.	1	10
		Instructional Hours	**15**
Suggested Learning Methods: Laboratory practice			
IV	**Food Microbiology and Public Health:** Food Hazards, Significance of Foodborne Disease, Risk Factors Associated with Foodborne Illness, The Alimentary Tract: Its Function and Microflora.	3	6
	Chemical Preservatives: Nitrite, Sulfur Dioxide, 'Natural' Food Preservatives, Control of Water Activity.	3	4
		Instructional Hours	**15**
Suggested Learning Methods: Video lectures about the hazards caused by the foodborne pathogens			
V	**Production of Industrially important compounds:** Organic acids (vinegar, lactic acid), alcoholic beverages (beer, wine, and distilled alcoholic beverages such as whiskey, rum), glycerol. Propagation of baker's yeasts; Microbial production of vitamins (B2 and B12), antibiotics (penicillin, streptomycin, tetracycline); Enzymatic production of glucose, fructose, starch, SCP and mushrooms	3	9
		Instructional Hours	**15**
Suggested Learning Methods : Video lectures and visit to the industry			
		Total Hours	**75**

Text Books	1. M.R. Adams and M.O. Moss, Food Microbiology. 2nd Edition. Royal society of chemistry. Thomas Graham House, science park, Cambridge. 2005. 2. James M Jay, Martin J. Loessner, David A. Golden. Modern Food Microbiology. 7th Edition. Springer Science,.2005. 3. Martin R. Adams and Maurice O. Moss. Food Microbiology. 3rd edition, Royal society of chemistry. Thomas Graham House, Science Park, Cambridge. 2008.
Reference Books	1. Jay, J.M. Modern Food Microbiology. Van Nostra and Rainhokdd Co. 4th Edition. 1991. 2. Roday. S. Food Hygiene and Sanitation. 2nd edition, Tata McGraw Hill

	Publications, 2011.
Web. URLs	1. https://rua.ua.es/dspace/bitstream/10045/39959/1/Lesson2AMIC-ARA-RUA.pdf 2. https://www.davuniversity.org/images/files/study-material/methods%20for%20detecting%20food%20borne%20pathogens.pdf

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	H	M	M	H	M	H	H	M	M	H	M	L	L
CO2	M	M	H	H	M	H	H	H	H	M	M	H	M
CO3	H	H	M	H	H	M	M	H	H	M	L	H	M
CO4	H	M	M	H	M	H	H	M	M	H	M	M	H
CO5	H	H	H	M	M	H	M	M	H	H	L	L	M

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. S. Esath Natheer	Dr. M. Thangavel

Course Code	Title		
23PGMBC208	Core Paper VIII: Bioprocess Technology		
Semester: II	Credits: 4	CIA: 25 Marks	ESE: 75 Marks

Course Objective	To gain knowledge about fermenter and develop skill with emphasis on screening, strain improvement methods and microbial production of various metabolites by using fermenter
Course Category	Skill Development / Employability
Development Needs	Global
Course Description	Design, types and importance of fermenter in product production on the basis of growth kinetics and the importance of strain improvement for product production.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand about the basic design of fermenter and its types	Lecture / Chalk and talk	Assignment
CO 2	Gain knowledge about the physical factors required for fermentation process and the sterilization process	Lectures / Video Lessons	Seminar
CO 3	Attain technical knowledge on bacterial growth kinetics.	Lectures / Tutorial	Quiz
CO 4	Demonstrate the screening and strain improvement of industrially important organisms.	Lectures / Group Discussion	Seminar / Assignment
CO 5	Analyse the types of microbial products produced by using fermenter and downstream processing.	Lecture / Tutorial	Seminar

Offered by **Microbiology**

Course Content **Instructional Hours / Week: 5**

Unit	Description	Text Book	Chapters
I	**Basic Design of Fermenter:** Design of a basic fermenter, bioreactor configuration, design features, computer control of fermentation process, measurement and control of process. Types of Bioreactors and its functions. Applications of computer in fermentation technology. Fermentation economics.	1	15
		Instructional Hours	**15**
Suggested Learning Methods: Video lectures about the design and features of fermenter			
II	**Physical factors and scale-up:** Transport phenomena in fermentation: Gas-liquid exchange and mass transfer, oxygen transfer, critical oxygen concentration, heat transfer, aeration/agitation, its importance. Sterilization of Bioreactors, nutrients, air supply, products and effluents, process variables and control, scale-up of bioreactors.	3	6

		Instructional Hours	15
Suggested Learning Methods: Prepare a flow chart or diagrammatic representation on working mechanism of fermenter			
III	**Cultures in the fermenter:** Growth of cultures in the fermenter. Importance of media in fermentation, media formulation and modification. Kinetics of growth in batch culture, continuous culture with respect to substrate utilization, specific growth rate, steady state in a chemostat, fed-batch fermentation, yield of biomass, product, calculation for productivity.	4	2
		Instructional Hours	**15**
Suggested Learning Methods: Practice for the media formulation, sterilization and prepare flow chart for determination of growth kinetics			
IV	**Strain improvement & Preservation:** Isolation, selection and improvement of microbial cultures. Strain improvement for the selected organism: Use of recombinant DNA technology, protoplast fusion techniques for strain improvement.	2	6
	Improvement of characters other than products and its application in the industry. Preservation of cultures after strain improvement programme.	3	4
		Instructional Hours	**15**
Suggested Learning Methods : Video lectures on the screening and strain improvement			
V	**Microbial Products and Downstream process:** Enzymes - Introduction, Immobilized enzyme system, large-scale production, medical and industrial application. Downstream process of microbial products (Peptides, biopolymers, surfactants, enzymes) - separation, extraction and purification, drying, crystallization centrifugation, filtration, freeze-drying, spray drying.	3	7,9,10,11
		Instructional Hours	**15**
Suggested Learning Methods: Video lectures and group project			
		Total Hours	**75**

Text Books	1. Mansi, E.M.T., and Bryce, C.F.A., Fermentation Microbiology and Biotechnology. 3rd edition, Taylor and Francis, NewYork, 2012. 2. McNeil. B and Harvey, L.M. Practical Fermentation Technology, John Wiley & Sons, Ltd., 2008. 3. Waites, M., Morgan, N.L., Rockey, J.S., Higton, G. Industrial Microbiology: An Introduction, Wiley, 2001. 4. Stanbury, P.T., A. Whitaker and S.J. Hall. Principles of Fermentation Technology, Pergamon Press. NY, 2016.
Reference Books	1. Patel, A.H. Industrial Microbiology. McMillan India Ltd. New Delhi, 2003. 2. Reed,G. Presscott and Dunn's Industrial Microbiology. 5th edition, CBS Publishers, New Delhi, 2002.
Web. URLs	1. https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Boundless)/17%3A_Industrial_Microbiology 2. https://www.cheric.org/files/education/cyberlecture/e200402/e200402-401.pdf 3. http://technologyinscience.blogspot.com/2012/08/different-types-of-fermentors.html#.YygApz1BzDc

Tools for Assessment (25 Marks)						
CIA I	**CIA II**	**CIA III**	**Assignment**	**Seminar**	**Quiz**	**Total**
5	**5**	**6**	**3**	**3**	**3**	**25**

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	H	H	M	H	M	M	L	H	H	H	M	H	H
CO2	M	M	M	H	M	M	H	H	H	H	H	M	H
CO3	H	H	H	M	H	M	M	M	H	M	H	H	H
CO4	H	H	M	M	H	M	M	H	H	H	H	H	M
CO5	M	H	H	H	H	H	H	M	H	M	M	H	M

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. S. Esath Natheer	Dr. M. Thangavel

Course Code	Title		
23PGMBE201	Elective Paper II – Group A Principles of Quality Assurance in Pharmaceuticals		
Semester: II	Credits: 4	CIA: 25 Marks	ESE: 75 Marks

Course Objective	To understand and implement quality assurance and quality control measures effectively for the particular operation during drug development in the Pharma Industry
Course Category	Employability
Development Needs	Global
Course Description	The various modern analytical techniques like UV-Visible, IR, NMR, Mass, GC, HPLC, different chromatographic methods and other important topics are taught to enable the students to understand and apply the principles involved in the determination of different bulk drugs and their formulation

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand the strategy of regulation to control microorganisms.	Lecture /	Assignment
CO 2	Identify things, situations, processes, etc. that may cause harm, particularly to people.	Flipped Learning /	Seminar
CO 3	Describe the qualifications, training and experience required.	Video Lessons	Quiz
CO 4	Implement their role within GMP with confidence and knowledge of the principle requirements.	Tutorial / Case Studies	Assignment
CO 5	Explain the principles of good laboratory practices (GLP) and its importance within a regulated laboratory environment.	Lecture / Class Projects	Seminar

Offered by	**Microbiology**

Course Content	Instructional Hours / Week: 5

Unit	Description	Text Book	Chapters
I	**Microbiological Control Strategy**: Overview, Main factors to be controlled, Controlled facilities, Controlled procedures, Controlled product ingredients, Controlled utilities, Controlled equipment's, Controlled formulation.	1	1
		Instructional Hours	**15**
Suggested Learning Methods: Group Discussion			
II	**Microbial Contamination Risk Assessment in Non-sterile Drug Product Manufacturing and Risk Mitigation:** Regulatory, Compendia, and Industry Guidance, Regulatory, Compendia, and Industry Guidance, Putting into Perspective the Microbiological Risk Associated with Non-sterile Products,	1	2
		Instructional Hours	15
Suggested Learning Methods: Videos			

III	**Qualification of Microbiological Laboratory Personnel and Equipment**: Introduction, Reasons, Requirements, and Strategies for Qualification, Critical Aspects of Microbiological Methods, Practical Examples for Qualification of Laboratory Personnel.	1	3
		Instructional Hours	15
Suggested Learning Methods: Group Discussion			
IV	**Good Manufacturing Practices**: Concept and philosophy of GMP, Organization and Personal, Premises, Equipment's, Raw Material, Manufacturing Documents, In Process Quality Control (IQPC), Standard Operating Procedure, Packaging and Labelling Control, Good Ware House Practices, Materials and Management, Finished Product Release, Distribution of Records.	2	2
		Instructional Hours	15
Suggested Learning Methods: Industrial Visit			
V	**Good Laboratory Practices**: Concept and philosophy of GLP, GLP Guidelines for Manufacturing Unit, GLP Guidelines for Non-Clinical Testing, Quality Audit.	2	3
		Instructional Hours	15
Suggested Learning Methods: Industrial Visit			
		Total Hours	**75**

Text Books	David Roesti and Marcel Goverde, **Pharmaceutical Microbiological Quality Assurance and Control**, John Wiley & Sons Inc., 2020. Nagori B.P., Ajay Gaur, Renu Solanki and Vipin Mathur. **Pharmaceutical Quality Assurance**, Seventh Edition, 2018.
Reference Books	Rosamund M. Baird, Norman A. Hodges, Stephen P. Denver, **Handbook of Microbiological Quality Control – Pharmaceuticals and Medical Devices**, Taylor and Francis, First Edition, 2005. Shayne Cox Gad, Pharmaceutical Manufacturing Handbook: Regulations and Quality. John Wiley & Sons Inc., 2008
Web. URLs	https://www.who.int/medicines/areas/quality_safety/quality_assurance/QualityAss urancePharmVol2.pdf. https://www.pharmaguideline.com/p/quality-assurance.html.

