

**SCOTT CHRISTIAN COLLEGE (AUTONOMOUS)
NAGERCOIL**



(Estd. 1893)

**CURRICULUM AND SYLLABUS
DEPARTMENT OF MICROBIOLOGY**

**(Approved by the Standing Committee of the Academic Councils
held on 21.10.2023 & 13.01.2024)**

**POSTGRADUATE PROGRAMME
CBCS-SEMESTER SYSTEM
(For those who join from 2023 to 2026)**

An evolution towards revolution ...

Education is crucial for attaining full human potential, developing an unbiased and evenhanded society and promoting national and global development. The education sector in India is witnessing a sweeping wave of change. The very first policy for education, *National Policy on Education* (NPE-1968) was promulgated in 1968, with the National Policy on Education (NPE- 1986) following in 1986. The National Policy on Education (NPE- 1992) and the Programme of Action 1992 (POA-1992) refined and implemented the NPE-1986. The National Education Policy 2020 (NEP 2020) is a landmark document and an evolution towards revolution in the Indian educational sector. It presents the vision for greater access, equity, excellence, inclusion, multiple entry and exit and affordability to help India emerge as the global knowledge superpower.

Providing access to quality education is the key to the curriculum and syllabus of Scott Christian College (Autonomous), in terms of social justice and equality, scientific advancement, cultural preservation and national and global integration. Students should have the freedom and flexibility in choosing their courses, skills, and capacities to become moral, successful, innovative, adaptable, and productive human beings.

Higher education plays an important role in promoting human as well as societal wellbeing and in contributing towards sustainable livelihoods and economic development. The present Outcome-Based Education (OBE) curriculum and syllabus, provides valuable insights and recommendations on aspects of education that include moving towards multidisciplinary and holistic education, mastery and high-order learning and promotion of quality research.

The current curriculum has been designed based on NEP 2020, the National Credit Framework (NCrF), the National Higher Education Qualifications Framework (NHEQF) and Curriculum and Credit Framework for Undergraduate Programmes (CCFUP) which envisage that students must develop into good, thoughtful, well-rounded, creative individuals with a standard of achievement. The themed curriculum aims to support teachers and students in developing their understanding of the curriculum design and delivery process as per the requirement of the world of work.



Dr. Sidney Shirly
Dean of Arts
Scott Christian College
(Autonomous)
Nagercoil



Dr. V. Robin Perinba Smith
Dean of Science
Scott Christian College
(Autonomous)
Nagercoil



Dr. B. Shamina Ross
Dean of IT and Technical Education
Scott Christian College
(Autonomous)
Nagercoil

DEPARTMENT OF MICROBIOLOGY

VISION

Department of Microbiology aims to provide the highest quality education to students, nurture their scientific talents, promote intellectual growth in research and shape their personal development, remain dedicated and steadfast in the pursuit of truth and serve humanity through the creation of multi-skilled and socially responsible global citizens.

MISSION

Department of Microbiology provides:

- i. Excellence, in teaching, learning, research & service
- ii. Innovation, through new research directions, programs & partnerships.
- iii. Creativity, in exploring new ways to add to the body of knowledge through new findings.
- iv. Collaborative and experimental learning, by sharing knowledge across traditional boundaries.
- v. Entrepreneurship, through emphasis on collaborative and interdisciplinary study.
- vi. Ethical conduct, through instilling a value system in students.
- vii. Social responsibility, dedicated to serving individuals, society and nation through research community engagement.
- viii. Diversity and Inclusion, by respecting all individuals regardless of class, caste, religion, ability and gender. ix. Global citizenship, by inculcating meaningful knowledge and skills leading to identification with the world community and building global values.

Eligibility:

Bachelor's degree in any discipline of science such as microbiology or applied medical science or medical science or allied medical science or biosciences or life sciences with 55% aggregate marks from a recognized university.