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO 2	PO3	PO4	PO 5	PO 6	PO7	PO 8	PSO 1	PSO2	PSO 3	PSO 4	PSO 5
CO1	H	M	H	L	M	H	M	H	H	H	M	H	H
CO2	H	H	L	L	M	H	M	H	H	H	H	M	H
CO3	H	M	L	M	H	M	H	M	H	M	H	M	H
CO4	L	L	L	L	H	H	H	M	H	H	M	H	M
CO5	M	L	M	M	M	L	M	H	H	H	H	H	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. R. Kasimani	Dr. M. Thangavel

Course Code	Title		
23PGMBE202	Elective Paper II – Group B Techniques in Parasitology		
Semester: II	Credits: 4	CIA: 25 Marks	ESE: 75 Marks

Course Objective	To enable students to understand the pathogenesis, clinical presentations and complications of parasitic diseases
Course Category	Skill Development / Employability
Development Needs	Global
Course Description	The study and identification of human parasites of medical significance, identify clinical signs, symptoms, treatment and epidemiology associated with human parasitic disease. Examine specimen collection and transportation. Explore laboratory methods used to detect and identify parasites.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Provide students with adequate knowledge about endemic parasites, national parasitic problems	Lecture	Assignment
CO 2	Provide with biological, epidemiological and ecological aspects of parasites that causing diseases to human beings.	Tutorial	Seminar
CO 3	Examine and identify the microscopic morphology of parasites and their larval stages in stained smears.	Video Lessons	Quiz
CO 4	Analyze the results obtained from history, clinical examination and investigational data into meaningful diagnostic formulation.	Tutorial / Case Studies	Observation
CO 5	Recognize sample collection, preservation and examination.	Lecture / Class Projects	Observation

Offered by | **Microbiology**

Course Content | **Instructional Hours / Week : 5**

Unit	Description	Text Book	Chapters
I	**General Introduction:** Protozoa: General features, amoebae, Flagellates, Examination of feces- Microscopy, Wet mount, Thick smear, Permanent stained smear- Iron Haematoxylin stain. Wheatley Trichrome stain.	1	2, 3
	Instructional Hours		**15**
Suggested Learning Methods: **Interactions**			
II	**Symbiosis and parasitism:** Commensalism, Phoresis, Parasitism, Mutualism, Parasite-Host interactions- Effect of Parasite on host: Tissue damage, Parenchymatous, Fatty degeneration, Necrosis, Tissue changes, Hyperplasia, Neoplasia, Metaplasia. **Intestinal nematodes:** *Enterobius vermicularius*, *Strongilusster coralis*, *Trichuristrichiura*.	2	1, 2 & 16
	Instructional Hours		15
Suggested Learning Methods: Video Lectures			
III	**Malarial parasites:** Examination of Blood, Examination for malarial Parasite. Thin smear, Thick smear, Wright stain, Examination for Micro filarial-wet mount, Concentration method, DEC Provocation method, **Laboratory methods for the**	1	6

	diagnosis of parasitic Infection overview: Intestinal protozoa, Blood and tissue protozoa. Parasitic infection in compromised host- *Entamoeba histolytica*, *Crytosporidium sp*, *Leishmania sp*, *Toxoplasma gondii*.		
		Instructional Hours	**15**
Suggested Learning Methods: Group Discussion			
IV	**Human Hook worm diseases:** *Necatoramericanus*, *Ancylostoma duodenale*, *Ascaris lumbricoi des*, Life cycle, Epidemiology, Diagnosis. Nematodes-Filarial Nematodes, *Wuchereria bancrofti*, *Bruchiamalayi*, Tropical pulmonary	1	18
		Instructional Hours	**15**
Suggested Learning Methods: Group Discussion			
V	**Collection Preservation, Shipment of Specimen:** Preservation of Specimen: Safety, Fresh specimen Collection times, Processing of Specimen Macroscopic and Microscopic examination of fecal specimens- ova and parasite identification, Direct wet smear, Concentration sedimentation and Flotation methods, Permanent stained smear.	4	26, 27
		Instructional Hours	15
Suggested Learning Methods: Laboratory practice			
		Total Hours	**75**

Text Books	1. Paniker CJK**, Text Book of Medical Parasitology**, 7th edition, Jaypee brothers Medical publishers (p) Ltd, New Delhi, 2013. 2. Burton.J.Bogitsh, Clint Carter.E, Thomas Oeltmann. N,**Human Parasitology**, 4th edition,Elsevier,AcademicPress.UK, 2013. 3. Braily& Scott, **Diagnostic Microbiology**, 13th edition, Patricia. M Tille Elsevier, 2014. 4. Lynne Shore Garcia, **Diagnostic Medical parasitology**,5th edition, ASM Press, Washington, 2007.
Reference Books	1. David Greenwood, Mike Barer, Richard Slack, Will Irving, **Medical Microbiology- Guide to Microbial Infection**, **Pathogenesis, Immunity, lab diagnosis and control**,.18th Ed.,British library, Elsevier, 2012
Web. URLs	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3109637/-2/phylum-protozoa/study-notes-on- entamoeba-histolytica.

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	H	H	H	H	H	H	H	M	H	H
CO2	M	H	H	H	H	H	H	H	H	H	H	M	H
CO3	H	H	H	H	H	H	H	H	H	M	H	H	H
CO4	H	H	H	M	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H	M	H	M

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. Dinesh M D	Dr. M. Thangavel

Course Code	Title		
23PGMBE203	Elective Paper II – Group C Fundamentals of Animal Tissue Culture		
Semester: II	Credits: 4	CIA: 25 Marks	ESE: 75 Marks

Course Objective	This course aims to provide a comprehensive overview of fundamentals of animal tissue culture in terms of the development, characterization, and applications
Course Category	Skill Development / Employability
Development Needs	Global
Course Description	Knowing the principles of cell culture techniques, importance of sterility and good aseptic technique. Manipulations with cell cultures, student's aseptic technique during these manipulations, student's accuracy and awareness during manipulations and sub culturing of animal cells in vitro.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Know and understanding the principles of cell culture techniques.	Lecture / Flipped Classroom	Assignment
CO 2	Describe the equipment's used in animal cell culture.	Tutorial	Seminar
CO 3	Manage to manipulate with cell cultures.	Video Lessons	Quiz
CO 4	Know and understanding the cell culture problems and possibilities.	Case Studies	Observation
CO 5	Demonstrate knowledge on design and use the cell culture facilities.	Demonstration / Class Projects	Observation

Offered by	**Microbiology**

Course Content	Instructional Hours / Week: 5

Unit	Description	Text Book	Chapters
I	**Introduction of Animal Cell and Tissue Culture**: Introduction of Animal Cell and Tissue Culture, History of development of Animal cell culture techniques, Significance and Applications of tissue culture techniques.	1	1
		Instructional Hours	**15**
Suggested Learning Methods: Group Discussion			
II	**Requirements in Animal Cell Culture Laboratory**: Requirements in Animal Cell Culture, Equipment's used in Cell culture, Culture vessels, Aseptic techniques, Culture media, designing of culture media, Serum free media development.	1	5, 8-10
		Instructional Hours	15
Suggested Learning Methods: Experiments			
III	**Primary culture and cell line Development**: Primary culture, secondary culture, cell line, cryopreservation, contaminations, organotypic culture, Insect Cell Culture: An Overview, In vitro transformation of animal cells.	2	7
		Instructional Hours	15

Suggested Learning Methods: Group Learning / Videos			
IV	**Characterization of cell line**: Characterization, Cell cycle analysis, FBS, Temperature, authentication, species identification, lineage or tissue markers, immunocytochemistry, karyotyping, chromosome banding, molecular identification by isoenzyme.	2	9
		Instructional Hours	15
Suggested Learning Methods: Demonstration / Cell culture lab visit			
V	**Applications of cell Line**: Cell culture in virus isolation, vaccine production, drug/therapeutics development, cancer studies using cell culture, production of hybridoma and monoclonal antibody production, therapeutic cloning, tissue engineering and CRISPR-Cas in gene function studies.	1	27
		Instructional Hours	15
Suggested Learning Methods: Laboratory practice			
		Total Hours	75

Text Books	1. Ian Freshney, R. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6th Edition, John Wiley & Sons, Inc., 2010. 2. John M. Davis. Animal Cell Culture Essential Methods, John Wiley & Sons, Inc., 2011.
Reference Books	1. Michael Butler. **Animal Cell Culture and Technology**, 2nd edition Bios Scientific Publishers Taylor & Francis Group London and New York, 2004.
Web. URLs	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7325846/

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	L	M	H	L	H	L	L	H	L	H
CO2	M	H	L	L	H	M	L	M	L	L	H	L	H
CO3	H	H	M	L	M	H	L	M	L	L	H	L	H
CO4	H	H	H	L	H	H	L	L	H	L	H	H	H
CO5	M	H	H	H	H	L	H	H	L	H	L	H	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. Dinesh M. D	Dr. M. Thangavel

Course Code	Title		
23PGMBQ202	Practical II – Food Microbiology and Immunology Practical		
Semester: II	Credits: 4	CIA: 40 Marks	ESE: 60 Marks

Course Objective	Students get hands on experience on the experiments related to molecular biology and immunology
Course Category	Skill Development / Employability
Development Needs	Global
Course Description	This course will cover the basics of microbiology and immunology followed by the role of microorganisms in foodborne illness and intoxication, food spoilage, general food quality, food processing and preservation, and microbes in food health

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	They will learn to carry out routine analysis of potable water and rapid detection of *E coli* by MPN technique.	Lecture / Demonstration	Assignment
CO 2	The students will have a fair knowledge of food spoilage and preservation techniques used in the food industry.	Tutorial	Behaviour
CO 3	They will be competent to take up the role of microbiologists in the Food and Dairy Industry.	Lectures / Video Lessons	Performance
CO 4	Perform various serological techniques.	Hands on	Observation
CO 5	Perform various immunotechniques.	Demonstration	Observation

Offered by | **Microbiology**

Course Content	Instructional Hours / Week : 5

Exp. No	Description
1.	Enumeration of microorganisms in foods
2.	Collection, sampling and microbiological analysis of food materials from local vendors.
3.	Study of microflora in fermented foods - Isolation of microbes from yoghurt, curd.
4.	Dairy Microbiology - Direct microscopic count and standard plate count
5.	Methylene blue reductase test
6.	Production of wine
7.	Demonstration of microbial succession
8.	Demonstration of microbial antagonism
9.	Agglutination reaction: Blood grouping.
10.	Serological tests: WIDAL, ASO, CPR, RPR
11.	Precipitation reaction: ODD, RID
12.	Immunoelectrophoresis: Counter current and Rocket electrophoresis