Duration of the Programme and Medium

2 years (4 semesters)

Medium of Instruction:

English Medium

FACULTY MEMBERS

Sl. No.	NAME	DESIGNATION
1.	Dr. K. Jenitha	Assistant Professor
2.	Dr. D.K. Helen Sheebha	Assistant Professor
3.	Dr. P. Jasmine Beula	Assistant Professor
4.	Dr. C.R. Shalini Mol	Assistant Professor
5.	Dr. P.W. Jeba Malar	Assistant Professor
6.	Dr. Neeta. V.M.Joshi	Assistant Professor
7.	Dr. B. Josephine Sheeba	Assistant Professor
8.	Dr. R. Bright	Assistant Professor
9.	Dr. P.J. Beena	Assistant Professor

MEMBERS OF THE BOARD OF STUDIES

- 1. Chairperson :** **Dr. K. Jenitha**
- 2. Faculty Members:**
Dr. D.K. Helen Sheebha
Dr. P. Jasmine Beula
Dr. C.R. Shalini Mol
Dr. P.W. Jeba Malar
Dr. Neeta. V.M.Joshi
Dr. B. Josephine Sheeba
Dr. R. Bright
Dr. P.J. Beena
- 3. Subject Expert 1:** Dr. P. Kiruthika Lakshmi
- 4. Subject Expert 2:** Dr. Shalom Gnana Thanga
- 5. Subject Expert: (Nominated by the VC)** Dr. Joys Selva Mary Albert

6. Representative from Industry:

Mrs. A.K. Ramya

7. Postgraduate Meritorious Alumnus:

Ms. Gamma Mohan (Ph.D)

The Scott Christian College (Autonomous) defines the focus reinforcing its academic programmes and student life experience on campus through the Graduate Attributes (GA), that describe the knowledge, competencies, values and skills students imbibe for holistic development, multidisciplinary development and contribution to society. These attributes comprise characteristics that are transferable beyond the sphere of study into the national and international realm through curricular, co-curricular and extra-curricular engagements. They equip graduates for life long personal development and employment. Every Graduate of Scott Christian College (Autonomous) – (SCC) is desired to possess the following Graduate Attributes:

GA 1: Intellectual Competencies

Graduates of SCC

- ❖ have a comprehensive and incisive understanding of their domain of study as well as the ability for cross-disciplinary learning
- ❖ have the ability to apply the knowledge acquired through the curriculum as well as self-directed learning to a broad spectrum ranging from analytical thinking to synthesize new knowledge through research
- ❖ are able to have critical, independent and individual outlook regarding academic work and socially relevant issues

GA 2: Problem Solving

Graduates of SCC

- ❖ have the capacity to extrapolate from what has been learnt, translate concepts to real-life situations and apply acquired competencies in the required contexts to generate solutions to specific problems
- ❖ can view a problem or a situation from multiple perspectives and think ‘out of the box’ and generate solutions to complex problems in unfamiliar contexts
- ❖ are effective problems-solvers, able to apply critical, creative and evidence-based thinking to conceive innovative responses to challenges

GA 3: Communication Skills

Graduates of SCC

- ❖ listen carefully, analyse texts and research papers, and present complex information in a clear and concise manner
- ❖ express thoughts and ideas effectively in writing and orally and communicate with others using appropriate media
- ❖ confidently express herself/himself and construct logical arguments using correct technical language related to a field of learning and area of professional practice

GA 4: Environmental Awareness

Graduates of SCC

- ❖ lessen the effects of environmental degradation, climate change, and pollution
- ❖ learn the nuances for cleanliness, conservation and wise use of resources so that it can be used for generations
- ❖ know the nuances of waste management, conservation of biological diversity, management of biological resources and biodiversity, and sustainable development and living

GA 5: Professional Ethics

Graduates of SCC

- ❖ develop principled and expert behavior, and this will be showcased in their chosen careers and constructive roles as citizens of the world at large
- ❖ imbibe intellectual integrity and ethics in scholarly engagement and develop a spirit of inclusiveness through interactions with diverse people at all levels in life
- ❖ acquire new knowledge and skills, including 'learning how to learn' skills, for pursuing learning activities throughout life and adapting to changing demands of the workplace through knowledge, skill development and reskilling, ethically