13.	ELISA
	Total Hours **75**
Text Books	James G. Cappuccino and Chad Welsh. **Microbiology A Laboratory Manual**. PearsonEducation Limited. 11th edition. 2017. Aneja, K. R. **Experiment sin Microbiology, Plant Pathology and Biotechnology**. NewAge International (P) Limited Publisher. 2014. Richard. K. Robinson. Dairy Microbiology Handbook. 3rd Edition. A John Wiley & Sons, Inc., Publication. 2002
Reference Books	Dixit, R., K. Bisen, A. Kumar, A. Borah and C. Keswani. **Lab Manual in MolecularBiology**.1st edition. 2016. Goldsby, R. A., T. J. Kindt, B. A. Osborne and J. Kuby. **Immunology**, 5th edition.W.H.Freeman and Company, 2003.
Web. URLs	https://www.classcentral.com/course/swayam-experimental-biochemistry-12909

Tools for Assessment (40 Marks)

Laboratory Performance						
Level of Engagement in Lab	**Preparation**	**Result**	**Test I**	**Test II**	**Observation Note Book**	**Total**
5	**5**	**5**	**10**	**10**	**5**	**40**

Mapping

CO \ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO 4**	**PSO 5**
CO1	H	H	H	H	H	H	H	H	H	H	M	H	H
CO2	M	H	H	H	H	H	H	H	H	H	H	M	H
CO3	H	H	H	H	H	H	H	H	H	M	H	H	H
CO4	H	H	H	M	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H	M	H	M

H-High; M-Medium; L-Low

Course designed by	**Verified by Chairman**
Dr. B. David Jayaseelan	Dr. M. Thangavel

SEMESTER – III

Course Code	Title		
23PGMBC309	Paper IX - Virology and Mycology		
Semester: III	Credits: 4	CIA: 25 Marks	ESE: 75 Marks
Course Objective	Students gain knowledge about classification, structure and cultivation methods of viruses and fungi. They understand about various diseases caused, diagnostic and therapeutic treatments for viral and fungal infections.		
Course Category	Employability		
Development Needs	Global		
Course Description	This course describes about the classification, properties, pathogenesis and lab diagnosis of DNA and RNA viruses. Also Understand about isolation, identification and pathogenesis of clinically important fungi.		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Know about viral classification, properties, cultivation and their diagnostic methods.	Lecture	Assignment
CO 2	Learn about morphology, replication, pathogenesis and lab diagnosis of DNA viruses.	Lectures / Video lessons	Seminar
CO 3	Learn about morphology, replication, pathogenesis and lab diagnosis of RNA viruses.	Lectures / Video Lessons	Assignment
CO 4	Gain knowledge about isolation, identification and diagnosis of clinically important fungi.	Lectures / Video lessons	Quiz
CO 5	Understand about the etiologies and basic mechanisms of pathogenesis in mycosis.	Lectures and Videos	Seminar

Offered by	Microbiology

Course Content	Instructional Hours / Week : 5

Unit	Description	Text Book	Chapters
I	**Viral classification and properties:** Viral classification and properties of viruses – Detection of viruses, purification and enumeration. Cultivation of viruses (animal inoculation, Embryonated egg and tissue culture) - Properties of viroids and Prions. Biosafety measures (BS4), Diagnosis of viral infection.	1	29
	Instructional Hours		**15**
Suggested Learning Methods: Video Lectures			
II	**Animal DNA viruses:** Animal viruses - DNA viruses -morphology, replication, pathogenesis and laboratory diagnosis of Poxvirus, Adenovirus, Hepatitis viruses - type A and B. Herpes simplex viruses, Oncogenic viruses.	1	32 - 35
	Instructional Hours		**15**
Suggested Learning Methods: Demonstration and Presentation			
III	**Animal RNA viruses:** Animal viruses - RNA viruses -morphology, replication, pathogenesis and laboratory diagnosis of Polio virus, Rabies virus, Influenza virus A and B. Retrovirus - HIV virus. Dengue, Japanese Encephalitis and Corona virus.	1	38 - 44
	Instructional Hours		**15**

Suggested Learning Methods: Presentations and Video lectures			
IV	**General Properties of Fungi:** Isolation and identification of medically important fungi - Diagnosis of fungal disease - Anti-fungal agents.	2	5
		Instructional Hours	**15**
Suggested Learning Methods: Videos and demonstration			
V	**Fungal Infections:** Superficial mycosis - *Pityriasis versicolor*, *Tinea nigra* and Piedra. Cutaneous mycosis - Dermatophytes. Systemic mycosis - Opportunistic mycosis - Candidiosis, Cryptococcosis and Aspergillosis. Subcutaneous mycosis - Mycetoma.	1 & 3	40 & 45
		Instructional Hours	**15**
Suggested Learning Methods: Seminars and Group learning			
		Total Hours	**75**

Text Books	1. Jawetz, E., J.L. Melnic and E.A. Adelberg. **Review of Medical Microbiology**. 22nd edition, Lange Medical Publishers, New York, 2001. 2. Fritz H. Kayser, K.A. Bienz and J. Eckert, **Medical Microbiology**. Thieme Stuttgart, New York, 2005. 3. Prescott, M., J.P. Harley and D.A. Klein. **Microbiology**, 10th edition, McGraw-Hill, New York, 2016.
Reference Books	1. Knipe D.M., P.M. Howley and D.E. Griffin. **Fields Virology**. 5th edition, Vol - I, II. Lippincott, Williams & Wilkins, 2006. 2. Cann, A.J. **Principles of Molecular Virology**, Academic Press, 2005. 3. Dimmock, N.J., A.J. Easton and K.N. Leppard. **Introduction to Modern Virology**, 6th edition, Blackwell Scientific Publications, Oxford, UK, 2007. 4. Flint, S.J., V.R. Racaniello, L.W. Enquist, V.R. Rancaniello and A.M. Skalka. **Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses**. American Society Microbiology, 2003.
Web. URLs	1. https://paramedicsworld.com/microbiology-notes/virology-notes/medical-paramedical-studynotes 2. https://nios.ac.in/media/documents/dmlt/Microbiology/Lesson-52.pdf

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO / PO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO 8	PSO 1	PSO2	PSO 3	PSO 4	PSO 5
CO1	H	H	M	H	H	H	H	H	H	H	L	L	M
CO2	H	H	M	H	H	M	M	M	H	M	L	L	H
CO3	H	H	L	M	H	H	M	H	H	H	H	M	L
CO4	H	H	L	H	H	H	M	H	H	M	H	M	M
CO5	H	H	M	M	H	H	H	M	M	M	H	H	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. M. Thangavel	Dr. M. Thangavel

Course Code	Title		
23PGMBC310	Paper X – Microbial Biotechnology and IPR		
Semester: III	Credits: 4	CIA: 25 Marks	ESE: 75 Marks

Course Objective	This course helps to adhere to the ethical practices appropriate to the discipline at all times, adopt safe working practices relevant to the industries and in research field.
Course Category	Skill Development
Development Needs	Global
Course Description	This course is structured in accordance with the processes in the discovery and development of biologics, discusses different uses of microorganisms and their patenting.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Outline Scope and Application of Microbial products.	Presentations and lectures	Assignment
CO 2	Interpret the use of microorganisms in Industrial Scale.	Interactive lecture	Seminar
CO 3	Applications of microbes in biotransformation, therapeutic and industrial biotechnology	Presentation	Assignment
CO 4	Explain Intellectual Property Rights and protection	Presentation	Seminar / Assignment
CO 5	Explicate patent agreements	Presentation and lectures	Seminar

Offered by	**Microbiology**

Course Content	Instructional Hours / Week: 5

Unit	Description	Text Book	Chapters
I	**Microbial biotechnology**: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology. Genetically engineered microbes for industrial application: Bacteria and yeast. Secondary metabolites as source of drugs.	1	2
		Instructional Hours	**15**
Suggested Learning Methods: **Video lectures and discussion**			
II	**Therapeutic and Industrial Biotechnology** Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine). Microbial polysaccharides and polyesters, Microbial production of bio-pesticides, bioplastics, Bio preservatives, Microbial biosensors, Single cell proteins	2	11, 12
		Instructional Hours	**15**
Suggested Learning Methods: Video lectures			
III	**Microbes in Biotransformations and Bioremediation** Microbial based transformation of steroids and sterols, Bio-catalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute. Bioremediation, Biomining.	3	1

		Instructional Hours	**15**
Suggested Learning Methods: Group Discussion			
IV	**Introduction to Intellectual Property:** Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge, Geographical Indications with examples- importance of IPR – patentable and non patentables – patenting life – legal protection of biotechnological inventions – World Intellectual Property Rights Organization (WIPO).	4	1
		Instructional Hours	**15**
Suggested Learning Methods: Group Discussion			
V	**Grant of Patent and Patenting Authorities:** Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patent owner.	4	4, 5
		Instructional Hours	**15**
Suggested Learning Methods: Group discussion and Video lecture			
		Total Hours	**75**

Text Books	1. Alexander N. Glazer and Hiroshi Nikaido **Microbial Biotechnology Fundamentals of applied Microbiology**, Cambridge University Press 2nd edition 2007. 2. Bernard R. Glick, Jack J. Pasternak and Cheryl L. Patten, **Molecular Biotechnology Principles and applications of recombinant DNA**. ASM Press 4th edition, 2010. 3. Colin Ratledge and Bjon Kristiansen, **Basic Biotechnology**, Cambridge University Press, 2nd Edition 2013. 4. Deepa Goel and Shomini Parashar, **IPR, Biosafety and Bioethics**, Pearson Publication 2013
Reference Books	1. Prescott, Harley and Klein's **Microbiology** by Willey JM, Sherwood LM, Woolverton CJ 9th edition, Mc Graw Hill Publishers. 2014. 2. Peter F. Stanbury, Allan Whitaker, Stephen J. Hall. **Principles of Fermentation Technology**, Butterworth-Heinemann – Elsevier. 3rd Edition 2017. 3. Kankanala C, **Genetic Patent Law & Strategy**, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi. 2007.
Web. URLs	1. Intellectual Property Rights and Biological Resources (wupperinst.org) 2. 9.4 Intellectual Property Rights.pdf (icsi.edu)

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	H	M	H	M	H	H	H	L	L	H
CO2	H	H	H	L	M	H	H	M	H	H	H	L	H
CO3	H	H	L	H	H	H	M	H	H	H	H	H	H
CO4	H	H	H	M	M	H	M	H	L	M	M	L	H
CO5	H	H	H	M	M	H	M	H	H	M	L	H	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. R. Kasimani	Dr. M. Thangavel

Course Code	Title		
23PGMBC311	Paper – XI : Biostatistics and Research Methodology		
Semester: III	Credits : 4	CIA : 25 Marks	ESE: 75 Marks
Course Objective	This course give knowledge about designing the research project and various statistical applications in Research		
Course Category	Skill Development		
Development Needs	Global		
Course Description	It provides a overview of Statistical methods for analyzing corrected data produced by longitudinal measures take over time		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Describing the method of data collection, presentation and memorizing different Measures of Central Tendency and Measures of Dispersion	Group learning/ Lectures.	Seminar
CO 2	Identify the applications of Correlation and Regression co efficient.	Peer Teaching/ Lectures	Unit Test
CO 3	Distinguishing different Statistical situations using Sampling Techniques	Lectures/ Tutorial	Seminar
CO 4	Executing one way and two way analysis using analysis of Variance and Experimental Design.	Video Lectures / Lectures	Assignment
CO 5	Critically evaluate the Research Designs.	Group learning / Lectures	Quiz

Offered by	Mathematics

Course Content	Instructional Hours / Week : 5

Unit	Description	Text Book	Chapters
I	**Basic Concepts of Biostatistics**: Scope of Biostatistics – Collection, Classification and Tabulation of Data. Diagrammatic and Graphical representation	1	1,3,5,6
	Measures of Central Tendency: Arithmetic mean, Median, Mode. Measure of Dispersion: Range, Quartile Deviation, Standard Deviation and Co efficient of Variation.	1	7 – 8
		Instructional Hours	**15**
Suggested Learning Methods: Seminar			
II	Correlation: Definition – Scatter diagram – Karl Pearson's correlation co – efficient – Properties - Rank correlation co – efficient –Properties. Regression: Introduction – Construction of regression equations – Properties of regression.	1	10
		Instructional Hours	**15**
Suggested Learning Methods: Problem Solving Practise			
III	**Sampling Techniques:** Introduction – Methods of Sampling- Sampling and Non-Sampling errors. **Testing of Hypothesis:** Test of significance for large sample –Difference between two means – Test of significance for Small sample — Chi Square test – Goodness of fit- F-test.	3 1	2 Vol II:3,4
		Instructional Hours	**15**

Suggested Learning Methods: Group Learning method			
IV	**Analysis of Variance:** One way and Two way Classifications.	2	12
	Experimental Design – Introduction – Basic Concepts and Principles – Completely Randomized Design (CRD) – Randomized Complete Block Design (RCBD)	3	10
		Instructional Hours	**15**
Suggested Learning Methods: https://youtu.be/0NwA9xxxtHw			
V	**Research Methodology** – Types of Research- Significance of Research. **Research Process** - Research Problem – Selection of Research Problem – **Research Design**.	2	1 – 3
		Instructional Hours	**15**
Suggested Learning Methods: Problem Solving Practice			
		Total Hours	**75**

Text Books	1. Gupta.S.P. **Statistical Methods**. Sulthan Chand and Sons. **2017**. **Unit I:** Chapter 1,3,5,6,7,8 Page No :1-15;39-61;91-126;127-166;177-221;275-280,286-304 **Unit II:** Chapter 10,11; Page No – 390-397,398-401,414-423, 451- 458 **Unit III:** Volume II – Chapter 3,4; Page No- 925-931,934,935, 953-1004 2. Kothari. **Research Methodology: Methods and Techniques**. New Age International Pubishers. New Delhi. 2004. **Unit IV –** Chapter 12 – Page no – 256 - 275 **Unit V –** Chapter – 1- 3 – Page no – 2 – 7,10 – 20, 24 – 26, 31 - 55 3. Irfan Ali Khan and Atiya Khanum, **Fundamentals of Biostatistics**, **Ukaaz publications**, Second Revised Edition, 2004. **Unit III:** Chapter 2- Page No – 1-16 **Unit IV :** Chapter 10 – page no – 393 – 396, 402 - 420
Reference Books	1. Sokal, R.R. and Rohlf, F.J. An **Introduction to Biostatistics**. W.H. Freeman and Company.1987. 2. Dr. P.N. Arora and Dr. P.K. Malhan, **Bio Statistics**, Himalaya Publishing House, Revised Edition, 2006
Web. URLs	1. https://nptel.ac.in/courses/102106051 2. https://in.coursera.org/lecture/six-sigma-analyze-advanced/intro-to-design-of-experiments-o3bgB

Tools for Assessment (25 Marks)

CIA I	CIA II	Model	Seminar	Class Participation	Periodical Quizzes	Total
5	5	6	3	3	3	25

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	L	M	M	M	L	H	H	H	L	L	H
CO2	M	H	M	L	H	H	M	H	H	H	H	L	H
CO3	M	H	H	L	H	H	M	H	H	H	H	H	H
CO4	H	L	H	M	M	M	M	M	L	M	M	L	H
CO5	H	H	M	L	H	H	L	H	H	M	L	H	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Ms. M. Dhanalakshmi	Dr. T. Chandra Pushpam

Course Code	Title		
23PGMBC312	Paper XII - Techniques in Plant and Animal Tissue Culture		
Semester: III	Credits: 4	CIA: 25 Marks	ESE: 75 Marks

Course Objective	To learn the technical advancements in the field of animal and plant tissue culture
Course Category	Employability
Development Needs	Global
Course Description	Student gain knowledge in plant tissue culture and animal tissue culture techniques

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understanding the basic development of plant and animal tissue culture.	Lecture / Video lessons	Assignment
CO 2	Gain knowledge about setup of animal and plant tissue culture laboratory and sterilization techniques.	Demo / Model	Model
CO 3	Acquire knowledge on media preparation and usage for animal and plant tissue culture.	Demo / Model	Model
CO 4	Understand the different concepts of animal and plant tissue culture.	Lecture / Video	Seminar
CO 5	Learn the different techniques of animal and plant tissue culture and their applications.	Lecture	Seminar

Offered by | **Microbiology**

Course Content	Instructional Hours / Week: 5

Unit	Description	Text Book	Chapters
I	**Cell culture and characterization:** Primary Culture- Isolation of Tissue, Steps involved in primary cell culture and Establishment of Cell culture. Cell Lines- Nomenclature, Subculture and Propagation, Immortalization of cell lines. Cell counting, Cell Proliferation, Plating Efficiency, Labeling Index	1	11, 12,15
		Instructional Hours	**15**
Suggested Learning Methods: Video lectures			
II	**Contamination and assay:** Source of contamination, Type of microbial contamination, Monitoring, Eradication of Contamination, Cross-Contamination. Cytotoxicity: measurement of cell death; Apoptosis and its determination; Cytotoxicity assays. **Cryopreservation & Stem cell culture:** Need of Cryopreservation, Preservation, Cell banks, Transporting Cells.	1	18, 19, 21
		Instructional Hours	**15**
Suggested Learning Methods: Online tutorial			

III	Media: Physiochemical Properties, Balanced salt solutions, Complete media, Serum, Disadvantages of Serum supplemented media, Serum-free media, Advantages of Serum free media	1	8, 9
	Composition of MS Media, Gamborgs media, Nitch's media, Whites media and their preparation. Plant growth regulators, sterilization techniques.	2	1, 2, 3
		Instructional Hours	**15**
Suggested Learning Methods: Model presentation			
IV	***Invitro* culture for plants:** Micropropagation, Callus culture, somatic embryogenesis, suspension culture, embryo culture, haploid culture, protoplast culture and fusion; Soma clonal variation; Artificial seeds; Greenhouse conditions, hardening.	2	8,9
		Instructional Hours	15
Suggested Learning Methods: Video lectures			
V	**Gene Transfer Methods:** *Agrobacterium* mediated gene transfer, *Agrobacterium* based vectors (Ti plasmids and Ri plasmids), viral vectors and their applications. Direct gene transfer methods - electroporation, microinjection and particle bombardment. Characterization of transgenics, screenable and selectable markers. Marker free methodologies and gene targeting.	3	16, 23
		Instructional Hours	**15**
Suggested Learning Methods: Model presentation and video lectures			
		Total Hours	**75**

Text Books	1. Ian Freshney. R., **Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications,** John Wiley & Sons, Inc., Hoboken, New Jersey, 6th Edition. 2010. 2. Razdan, M. K., **Introduction to Plant Tissue Culture,** Science Publisher Inc., UK.2003. 3. Chawla, H. S., **Introduction to Plant Biotechnology,** Science Publisher Inc., UK. 2002.
Reference Books	1. Mantel. S.H, Mathews. J.A. and Mickee, R.A., **An Introduction to Genetic Engineering in Plants**, Black well Scientific Publishers, London, 1985. 2. Pierik, R.L.M., ***Invitro* Culture of Plants,** Martinus Nijhoff Publishers, Dordrecht, 1987.
Web. URLs	1. https://www.elsevier.com/books/animal-biotechnology/verma web.nchu.edu.tw/pweb/users/taiwanfir/lesson/1146.pdf

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Demo	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	M	H	M	M	H	H	M	L	L	H
CO2	H	H	H	M	M	H	M	H	H	H	L	L	M
CO3	H	M	M	H	H	M	M	M	M	M	L	L	M
CO4	M	M	H	H	M	H	M	H	H	M	M	M	L
CO5	H	H	M	H	H	H	H	H	H	M	L	L	M

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. S. Esath Natheer	Dr. M. Thangavel

Course Code	Title		
23PGMBE301	Elective Paper III Group A - Total Quality Management		
Semester: III	Credits: 4	CIA :25 Marks	ESE:75 Marks

Course Objective	To provide the student with basic knowledge on total quality management and ISO Registration.
Course Category	**Employability/ Entrepreneurship**
Development Needs	**Global**
Course Description	This course introduces students to the concepts, tools, and techniques used in Total Quality Management, quality cultures, and effective team structures, measurement of quality, productivity, and competitiveness in an industrial environment.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand the Need for quality Evolution.	Lecture	Assignment
CO 2	Familiarize with seven traditional tools of quality.	Lecture / Demonstration	Seminar
CO 3	Familiarize with Quality Statements, Strategic quality planning.	Lectures / Video Lessons	Quiz
CO 4	Discuss Cost of Quality and Quality Function Deployment.	Tutorial / Videos	Seminar
CO 5	Familiarize with Benefits of ISO Registration and Audits.	Lecture / Group Discussion	Quiz

Offered by	**Microbiology**

Course Content	**Instructional Hours / Week: 5**

Unit	Description	Text Book	Chapters
I	Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - orientation, satisfaction, complaints, retention.	1	1,2
		Instructional Hours	**15**
Suggested Learning Methods: Lecture / Demonstration			
II	The seven traditional tools of quality – New management tools – Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, FMEA – Stages, Types.	1	3
		Instructional Hours	**15**
Suggested Learning Methods: Lectures / Video Lessons			
III	Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.	1	16
		Instructional Hours	**15**

Suggested Learning Methods: Lectures / Video Lessons			
IV	Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.	2	14
		Instructional Hours	**15**
Suggested Learning Methods: Tutorial / Videos			
V	Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific, Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation— Documentation—Internal Audits—Registration- Environmental Management System: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.	2	8
		Instructional Hours	**15**
Suggested Learning Methods: Lecture / Group Discussion			
		Total Hours	**75**

Text Books	1. Jens J.Dahlgaard, Kai Kristensen, Gopal K.Kanji: Taylor & Franci, **Fundamentals of Total Quality Management Process analysis and improvement**, Routledge, London.2005. 2. Dale H. Besterfiled, Carol B.Michna, Glen H. Besterfield, Mary B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, **Total Quality Management**, Pearson Education Asia, Revised 3rd Edition, Indian Reprint, 6th Impression, 2013.
Reference Books	1. James R. Evans and William M. Lindsay, **"The Management and Control of Quality"**, 8th Edition, First Indian Edition, Cengage Learning, 2012. 2. Janakiraman. B and Gopal.R.K., **"Total Quality Management - Text and Cases",** Prentice Hall (India) Pvt. Ltd., 2006. 3. Suganthi .L and Anand Samuel, **"Total Quality Management"**, Prentice Hall (India) Pvt. Ltd., 2006.
Web. URLs	1.GE-6757-TOTAL-QUALITY-MANAGEMENMT-IV-YEAR-VII-SEM-NOTES.pdf (velhightech.com) 2. totalqualitymanagement.pdf (rmkec.ac.in)