GA 6: Leadership Qualities

Graduates of SCC

- ❖ inculcate leadership qualities and attitudes, and team behaviour along autonomous lines through curricular, co-curricular and extra-curricular activities
- ❖ develop managerial and entrepreneurial skills to create new opportunities for diverse careers and gear up to take up competitive examinations
- ❖ act together as a group or a team in the interests of a common cause and work efficiently as a member of a team

GA 7: Holistic Skill Development

Graduates of SCC

- ❖ develop critical thinking, problem-solving capacity, effective communication, and social skills
- ❖ are self-aware, flexible, resilient and have the capacity to accept and give constructive feedback and cope up with stress
- ❖ develop soft skills, e-skills and life skills to live, learn and work in the technically sound society globally and use appropriate digital methods for analysis of data

GA 8: Cross-Cultural Competencies

Graduates of SCC

- ❖ gain cross-cultural competencies through engaging with diverse linguistic, ethnic and religious communities and know how to understand, accept and appreciate individuals at local, national and international levels
- ❖ develop a global perspective through contemporary curriculum, culture, language and international exchange programmes
- ❖ acquire knowledge of the values and beliefs of multiple cultures and a global perspective to honour diversity, gender sensitivity and adopt gender-neutral approach and show empathy to the less advantaged and the differently-abled

GA 9: Community Engagement

Graduates of SCC

- ❖ are sensitive to social concerns and have conviction toward social justice through active social engagement

- ❖ are endowed with a strong sense of environmental awareness through the curriculum and a friendly and serene campus eco-system.
- ❖ formulate an inspiring vision and build a team that can help achieve the vision, and motivate people to the right destination

GA 10: Value-Based Ethical Competency

Graduates of SCC

- ❖ are rooted in the principles of ethical responsibility and integrity permeated with Christian values, leading to the building of character and constitutional values
- ❖ develop virtues such as truth, love, courage, unity, integrity, brotherhood, industry and uprightness
- ❖ practise responsible national and global citizenship required for responding to contemporary challenges, enabling learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies

Learning Outcomes Descriptors for a Higher Education Qualification at Level 6 on the NHEQF

The Bachelor’s degree (Honours / Honours with Research) or the Post-Graduate Diploma is awarded to students who have demonstrated the achievement of the outcomes located at level 6 on the NHEQF.

Descriptors for qualifications at levels 6 on the NHEQF

Element of the Descriptor	NHEQF Level Descriptors
Knowledge and Understanding	<p>The graduates should be able to demonstrate the acquisition of:</p> <ul style="list-style-type: none"> • advanced knowledge about a specialized field of enquiry, with depth in one or more fields of learning within a broad interdisciplinary context. • a coherent understanding and awareness of the established methods and techniques of research and enquiry • procedural knowledge required for performing and accomplishing professional tasks

Element of the Descriptor	NHEQF Level Descriptors
General, Technical and Professional Skills	<p>The graduates should be able to demonstrate the acquisition of:</p> <ul style="list-style-type: none"> • a range of cognitive and technical skills required for performing and accomplishing complex tasks required to undertake research to generate solutions to real-life problems • generating solutions to complex problems independently, requiring the exercise of full personal judgement, responsibility, and accountability for the output of the initiatives taken as a practitioner • apply advanced knowledge relating to research methods to carry out research and investigations to formulate evidence-based solutions to complex and unpredictable problems
Generic Learning Outcomes	<p>The graduates should be able to demonstrate the ability to:</p> <ul style="list-style-type: none"> • communicate technical information and explanations, and the findings/ results of the research studies relating to specialized fields of learning and pursue self-paced and self-directed learning • present in a concise manner one's views on the relevance and applications of the findings of research and evaluation studies in the context of emerging developments and issues. • define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and-effect relationships
Constitutional, Humanistic, Ethical, and Moral Values	<p>The graduates should be able to demonstrate the willingness and ability to:</p> <ul style="list-style-type: none"> • embrace and practice constitutional, humanistic, ethical, and moral values in professional practice and life. • present coherent arguments in support of relevant ethical and moral issues and participate in actions to address environmental and sustainable development issues. • follow ethical practices in all aspects of research and development,
Employability And Entrepreneurship Skills	<p>The graduates should be able to demonstrate the acquisition of knowledge and skills required for:</p> <ul style="list-style-type: none"> • adapting to the future of work and to the demands of the fast pace of technological developments and innovations that drive a shift in employers' demands for skills • managing complex technical or professional activities or projects • should be willing to take a calculated risk and be open to new ideas
Credit Requirements	A Post-Graduate Diploma programme builds on a 3-year/6-semester