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO7	PO 8	PSO 1	PSO2	PSO 3	PSO 4	PSO 5
CO1	H	H	L	L	H	M	M	M	L	L	L	L	M
CO2	M	H	M	H	M	H	M	H	L	L	L	L	M
CO3	H	M	H	M	H	H	H	H	L	L	L	L	L
CO4	H	M	H	M	M	M	H	M	L	L	L	L	L
CO5	H	M	H	M	H	H	M	H	L	L	L	H	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. Dinesh M. D	Dr. M. Thangavel

Course Code	Title		
23PGMBE302	Elective Paper III-Group B – Human Anatomy and Physiology		
Semester: III	Credits: 4	CIA: 25 Marks	ESE: 75 Marks
Course Objective	Students gain knowledge about Fundamentals of Anatomy & Physiology gives students in-depth instruction in the organization, structures, and functions of the human body.		
Course Category	Employability/Skill		
Development Needs	Global		
Course Description	This course explores the inner workings of the human body and focuses on anatomical and medical terminology.		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Use correct terminology to discuss the chemistry, cell structure, and tissues of the human body.	Lecture	Assignment
CO 2	Gain knowledge circulatory system	Lectures / Video lessons	Seminar
CO 3	Understand the different concepts Identify and explain the structure and functions of each body communication system.	Lectures / Video Lessons	Assignment/ Seminar
CO 4	Acquire knowledge Identify and explain the structure and functions of digestive system.	Lectures / Video lessons	Quiz/Assignment
CO 5	Learn the role of nervous system in the body	Lectures and Videos	Seminar

Offered by	Microbiology
Course Content	Instructional Hours / Week: 5

Unit	Description	Text Book	Chapters
I	**Introduction to the human body, chemical and tissue level of organization**: The body and its constituents, Introduction to the human body, Introduction to the chemistry of life, The cells, tissues and organization of the body.	2	1-4
		Instructional Hours	**15**
Suggested Learning Methods: Video Lectures			
II	**Circulatory and cardiac system:** The blood, The cardiovascular system.	1	7, 8
		Instructional Hours	**15**
Suggested Learning Methods: Demonstration and Presentation			
III	**Body communication and respiration:** The nervous system, endocrine system, and respiratory system.	2	12-18, 23
		Instructional Hours	**15**
Suggested Learning Methods: Presentations and Video lectures			
IV	**Digestive system**: Activity, organization, organs, mouth, pharynx, esophagus, structure of digestive system, process of digestion.	1	9

		Instructional Hours	**15**
Suggested Learning Methods: Videos and demonstration			
V	**NERVOUS SYSTEM** Location of brain and spinal cord, structure and function of brain and spinal cord, details of central nervous system, peripheral nervous system and autonomous nervous system, structure of neuron, synapse, transmission and conduction of nerve impulse	1	4-6, 10, 17
		Instructional Hours	**15**
Suggested Learning Methods: Seminars and Group learning			
		Total Hours	**75**

Text Books	1. Ian Peate, Muralitharan Nair, **Fundamentals of Anatomy and Physiology for Nursing and Healthcare Students**, 2nd edition, Wiley Balckwell, 2017. 2. Gerard J. Tortora, Bryan H. Derrickson, **Principles of Anatomy and Physiology,** 14th Edition, Wiley, 2014
Reference Books	1. Anne Waugh, Allison Grant, **Ross & Wilson Anatomy and Physiology in Health and Illness,** 13th edition, Elsevier, 2018. 2. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew. **Fundamentals of Anatomy & Physiology**, 9th edition, Benjamin Cummings, 2012.
Web. URLs	1. https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/nursing_students/LN_human_anat_final.pdf 2. https://www.drnaitiktrivedi.com/index.php/notes/anatomy-physiology-notes/

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO 5
CO1	H	H	M	H	H	H	H	H	H	H	L	L	M
CO2	H	H	M	H	H	M	M	M	H	M	L	L	H
CO3	H	H	L	M	H	H	M	H	H	H	H	M	L
CO4	H	H	L	H	H	H	M	H	H	M	H	M	M
CO5	H	H	M	M	H	H	H	M	M	M	H	H	H

H-High; M-Medium; L-Low

Course designed by	Verified by
Dr. P. Vinoth Kumar	Dr. M. Thangavel

Course Code	Title		
23PGMBE303	Elective Paper III – Group C Computational Biology, Microbial Genomics and Proteomics		
Semester: III	Credits: 4	CIA: 25 Marks	ESE: 75 Marks

Course Objective	To know the computational analysis of genes and genomes, protein sequences, analyzing proteins in lab and protein and gene sequence modification methods
Course Category	**Skill Development**
Development Needs	**Global**
Course Description	This course deals with the analysis of modern genomic data; sequence analysis, gene expression/functional genomics analysis, and gene mapping / applied population genetics.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	List the importance of bioinformatics in systems biology.	Group learning/ Lectures.	Seminar
CO 2	Explain computational analysis the sequences for gene prediction.	Peer Teaching / Lectures	Unit Test
CO 3	Identify the use of genes and metabolic pathways in systems biology.	Lectures/ Tutorial	Seminar
CO 4	Infer the appropriate tools in systems biology for modelling.	Video Lectures / Lectures	Assignment
CO 5	Know about Concepts of OMICS.	Group learning / Lectures	Quiz

Offered by Microbiology

Course Content — **Instructional Hours / Week :5**

Unit	Description	Text Book	Chapters
I	**Biological Databases:** Introduction to bioinformatics - classification of biological databases, Biological data formats, Application of bioinformatics in various fields. **Systems Biology-** Understanding Biology at system level, requirement of system level understanding, computing and system biology.	1	1
		Instructional Hours	**15**
Suggested Learning Methods: **Seminar**			
II	**Introduction to Sequence alignment:** Substitution matrices – PAM and BLOSUM. Pairwise alignment methods; Multiple sequence alignment methods. Evolutionary analysis: distances - clustering methods – rooted and unrooted tree representation – Bootstrapping strategies. Sequence similarity, identity.	1	4
		Instructional Hours	15
Suggested Learning Methods : Problem Solving Practise			
III	**Genes and Genomes:** Interpreting expression data using Gene Ontology; Evolution of modularity and transcriptional networks, metabolite sensing and translational control; Microarrays-types and applications. Applications of up and down regulation of genes.	3	5
		Instructional Hours	**15**

Suggested Learning Methods: Group Learning method			
IV	Metabolic pathway database: KEGG pathway database, Concept of metabolome and metabolomics. Gene networks - Integration of Networks. Metabolic disease Analysis.	4	24
		Instructional Hours	**15**
Suggested Learning Methods: You tube Videos			
V	**OMICS Concepts:** Genomics, Proteomics, transcriptomics, interactomics, Phenomics, localizomics; Combination of omics approaches: data integration, modeling; Synthetic biology	3	7
		Instructional Hours	**15**
Suggested Learning Methods: Problem Solving Practice			
		Total Hours	**75**

Text Books	1. Rastogi, C. S., Namita Mendiratta, **Bioinformatics-Methods and Applications,** PHI Learning Pvt. Ltd., 4th Edition, 2013. 2. Harisha, S., **Fundamentals of Bioinformatics**, I. K. International Publishing House, 1st Edition, 2007. 3. Sandy Primrose and Richard Twyman., **Principles of Gene Manipulation and Genomics**, Blackwell Publishing, 2010.
Reference Books	1. Teresa Attwood., **Introduction to Bioinformatics**, Pearson Publications, 1st Edition, 2007. 2. Andreas D. Baxevanis, B.F. Francis Ouellette., **Bioinformatics**, Wiley Publishers, 3rd Edition, 2011. 3. Dov Stekel., **Microarray Bioinformatics**, Cambridge University Press, 1st Edition, January 2010. 4. David Mount., **Bioinformatics: Sequence and Genome Analysis,** Cold Spring Harbor Lab Press, 2nd Edition, 2004
Web. URLs	1. https://www.ncbi.nlm.nih.gov/books/NBK143764/ 2. https://www.expasy.org/links 3. https://ww2.chemistry.gatech.edu/~lw26/course_Information/4581/labs/tbp/rasmol/ras mol_tbp_fset.html

Tools for Assessment (25 Marks)

CIA I	CIA II	Model	Seminar	Class Participation	Periodical Quizzes	Total
5	5	6	3	3	3	25

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	M	L	M	M	H	H	H	H	M	H
CO2	H	H	H	H	M	H	M	H	H	M	H	H	H
CO3	M	H	M	M	M	M	M	M	H	H	M	H	H
CO4	M	H	M	L	H	H	H	M	H	H	H	M	H
CO5	H	H	L	L	H	H	H	H	H	M	H	H	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. Thulasi Sivaraman	Dr. M. Thangavel

Course Code	Title		
24PGMBQ303	Practical III: Virology, Mycology and Microbial Biotechnology Practical		
Semester: III	Credits: 4	CIA: 40 Marks	ESE: 60 Marks

Course Objective	To assimilate knowledge on characteristics of bacteria, protozoa, yeasts, molds, and viruses are used to understand the role of microorganisms in human health and disease.
Course Category	Skill Development / Employability
Development Needs	Global
Course Description	Students will develop skills on interactions between the host and the microorganisms are emphasized as well as the physical and chemical methods of control.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Acquire knowledge on basic principles of virus and infectious disease.	Lecture / Hands on	Behaviour & Performance
CO 2	Understand infectious disease transmission by virus.	Lecture / Hands on	Observation
CO 3	Understand the different conceptual basis for pathogenic microorganisms and the mechanisms by which they cause disease in the human body.	Lecture / Hands on	Performance
CO 4	Gain knowledge on relationship of this infection and symptoms and the accompanying pathology.	Lecture / Hands on	Performance
CO 5	Learn the techniques for Biotechnology	Lecture / Hands on	Performance

Offered by	**Microbiology**

Course Content	Instructional Hours / Week: 5

Exp No	Experiments
1.	Virus cultivation – Egg inoculation techniques.
2.	One step growth curve for determination of virus titre.
3.	Phage typing of *E. coli* bacteriophages
4.	Microscopic examination of Infectious Agents- Entamoeba, Ascaris, Hook worm and Filarial parasite
5.	Isolation and identification of clinically important fungi - *Candida albicans, Aspergillus sp, Cryptococcus neoformans*
6.	Examination of blood smear study for *Plasmodium sp*
7.	Separation of proteins by SDS - PAGE and native gel

8.	Preparation of competent *E. coli* cells.
9.	Transformation of Plasmid DNA to the *E. coli* cells.
10.	PCR amplification - 16S rRNA and RAPD.
	Total Hours **75**
Text Books	1. Dubey, R.C and Maheswari, D.K. **Practical Microbiology** S. Chand Ltd.2002. 2. Cappuccino, J. G., Sherman, S., **Microbiology. A Laboratory Manual**, Benjamin 3. Manual of Diagnostic Microbiology, Dr.B. J. Wadher & Dr. G. L. Bhoosreddy, First .Ed., Himalaya publishing house, Nagpur
Reference Books	1. James G. Cappuccino and Chad Welsh. **Microbiology A Laboratory Manual**. Pearson Education Limited, 2017. 2. Dubey RC and Maheshwari DK. (2002). **Practical Microbiology**. S Chand and Co. Ltd., New Delhi, 2002. 3. Gunasekaran P. **Laboratory Manual in Microbiology**. New Age International, 2007.
Web. URLs	1. https://www.cdc.gov/nchs/data/nhanes/nhanes_03_04/lab.pdf

Tools for Assessment (40 Marks)

Laboratory Performance			Test - I	Test - II	Observation Note Book	Total
Level of engagement in lab	Preparation	Result				
5	5	5	10	10	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	M	H	H	M	M	H	H	M	M	L	H
CO2	H	M	M	H	H	H	H	H	H	M	L	L	M
CO3	M	M	M	H	M	L	L	M	M	H	M	M	H
CO4	M	M	M	H	H	M	M	M	H	M	L	M	H
CO5	H	H	H	H	H	M	M	M	H	L	L	L	M

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. M. Thangavel	Dr. M. Thangavel

SEMESTER IV

Course Code	Title		
23PGMBC413	Paper XIII – Medical Microbiology		
Semester: IV	Credits: 4	CIA: 25 Marks	ESE: 75 Marks
Course Objective	Students gain knowledge about foundation in medical microbiology. Concepts in bacteriology, mycology and parasitology.		
Course Category	Employability/Skill		
Development Needs	Global		
Course Description	This course describes about the classification Infection, types of infection, Host-parasite relationship.		

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Understand the Infection, types of infection, Host-parasite relationship and Micro flora of human body.	Lecture	Assignment
CO 2	Gain knowledge on nature of antimicrobial agents.	Lectures / Video lessons	Seminar
CO 3	Understand the different types of bacterial infections.	Lectures / Video Lessons	Assignment/ Seminar
CO 4	Acquire knowledge on parasitology morphology and life cycle.	Lectures / Video lessons	Quiz/Assignment
CO 5	Learn the techniques to control the pathogenicity and laboratory diagnosis of fungi.	Lectures and Videos	Seminar

Offered by	Microbiology

Course Content	Instructional Hours / Week: 5

Unit	Description	Text Book	Chapters
I	**Infection**: types of infection, sources of infection, reservoirs and vehicles of infection, predisposing factors. **Normal Micro flora of human body**: normal flora of skin, respiratory, gastrointestinal, genital tract, role of resident flora, concept of probiotics. Mode of spread of infection; Respiratory, skin, wound & burn infection, venereal infections, alimentary tract infection, blood born infection and nosocomial infection.	1	9,10
		Instructional Hours	**15**
Suggested Learning Methods: Video Lectures			
II	**Antimicrobial agents:** History, Antibiotics, Antifungal and Antivirals (common drugs, their spectrum and mode of action). Methodologies for testing of antibacterial, antifungal, and antiviral drugs (in vivo and in vitro infectivity models), mechanism drug resistance.	1	28
		Instructional Hours	**15**
Suggested Learning Methods: Demonstration and Presentation			

III	**Bacteriology: Gram positive organisms** - Morphology, cultural characteristics, pathogenicity and laboratory diagnosis of *Staphylococcus aureus, Streptococccus pyogenes, Bacillus anthracis, Mycobacterium tuberculosis.* **Gram negative organisms** -. *E. coli, Salmonella typhi, Vibrio cholerae, Pseudomonas aeruginosa, Neiserria gonorrhoeae*	2	22-41
		Instructional Hours	**15**
Suggested Learning Methods: Presentations and Video lectures			
IV	**Parasitology:** Morphology, Life cycle, Pathogenicity and laboratory diagnosis of *Entamoeba histolytica, Trichomonas vaginalis, Plasmodium malariae, Taenia solium, Enterobius vermiculari, Ascaris lumbricoides.*	3	3-18
		Instructional Hours	**15**
Suggested Learning Methods : Videos and demonstration			
V	**Mycology:** Morphology, Pathogenicity and laboratory diagnosis of *Candida albicans, Cryptococcus neoformans, Aspergillosis, Histoplasma capsulatum.*	4	8-15
		Instructional Hours	**15**
Suggested Learning Methods : Seminars and Group learning			
		Total Hours	**75**

Text Books	1. Brooks, G. F.,Jawetz, Melnick and Adelbergs **Medical Microbiology**. New York.: Graw-Hill Medical. 2. Paniker, C. K., and Ananthanarayan, , **Textbook of** 3. **Microbiology**. Himayatnagar, Hyderabad: Orient Longman.2005. 4. Paniker, C. K.,**Textbook of Medical Parasitology**. New Delhi: Jaypee Brothers 5. Anaissie, E. J., **Clinical Mycology**. Churchill Livingstone: Elsevier.2009.
Reference Books	1. Patricia, M.T. Bailey and Scott's **Diagnostic Microbiology**, 13th Edition, Mosby, Inc. Publishers, China. 2014. 2. Patrick R.Murray, Ken.S.Rosenthal, George.S.Kobayashi, Michael A.Ptaller **Medical Microbiology**,, 3rd Edition, C.V. Mosby Co. 1998.
Web. URLs	1. https://microbiologyinfo.com/

Tools for Assessment (25 Marks)

CIA I	CIA II	CIA III	Assignment	Seminar	Quiz	Total
5	5	6	3	3	3	25

Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	H	H	H	H	H	H	H	L	L	M
CO2	H	H	M	H	H	M	M	M	H	M	L	L	H
CO3	H	H	L	M	H	H	M	H	H	H	H	M	L
CO4	H	H	L	H	H	H	M	H	H	M	H	M	M
CO5	H	H	M	M	H	H	H	M	M	M	H	H	H

H-High; M-Medium; L-Low

Course designed by	Verified by Chairman
Dr. B. David Jayaseelan	Dr. M. Thangavel

Course Code	Title		
23PGMBV401	Project & Viva-Voce		
Semester: IV	Credits: 8	CIA: 80 Marks	ESE: 120 Marks

Project Guidelines

1. ARRANGEMENT OF CONTENTS:

The sequence in which the project report material should be arranged and bound is as follows:

1. Cover Page & Title Page
2. Table of Contents
3. List of Tables
4. List of Figures
5. List of Symbols, Abbreviations
6. Chapters
7. References
8. Appendices

The table and figures shall be introduced in the appropriate places.

2. PAGE DIMENSION AND SIZE OF THE PROJECT REPORT:

a) The size of the project report for undergraduate and post graduate degree should contain a minimum of 40 and 60 pages of content respectively. The pages will be counted from the first page of Chapter I. The dimension of the project report should be in A4 size.

b) The project report should be bound using flexible cover of thick art paper. The cover should be **printed in black letters** and the text for printing should be identical.

c) Page Numbering

All page numbers **(whether it is in Roman or Arabic numbers)** should be typed without punctuation on the central bottom of each page. The preliminary pages of the reports (such as Title page, Acknowledgement, Table of Contents, etc.) should be numbered in lower case Roman numerals. The title page will be numbered as (i) but this should not be typed. The page immediately following the title page shall be numbered as (ii) and it should appear at the top right hand corner as already specified. Pages of main text, starting with Chapter 1 should be consecutively numbered using Arabic numerals.

3. PREPARATION FORMAT:

Cover Page & Title Page – A specimen copy of the Cover page & Title pageof the project report are given in **Appendix 1.**

Table of Contents – The table of contents should list all material following it as well as the Abstract which precedes it. The Title page and Bonafide Certificate will not find a place among the items listed in the Table of Contents. **One and a half** spacing should be adopted for typing the matter under this head.

List of Tables – The list should use exactly the same captions as they appear above the tables in the text. **One and a half** spacing should be adopted for typing the matter under this head.

List of Figures – The list should use exactly the same captions as they appear below the figures in the text. **One and a half** spacing should be adopted for typing the matter under this head.

Table and figures - By the word Table, is meant tabulated numerical data in the body of the project report as well as in the appendices. All other non- verbal materials used in the body of the project work and appendices such as charts, graphs, maps, photographs and diagrams may be designated as figures.

List of Symbols, Abbreviations– One and a half spacing should be adopted for typing the matter under this head. Standard symbols, abbreviations etc. should be used.

Chapters – The chapters may be broadly divided into 3 parts introductory chapter,

(i) Chapters developing the main theme of the project work

(ii) Conclusions and scope

The introductory chapter will have sections covering a general introductionand importance of the research project.

The main text will be divided into several chapters and each chapter may befurther divided into several divisions and sub-divisions.

❖ Each chapter should be given an appropriate title.

❖ Tables and figures in a chapter should be placed in the immediate vicinity of the reference where they are cited.

Appendices – Appendices are provided to give supplementary information, which if included in the main text may serve as a distraction.

- Appendices should be numbered using Arabic numerals, e.g. Appendix 1, Appendix 2, etc.

- Appendices, Tables and References appearing in appendices should be numbered and referred at appropriate places just as in the case of Chapters.
- Appendices shall carry the title of the work reported and the same title shall be made in the contents page also.

List of References –The listing of references should be typed 4 spaces below the heading "REFERENCES" in alphabetical order in single spacing left – justified. The reference material should be listed in the alphabetical order of the first author.The name of the author / authors should be immediately followed by the year and other details.

(i) If more than one paper by the same first author and same year of publications, the year of citation will be followed by a, b etc to differentiate them.

(ii) While citing the paper in the text, the name of the first author and year alone must be cited. e.g Samson (2004) or Jeyaraj (2007a). The reference numbers should not be used in the text of the paper

(iii) A paper, a monograph or a book may be designated by the name of the first author followed by the year of publication, placed inside brackets at the appropriate places in the Thesis.

4. TYPING INSTRUCTIONS:

The impression on the typed copies should be black in colour.

One and a half spacing should be used for typing the general text. The general text shall be typed in the **Font style „Times New Roman" and Font size 13.**

APPENDIX 1

TITLE <Font Size 18> <1.5 line spacing>

a project report submitted by

<Font Size 14> <Italic>

NAME OF THE STUDENT (REGISTER NUMBER)<Font Size 16>

in partial fulfillment for the award of the degree

<Font Size 14> <Italic> <1.5 line spacing>

in

NAME OF THE PROGRAMME <Font Size 16>

***under the supervision of* <Font Size 14> <Italic>**

NAME OF THE SUPERVISOR <Font Size 16>

NAME OF THE DEPARTMENT<Font Size 14>

NEHRU ARTS AND SCIENCE COLLEGE
(An Autonomous Institution affiliated to Bharathiar University)
(Reaccredited with "A+" Grade by NAAC, ISO 9001:2015 & 14001:2004 Certified
Recognized by UGC with 2(f) &12(B), Under Star College Scheme by DBT, Govt. of India)
Nehru Gardens, Thirumalayampalayam, Coimbatore - 641 105, Tamil Nadu.