Element of the Descriptor	NHEQF Level Descriptors
	bachelor's degree and requires a minimum of 40 credits for individuals who have completed a Bachelor's programme.
Entry Requirements	<ul style="list-style-type: none"> An individual seeking admission to the bachelor's degree (Honours/ Honours with Research) in a specified field of learning would normally have completed all requirements of the relevant 3-year Bachelor's degree.

Learning Outcomes Descriptors for a Higher Education Qualification at Level 6.5 on the NHEQF

The Master's degree (e.g. M.A., M.Com., M.Sc., etc.) is awarded to students who have demonstrated the achievement of the outcomes located at level 6.5 on the NHEQF.

Descriptors for qualifications at levels 6.5 on the NHEQF

Element of the Descriptor	NHEQF Level Descriptors
Knowledge and Understanding	<p>The graduates should be able to demonstrate the acquisition of:</p> <ul style="list-style-type: none"> advanced knowledge about a specialized field of enquiry with a critical understanding of the emerging developments and issues relating to one or more fields of learning advanced knowledge and understanding of the research principles, methods, and techniques applicable to the chosen field of learning or professional practice, procedural knowledge required for performing and accomplishing complex, specialized and professional tasks relating to teaching, and research and development.
General, Technical and Professional Skills	<p>The graduates should be able to demonstrate the acquisition of:</p> <ul style="list-style-type: none"> advanced cognitive and technical skills required for performing and accomplishing complex tasks related to the chosen fields of learning. advanced cognitive and technical skills required for evaluating research findings and designing and conducting relevant research that contributes to the generation of new knowledge. specialized cognitive and technical skills relating to a body of knowledge and practice to analyze and synthesize complex information and problems.

Element of the Descriptor	NHEQF Level Descriptors
Application of Knowledge and Skills	<p>The graduates should be able to demonstrate the ability to:</p> <ul style="list-style-type: none"> • apply the acquired advanced theoretical and/or technical knowledge about a specialized field of enquiry or professional practice and a range of cognitive and practical skills to identify and analyze problems and issues associated with the chosen fields of learning. • apply advanced knowledge relating to research methods to carry out research and investigations and to formulate evidence-based solutions to complex and unpredictable problems. • develop appropriate tools for data collection for research
Generic Learning Outcomes	<p>The graduates should be able to demonstrate the ability to:</p> <ul style="list-style-type: none"> • communicate in a well-structured manner, technical information and explanations, and the findings/results of the research studies undertaken in the chosen field of study, • evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and address opposing viewpoints • pursue self-paced and self-directed learning to upgrade knowledge and skills, including research-related skills, required to pursue a higher level of education and research.
Constitutional, Humanistic, Ethical, and Moral Values	<p>The graduates should be able to demonstrate the willingness and ability to:</p> <ul style="list-style-type: none"> • embrace and practice constitutional, humanistic, ethical, and moral values in one’s life and in the field of study and professional practice, • participate in actions to address environmental protection and sustainable development issues, • follow ethical principles and practices in all aspects of research and development, including inducements for enrolling participants and avoid unethical practices
Employability and Entrepreneurship Skills	<p>The graduates should be able to demonstrate the acquisition of knowledge and skill sets required for:</p> <ul style="list-style-type: none"> • adapting to the future of work and responding to the demands of the fast pace of technological developments and innovations that drive the shift in employers’ demands for skills • transition towards more technology-assisted work involving the creation of new forms of work and rapidly changing work and production processes. • exercising full personal responsibility for the output of own work as well as for group outputs and for managing work that is complex and unpredictable requiring new strategic approaches.

Element of the Descriptor	NHEQF Level Descriptors
Credit Requirements	<ul style="list-style-type: none"> The 2-year/4-semester Master's programme builds on a 3-year/6-semester bachelor's degree and requires a total of a minimum of 80 credits from the first and second years of the programme, with a minimum of 40 credits in the first year and minimum of 40 credits in the second year of the programme at level 6.5 on the NHEQF.
Entry Requirements	<ul style="list-style-type: none"> A 3-year Bachelor's degree for the 2-year/4-semester Master's degree programme (e.g. M.A., M.Com., M.Sc., etc.).

PLO & GA Mapping

Programme Learning Objective #	Programme Learning Objective (PLO)	Description of PLO	PLO Mapped with GA#
PLO 1	Learning Dispositions	Recognize and reflect on the production of knowledge in multiple spaces	GA 1 GA 8
		Develop the leadership capacity to negotiate intercultural learning spaces	GA 1 GA 6 GA 8
		Engage dialogically with distinct and/or intersecting intellectual communities to develop the scope of inquiry	GA 2 GA 3
PLO 2	Domain specific knowledge	Develop intensive and extensive knowledge and expertise in their respective domains	GA 1
		Formulate and extrapolate the knowledge gained to be applied in real- life situations, for self-directed learning and in competitive examinations	GA 1 GA 2 GA 3
		Evaluate and create domain specific knowledge in areas of learning, research and industry	GA 1 GA 2
PLO 3	Application oriented knowledge and diverse perspectives	Translate theoretical understanding to experimental knowledge for solving complex problems	GA 1 GA 3
		Ability to solve problems using pragmatic, alternative and creative approaches	GA 1 GA 2 GA 3 GA 5
		Capacity to apply advanced knowledge and approaches to solve concrete and abstract problems in domain-related and multi-disciplinary issues.	GA 1 GA 2

Programme Learning Objective #	Programme Learning Objective (PLO)	Description of PLO	PLO Mapped with GA#
PLO 4	Innovation and research	Develop aptitude for innovation and entrepreneurship	GA 6
		Identify contemporary research problems, analyze data qualitatively and quantitatively and propose solutions	GA 1 GA 2 GA 9
		Create new ideas, analyze problems, diagnose them and identify their causes independently and/or in groups	GA 6 GA 7
PLO 5	Scientific communication skills	Document, prepare and present research work as reports and articles in academic forums	GA 6
		Critically assess, review and present theories and concepts	GA 1
		Take technically complex scientific topics and craft them into accessible, informative, and compelling content for specific audiences	GA 1 GA 2
PLO 6	Digital competency	Use domain-related advanced software resources, computational skills and digital tools for data analysis and interpretation	GA 2 GA 5
		Ethically apply digital skills to creatively communicate ideas and issues related to academic experiences	GA 5 GA 10
		Acquire the ability to leverage digital technologies to communicate, collaborate, and analyze data	GA 5
PLO 7	Ethical reasoning	Apply domain specific ethical principles and practices in academic, professional and social engagements	GA 1 GA 5
		Transform the behaviour of students to preserve public interest, the environment and be a source of help	GA 4 GA 5
		Being honest and taking responsibility for academic work and environmental sustainability	GA 4 GA 5
PLO 8	Comparative and interdisciplinary knowledge practices	Develop an interdisciplinary approach to research	GA 1 GA 7
		Compare scientific, social and historical phenomena in order to yield new insights	GA 1 GA 9

Programme Learning Objective #	Programme Learning Objective (PLO)	Description of PLO	PLO Mapped with GA#
		Articulate how the complexities of social differentiation, like sex, gender, disability, race, ethnicity, nation, class, and such give insights and shape intellectual projects	GA 3 GA 5 GA 8 GA 9
PLO 9	Career readiness	Choose from diverse career options available in local, national and international realms.	GA 8
		Find success in workplace, manage one's career and apply the skills learned	GA 7
		Carry out further research or pursue higher education in the country or abroad	GA 1
PLO 10	Creating collaboration with the corporate world	Cultivate relationship with mentors and advisors, whose expertise and experience can assist in the development of work	GA 3 GA 7
		Recognize and reflect on the value, effectiveness, and ethics of collaboration in different settings and situations	GA 5 GA 9
		Produce new knowledge by working at the intersection of multiple disciplines and interdisciplinary fields	GA 1