MONTH & YEAR <Font Size 14>

APPENDIX 2
(A typical specimen of Bonafide Certificate)
<Font Style Times New Roman>

BONAFIDE CERTIFICATE

<Font Style Times New Roman – size -16>

<Font Style Times New Roman – size -14>

This is to certify that the project report entitled **"……. TITLE OF THE PROJECT……..."** is the bonafide work of "**…….. NAME OF THE CANDIDATE(S) WITH REGISTER NUMBER……"** who carried out the project work under my supervision.

<<Signature of the Head of the Department>>
SIGNATURE
<<Name>> <<size -16>>

<<Signature of the Supervisor>>
SIGNATURE
<<Name>> <<size -16>>

HEAD OF THE DEPARTMENT
<<Academic Designation>>
<<Department>>

SUPERVISOR
<<Academic Designation>>
<<Department>>

<Font Style Times New Roman – size -14> <Font Style Times New Roman – size -14>

Submitted for the Viva Voce held on …….

Internal Examiner **External Examiner**

EVALUATION PROCESS

Distribution of marks for Continuous Internal Assessment in PG Project

S. No	Project Work	Distribution of Marks
1.	Review – I	15
2.	Review – II	15
3.	Review – III	15
4.	Document, Preparation and Implementation	15
5.	Paper Publication in Journals **	20
TOTAL MARKS		**80**

Distribution of marks for the External examination in PG Project

S. No	Project Work	Distribution of Marks
1.	Record Work and Presentation	80
2.	Viva Voce	40
TOTAL MARKS		**120**

Viva-Voce examination will be conducted at the end of the semester by both Internal (Respective Guides) and External Examiners, after duly verifying the Project Report available

Course designed by	Verified by Chairman
Dr. B. David Jayaseelan	**Dr. M. Thangavel**

Course Code	Title		
24PGMBQ404	Practical IV – Medical Microbiology Practical		
Semester: IV	Credits: 4	CIA :40 Marks	ESE:60 Marks

Course Objective	To assimilate knowledge on characteristics of bacteria, protozoa, yeasts, molds, and viruses are used to understand the role of microorganisms in human health and disease.
Course Category	Skill Development / Employability
Development Needs	Global
Course Description	Students will develop skills on interactions between the host and the microorganisms are emphasized as well as the physical and chemical methods of control.

Course Outcomes		Teaching Methods	Assessment Methods
CO1	Acquire knowledge on basic principles of medical microbiology and infectious disease.	Lecture / Hands on	Behaviour & Performance
CO2	Understand infectious disease transmission, and the role of the human body's normal microflora.	Lecture / Hands on	Observation
CO3	Understand the different conceptual basis for pathogenic microorganisms and the mechanisms by which they cause disease in the human body.	Lecture / Hands on	Performance
CO4	Gain knowledge on relationship of this infection and symptoms and the accompanying pathology.	Lecture / Hands on	Performance
CO5	Learn the techniques for pathogenic mycology and the mechanisms	Lecture / Hands on	Observation

Offered by	**Microbiology**

Course Content	Instructional Hours / Week: 5

Exp No	Experiments
1.	Demonstration normal microbial flora of skin, mouth and throat
2.	Isolation and identification of *Staphylococcal species* using suitable media, staining techniques and biochemical tests
3.	Identification of bacterial species belonging to Enterobacteriaceae family using suitable biochemical tests (*E. coli*, *Proteus*, *Pseudomonas*, *Klebsiella*)
4.	Microbiological analysis of urine, blood and pus specimens
5.	To determine antibiotic sensitivity for Gram negative and Gram-positive bacteria by disc diffusion method

6.	To determine Minimal Inhibitory Concentration (MIC) and Minimal Bactericidal concentration of an antibiotic for test bacteria.
7.	Rapid Screening test for HIV – Tridot ELISA
8.	Serodiagnosis of HBV
9.	RAPD analysis
10.	Observation of parasites – *Entamoeba, Plasmodium, Ascaris, Taenia.*
11.	Isolation and identification of fungal pathogens from clinical samples.
	Total Hours **75**

Text Books	1. Dubey, R.C and Maheswari, D.K. **Practical Microbiology** S. Chand Ltd.2002. 2. Cappuccino, J. G., Sherman, S., **Microbiology. A Laboratory Manual**, Benjamin
Reference Books	1. James G. Cappuccino and Chad Welsh. **Microbiology A Laboratory Manual**. Pearson Education Limited, 2017. 2. Dubey RC and Maheshwari DK. (2002). **Practical Microbiology**. S Chand and Co. Ltd., New Delhi, 2002. 3. Gunasekaran P. **Laboratory Manual in Microbiology**. New Age International, 2007.
Web. URLs	https://www.cdc.gov/nchs/data/nhanes/nhanes_03_04/lab.pdf

Tools for Assessment (40 Marks)

Laboratory Performance			**Test - I**	**Test - II**	Observation Note Book	**Total**
Level of engagement in lab	**Preparation**	**Result**				
5	**5**	**5**	**10**	**10**	**5**	**40**

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	M	H	H	M	M	H	H	M	M	L	H
CO2	H	M	M	H	H	H	H	H	H	M	L	L	M
CO3	M	M	M	H	M	L	L	M	M	H	M	M	H
CO4	M	M	M	H	H	M	M	M	H	M	L	M	H
CO5	H	H	H	H	H	M	M	M	H	L	L	L	M

H-High; M-Medium; L-Low

Course designed by	**Verified by Chairman**
Dr. B. David Jayaseelan	Dr. M. Thangavel

SELF STUDY PAPERS

Course Code	Title	
23PMBSS01	Advanced Learners Course – Cellular Organization	
Semester: I - IV	Credit: 2	ESE: 50 Marks

Course Objective	The course aims at giving the student an overview of cellular organization with the cellular microenvironment and the signalling events resulting from these interactions, cells response to physiological cues
Course Category	Skill and Knowledge
Development Needs	Global
Course Description	Students will acquire the knowledge of the anatomy of the cell

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Recognize the types of cell and understand the importance of cell in biology.	Lecture / Videolessons	Assignment
CO 2	Know and be able to discuss the energy and central dogma of cell, be able to give examples of their functions.	Demo / Model Preparation	Model Preparation
CO 3	Understand and discuss central cellular signal pathways and cellular adhesion in cells.	Demo / Model Preparation	Model Preparation
CO 4	Demonstrate the background of cell with skeleton and their motility.	Lecture / Video Tutorial	Seminar
CO 5	Interpret the cell division and their communication of the molecules.	Lecture	Seminar

Offered by | **Microbiology**

Course Content

Unit	Description	Text Book	Chapters
I	**Introduction to cell biology-** Introduction to cells, Evolution, prokaryotic and Eukaryotic cell, chemical and Physical background, micro and macro molecules of cells, Chromatin, chromosomes and nucleus of cell	1 2	1,2,3 1,2
II	**Energy, Catalysis and Biosynthesis –** use of energy by cells, free energy and catalysis, Activated carriers and biosynthesis, **Central Dogma –** from Gene to protein, Membrane Structure and function, Cellular Organelles and Membrane Trafficking	1 2	4 3
III	**Energy, Catalysis and Biosynthesis –** use of energy by cells, free energy and catalysis, Activated carriers and biosynthesis, **Central Dogma –** from Gene to protein, Membrane Structure and function, Cellular Organelles and Membrane Trafficking	1 2	4 3
IV	**Cytoskeleton and Cellular motility:** Cytoskeleton – Intermediate filaments, Microtubles and centrosomes, Actin and actin binding Filaments, intermediate filaments, motor proteins, Intracellular Motility, Cellular Motility and muscle contraction	1 2	9 17

V	**Cell division cycle and Cellular communication:** overview of cell cycle, cell cycle control system, Phases of cell cycle, Mitosis and cytokinesis Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation	1 2	10 18

Text Books	1. Thomas D Pollard, Willam C Earnshaw, Jennifer Lippincott Schwartz, Graham T Johnson, **Cell Biology** –. 3rd edition, Elsevier Press, 2017. 2. Alberts, Bray, Hopkin, Johnson, Lewis, Raff, Roberts, Walter, 4th Edition, **Essential Cell Biology,** Garland Science, Taylor and Francis group, 2014.
Reference Books	1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. **Molecular Biology of the Cell**. Garland Science, 2015. 2. Gerald C. Karp. **Cell and Molecular Biology, Concepts and Experiments**. John Wiley and Sons, Inc., 2003.
Web. URLs	1. https://www.bioexplorer.net/cellular-organization.html/

Course designed by	**Verified by Chairman**
Dr. R. Kasimani	Dr. M. Thangavel

Course Code	Title	
23UMBSS02	Advanced Learners Course – Cell communication and Cell Signalling	
Semester–I to IV	Credit: 2	ESE : 50 Marks

Course Objective	The course aims at giving the student an overview of cellular interactions with the cellular microenvironment and the signalling events resulting from these interactions, cells response to physiological cues.
Course Category	Skill and Knowledge
Development Needs	Global
Course Description	The course describes about every aspect of cell structure and function, an understanding of cell signaling requires knowledge about other types of cellular activity and insights into cell signaling can tie together a variety of seemingly independent cellular processes.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Recognize the principle mechanism of pathogen interaction with cell.	Lecture / Video lessons	Assignment
CO 2	Know and be able to discuss the major groups of intracellular-and membrane-bound receptors, be able to give examples of such receptors.	Lecture / Video Preparation	Model Preparation
CO 3	Understand and discuss central cellular signal pathways in eukaryotic cells.	Lecture / Video Preparation	Model Preparation
CO 4	Demonstrate the connection between cellular signal pathways and medical phenomena, using examples.	Lecture / Video Tutorial	Seminar
CO 5	Describe the principles of cells involved in immunity.	Lecture	Seminar

Offered by	**Microbiology**

Course Content

Unit	Description	Text Book	Chapters
I	Host-parasite interaction: Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behaviour by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells	1	8
II	Cell signalling: Hormones and their receptors, cell surface receptor, signalling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signalling pathways, bacterial and plant two-component signalling systems, bacterial chemotaxis, and quorum sensing	1	11,12
III	Cellular communication: Regulation of haematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation	1	1,2
IV	Cancer: Genetic rearrangements in progenitor cells, oncogenes, tumour suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth	2	4,5
	Innate and adaptive immune system: Cells and molecules involved	1	1

V	in innate and adaptive immunity, antigens, antigenicity, and immunogenicity. B and T cell epitopes, structure and function of antibody molecules, generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions		

Text Books	1. Donald R. Demuth and Richard Lamont, **Bacterial Cell-to-Cell Communications – Role in Virulence and Pathogenesis**. Cambridge University Press, New York, 2006. 2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. **Molecular Biology of the Cell**. Garland Science, 2015.
Reference Books	1. Gerald C. Karp. **Cell and Molecular Biology**, Concepts and experiments. John Wiley and Sons, Inc. 2003. 2. Lodish, Arnold Berk, Paul Matsudaira, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Lawrence Zipursky, James Darnell. **Molecular Cell Biology**, 5th edition. Macmillan Learning, 2003. 3. Jeremy M. Berg, John L. Tymocsko, Lubert Stryer. **Biochemistry**, WH Freeman and Company. 5th edition, 2002.
Web. URLs	1. Karp-Cell-and-Molecular-Biology-Concepts-and-Experiments-7ed-pdf-179-Mb.pdf (colorado.edu)