METHODS OF ASSESSMENT

Remembering (K1)	<ul style="list-style-type: none"> • The lowest level of questions require students to recall information from the course content • Knowledge questions usually require students to identify information in the textbook
Understanding (K2)	<ul style="list-style-type: none"> • Understanding of acts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words • The questions go beyond simple recall and require students to combine the ideas together
Application (K3)	<ul style="list-style-type: none"> • Students have to solve problems by using/applying a concept learned in the classroom • Students must use their knowledge to determine exact response

Analyze (K4)	<ul style="list-style-type: none"> Analyzing the question by asking students to break down something into its component parts Analyzing requires students to identify reasons, causes or motives and reach conclusions or generalizations
Evaluate (K5)	<ul style="list-style-type: none"> Evaluation requires an individual to make judgment on something Questions to judge the value of an idea, a character, a work of art, or a solution to a problem Students are engaged in decision-making and problem-solving
Create (K6)	<ul style="list-style-type: none"> The questions of this category challenge students to get engaged in creative and original thinking Developing original ideas and problem solving skills

Cognitive Level (CL)

No.	Code	Cognitive Level
1	R	Remember
2	U	Understanding
3	Ap	Apply
4	An	Analyse
5	E	Evaluate
6	C	Create

Knowledge Category (KC)

No	Code	Knowledge
1	F	Factual
2	C	Conceptual
3	P	Procedural
4	M	Metacognitive

Learning Activities

A. Participative Learning

No	Code	Description
1	GD	Group Discussion
2	SI	Simulation
3	OO	One to One Learning
4	RF	Rapid Fire
5	KWL	Know, Want to Know, Learned
6	Sem	Seminar
7	WSQ	Watch Summarise Question
8	FC	Flipped Class

B. Cooperative Learning

No	Code	Description
1	Lec	Lecture
2	Soc	Socrates Method
3	BS	Brain Storming
4	GT	Group Learning
5	OT	One to One Tutoring

C. Peer Learning

No	Code	Description
1	TPS	Think Pair Share
2	RPT	Reciprocal Peer learning
3	PT	Peer Learning

D. Experiential Learning

No	Code	Description
1	RP	Roleplay
2	FW	Fieldwork
3	MPr	Micro/Mini Project
4	Pr	Project
5	Viv	Viva-Voce
6	Rep	Report Writing
7	Rev	Review Writing
8	CW	Critique Writing

E. Problem Solving Method

No	Code	Description
1	CS	Case Study
2	Ess	Essay
3	AW	Article Writing
4	SP	Solution to Problem
5	PF	Problem Finding

Assessment Task

No	Code	Description
1	CA	Class Assignment
2	HrA	Hour Assignment
3	CT	Class Test
4	ST	Self Test
5	OT	Online Test
6	OBT	Open Book Test
7	Qui	Quiz
8	HoA	Home Assignment
9	MCQ	Multiple Choice Question
10	SA	Short Answer
11	Ess	Essay

METHODS OF EVALUATION

Evaluation	Methods	Marks
Internal	Continuous Internal Assessment Test	40
	Assignments / Snap Test / Quiz	
	Seminars	
	Attendance and Class Participation	
External	End Semester Examination	60
Total		100

Consolidated Curriculum Framework

Year	Semester	Module No.	Courses	Subject Code	Hours						Total Hours	Credits	
					Lecture	Tutorial	Practical	Internship	Self-Learning	Demonstration			Research Project
I	I	1.1	Core Course 1 - Core Course (Major) (CC 1) General microbiology & Microbial Diversity (Theory)	23PY11	5						5	4	
		1.2	Core Course 2- Immunomics & Microbial Genetics (Theory)	23PYP1	5						5	4	
		1.3	Core Course 3 - Practical I- General Microbiology & Microbial Diversity (Practical)	23PY12			5					5	2
		1.4	Core Course 3 - Practical II- Immunomics & Microbial Genetics (Practical)	23PY2			5					5	2
		1.5	Discipline Specific Elective (DSE1) General Biochemistry (Theory)	23PYEA	5							5	4
		1.5	Discipline Specific Elective 2- Bioinstrumentation (Theory)	23PYEB	5							5	4
		Total										30	20