Course designed by	**Verified by Chairman**
Dr. Thulasi Sivaraman	Dr. M. Thangavel

Course Code	Title	
23PMBSS03	Advanced Learners Course – Developmental Biology	
Semester: I - IV	Credit: 2	ESE: 50 Marks

Course Objective	The course aims at giving the student an overview of presents the basic concepts and facts relating to the developmental biology of animals.
Course Category	Employability
Development Needs	Global
Course Description	Explains about the genetics and developmental stages and concepts of stem cells

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Recognize the basic concepts and development stages of animals in biology.	Lecture	Assignments
CO 2	Know and discuss the model organisms with their anatomy and genetics.	Demo / Model Preparation	Assignments
CO 3	Understand and discuss early and late development of cells.	Demo / Model	Model Preparation
CO 4	Demonstrate the concept of stem cells.	Video Tutorial	Seminar
CO 5	Interpret the application of developmental biology in various fields with updated molecular methods.	Lecture	Seminar

Offered by | **Microbiology**

Course Content

Unit	Description	Text Book	Chapters
I	**History & Basic concepts of development:** Overview of how the modern era of developmental biology emerged through multidisciplinary approaches, stages of development- zygote, blastula, gastrula, neurula cell fate & commitment – potency- concept of embryonic stem cells, differential gene expression, terminal differentiation, lineages of three germ layers, fate map Mechanisms of differentiation- cytoplasmic determinants, embryonic induction, concept of morphogen, mosaic and regulative development Pattern formation- axis specification, positional identification (regional specification) Morphogenetic movements	1	4,5
II	**Model organisms, Anatomy and Genetics:** Xenopus, Zebra fish, chick, mouse, *Drosphila*, *C. elegans*. Cycle of life – Frog's Life, Evolutionary embryology, Medical embryology and teratology, Evidence for genomic Equivalence, Differential Gene Transcription, DNA methylation and Control of transcription, Differential RNA processing, Control of gene expression at the level of translation	1 2	1,2,3 3, 6,7,8,9,10 ,11,12
III	**Early Development** in invertebrate /vertebrate models *Drosophila, C. elegans, Xenopus*, Mouse/ human Cleavage, gastrulation, Axis specification (Dorsoventral, anterior posterior), & body plan patterning, left right asymmetry in vertebrates, **Late Development** in invertebrate /vertebrate models. Organogenesis- development of central nervous system	1	4,5, 6,7, 8

	in vertebrates, vulval formation in *C. elegans*		
IV	**The stem cell concept - Organogenesis:** stem cell concept, Mesenchymal stem cells, Emergence of the ectoderm, Neural crest cells and axonal specificity, paraxial and intermediate mesoderm, Sex determination, post embryonic development, saga of the germ line	1 2	9-16 20-22
V	**Systems biology- developmental biology to medicine, ecology and Evolution:** Medical aspects of Developmental biology, Developmental Plasticity and Symbiosis, developmental mechanisms of evolutionary change and Molecular methods in developmental biology – Animal cap assay, ribonuclease protection analysis, WISH, Microinjection, DNA foot printing, Mapping	1 2	1, 3, 5, 9, 10, 11, 16, 17

Text Books	1. Scott F Gilbert Sinauer Associates, **Developmental Biology**. Publishers Sunderland, Massachusetts USA, 2010.2. 2. M W Slack. **Essential Developmental Biology**, Blackwell Publishing Ltd, by John Wiley & Sons, Ltd. 3rd edition, 2013.
Reference Books	1. Matthew Guille, **Molecular Methods in Developmental Biology,** Volume 127, Humana Press Inc., Totowa, NJ, 1999. 2. Scott F Gilbert. **Developmental Biology**, 6th edition, Sunderland (MA): Sinauer Associates; 2000.
Web. URLs	Developmental Biology Notes - Microbe Notes

Course designed by	**Verified by Chairman**
Dr. B. David Jayaseelan	Dr. M. Thangavel

Course Code	Title	
23PMBSS04	Advanced Learners Course - Inheritance Biology	
Semester: I-IV	Credit: 2	ESE: 50 Marks

Course Objective	To make students understand the principles of Genetics and inheritance biology, and to study gene functions for individual characteristics and also may contribute to susceptibility to certain diseases.
Course Category	Employability
Development Needs	Global
Course Description	The course highlights on the gene and its functions and related diseases.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Imparts knowledge on the different aspects of genetics and model organisms.	Lecture / Video lessons	Assignment
CO 2	Understand the central dogma of molecular biology and the genome of prokaryotic and eukaryotic microorganisms.	Demo / Model Preparation	Model Preparation
CO 3	Know the molecular linkage and recombination process.	Demo / Model Preparation	Model Preparation
CO 4	Explain the mutations in familial inheritance.	Lecture / Video Tutorial	Seminar
CO 5	Describe applications and techniques of modern genetic technology.	Lecture	Seminar

Offered by	**Microbiology**

Course Content

Unit	Description	Text Book	Chapters
I	**Introduction to inheritance biology:** General introduction to inheritance biology. Historical developments: Model organisms in genetic analyses and experimentation: *Escherichia coli, Saccharomyces cerevisiae, Neurospora crassa, Caenorhabditis elegans, Drosophila melanogaster, Arabidopsis thaliana, Danio rerio.*	1	2
II	**Mendel's Laws:** Mendel's Laws: Dominance, segregation, independent assortment, deviation from Mendelian inheritance, Rediscovery of Mendel's principles, Chromosome theory of inheritance: Allele, multiple alleles, pseudoallele, complementation tests, Extensions of Mendelian genetics: Allelic interactions, concept of dominance, recessiveness, Incomplete dominance and co-dominance, Multiple alleles, Epistasis, penetrance and expressivity.	1	3

III	**Linkage and recombination of genes:** Linkage and recombination of genes, Cytological basis of crossing over, Crossing over at four-strand stage, Molecular mechanism of crossing over, mapping Homologous and non-homologous recombination, including transposition, site-specific recombination	3	2-7
IV	**Rules of extra nuclear inheritance:** Rules of extra nuclear inheritance, Organelle heredity - Chloroplast mutations in Chlamydomonas, mitochondrial, mutations in Saccharomyces, Kappa particles in Paramecium. Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Polygenic inheritance, heritability and its measurements, QTL mapping.	1	13
V	**Structural organization of chromosomes:** Structural organization of chromosomes - centromeres, telomeres and repetitive DNA, Packaging DNA molecules into chromosomes, Concept of euchromatin and heterochromatin, Normal and abnormal karyotypes of human chromosomes, Chromosome banding, Giant chromosomes: Polytene and lamp brush chromosomes, Variations in chromosome structure: Deletion, duplication, inversion and translocation, Variation in chromosomal number and structural abnormalities –Kline felter syndrome, Turner syndrome, Down syndrome.	2	11

Text Books	1. Snustad DP, Simmons MJ. **Principles of Genetics**.6th edition, John Wiley and Sons Inc., 2011. 2. Russell PJ. **Introduction to Genetics** - A Molecular Approach. 3rd edition, Benjamin Cummings, 2009.
Reference Books	1. Klug WS, Cummings MR, Spencer CA, Palladino M. **Concepts of Genetics**.10th edition, Benjamin Cummings, 2012. 2. Griffith AJF, Wessler SR, Lewontin RC, Carroll SB. **Introduction to Genetic Analysis**. 9th edition, W.H.Freeman and Co., New York, 2007. 3. Hartl DL, Jones EW. **Genetics: Analysis of Genes and Genomes**. 7th edition, Jones and Bartlett Publishers, 2009.
Web. URLs	PowerPoint Presentation (ddtwo.org)

Course designed by	**Verified by Chairman**
Dr. Dinesh M. D	Dr. M. Thangavel

Course Code	Title	
23PMBSS05	Advanced Learners Course - Evolution and Behavior	
Semester: I - IV	Credit: 2	ESE : 50 Marks

Course Objective	Students will understand the concepts in Evolution of living organisms and their behavioral patterns according to time.
Course Category	Knowledge
Development Needs	Global
Course Description	Students have the ability on entrepreneurship that enable to combine science with business skills and give way for employability.

Course Outcomes		Teaching Methods	Assessment Methods
CO 1	Know about the emergence of evolutionary thought and concepts of life.	Lecture / Video lessons	Assignment
CO 2	Understand the origin of cells and other living organisms.	Demo / Model Preparation	Model Preparation
CO 3	Analyse the evolution of cell organelles and genetic material.	Demo / Model Preparation	Model Preparation
CO 4	Describe the mechanism of genetic drift over evolution.	Lecture / Video Tutorial	Seminar
CO 5	Explain about the behavioural changes of living organisms.	Lecture	Seminar

Offered by	**Microbiology**

Course Content

Unit	Description	Text Book	Chapters
I	**Emergence of Evolutionary thoughts:** Lamarck, Darwin – concepts of variation, adaptation, struggle, fitness and natural selection, Mendelism, Spontaneity of mutations, The evolutionary synthesis.	2	2
II	**Origin of cells and unicellular evolution**: Origin of basic biological molecules, Abiotic synthesis of organic monomers and polymers, Concept of Oparin and Haldane, Experiment of Miller (1953), Evolution of prokaryotes, Origin of eukaryotic cells, Evolution of unicellular eukaryotes.	3	1
III	**Molecular Evolution:** Concepts of neutral evolution, molecular divergence and molecular clocks, Molecular tools in phylogeny, classification and identification, Protein and nucleotide sequence analysis, Origin of new genes and proteins, Gene duplication and divergence.	1	8
IV	**The Mechanisms**: Population genetics – populations, gene pool, gene frequency, Hardy-Weinberg law, Concepts and rate of change in gene frequency through - Natural selection, Migration, Random genetic drift.	4	9
V	**Behavior:** Approaches and methods in study of behavior, Proximate and ultimate causation, Neural basis of learning, memory, cognition, sleep and arousal. Development of behavior, Social communication, Social dominance, Use of space and	1	10

	territoriality. Parental care, Aggressive behavior, Habitat selection and optimality in foraging, Migration, orientation and navigation, Domestication and behavioral changes.		

Text Books	1. Bateson, P. **Behaviour, Development and Evolution**, Open Book Publishers. 2017. 2. Workman, L. and W. Reader. **Evolution and Behaviour**. CRC Press. 2016. 3. Barton, N.H., D.E.G. Briggs, J.A. Eisen, D.B. Goldstein and N.H. Patel. **Evolution**, Cold Spring Harbour Laboratory Press. 2007. 4. Douglas J. Futuyma, **Evolution**, 3rd Edition, Sinaeur Associate Inc., 2013.
Reference Books	1. Wise, J. R. Roush and S. Flower. **Concepts of Biology**, Create Space Independent Publishing Platform. 2013. 2. Skinner, B.F. **Science and Human Behaviour**, The Free press. 2014.
Web. URLs	1. Evolution and behavior (acetheraceonline.com)

Course designed by	**Verified by Chairman**
Dr. B. David Jayaseelan	Dr. M. Thangavel