I	II	2.1	Core Course (Major) (CC 5) Medical Microbiology (Theory)	23PY21	5								5	4		
		2.2	Core Course (Major) (CC 6) Microbial Physiology (Theory)	23PY22	5									5	4	
		2.3	Core Course (Major) (CC 7) Medical Microbiology (Practical)	23PYP3				5							5	2
		2.4	Core Course (Major) (CC 8) Microbial Physiology (Practical)	23PYP4				5							5	2
		2.5	Discipline Specific Elective Course (DSE 3) (IDC) Health & Hygiene (Theory)	23PYN1	5										5	4
		2.6	Discipline Specific Elective Course (DSE 4)/ Interdisciplinary Course Biosafety, Bioethico & UPR (Theory)	23PYEC	5										5	4
		Total												30	20	
II	III	3.1	Core Course (Major) (CC 9) Soil, Agricultural & Environmental Microbiology (Theory)	23PY31	6								6	5		
		3.2	Core Course (Major) (CC 10) Soil, Agricultural & Environmental Microbiology (Practical)	23PYP5				6						6	3	
		3.3	Core Course (Major) (CC 11) Research Project	23PYD1	6									6	6	
		3.4	Discipline Specific Elective Course (DSE 5) Bioinformatics & Research Methodology	23PYED	5									5	5	
		3.5	Discipline Specific Elective Course (DSE 6) Fermentation Technology & Pharmaceutical Microbiology	23PYEE	5									5	5	

		3.7	Internship	23PYDI								0	4	
			Total									30	28	
II	IV	4.1	Core Course (Major) (CC 12) Molecular Biology & Recombinant DNA Technology (Theory)	23PY41	5							5	4	
		4.2	Core Course (Major) (CC 13) Food & Dairy Microbiology (Theory)	23PY42	5								5	4
		4.3	Core Course (Major) (CC 14) Molecular Biology & Recombinant DNA Technology (Practical)	23PYP6				5					5	4
		4.4	Core Course (Major) (CC 15) Food & Dairy Microbiology (Practical)	23PYP7				5					5	4
		4.5	Discipline Specific Elective Course (DSE 7) Clinical and Diagnostic Microbiology	23PYEF	5								5	4
		4.6	Discipline Specific Elective Course (DSE 8) Life science for competitive examinations	23PYEG	5								5	4
					Total									30
Total Credits for the PG MICROBIOLOGY Programme											120	88		

**Credit Distribution for M.Sc. Microbiology
SEMESTER – I
(Credit Level- 6.0)**

List of Courses	Sub. Code	Credits	Credit Points	No. of Hours
Core Course (Major) (CC 1) General microbiology & Microbial Diversity (Theory)	23PY11	4	24	5

Core Course (Major) (CC 2) Immunomics & Microbial Genetics (Theory)	23PYP1	4	24	5
Core Course (Major) (CC 3) General Microbiology & Microbial Diversity (Practical)	23PY12	2	12	5
Core Course (Major) (CC 4) Immunomics & Microbial Genetics (Practical)	23PY2	2	12	5
Discipline Specific Elective (DSE1) General Biochemistry (Theory)	23PYEA	4	24	5
Discipline Specific Elective (DSE 2) Bioinstrumentation (Theory)	23PYEB	4	24	5
	Total	20	120	30

SEMESTER- II
(Credit Level- 6.0)

List of Courses	Sub. Code	Credits	Credit Points	No. of Hours
Core Course (Major) (CC 5) Medical Microbiology (Theory)	23PY21	4	24	5
Core Course (Major) (CC 6) Microbial Physiology (Theory)	23PY22	4	24	5
Core Course (Major) (CC 7) Medical Microbiology (Practical)	23PYP3	2	12	5
Core Course (Major) (CC 8) Microbial Physiology (Practical)	23PYP4	2	12	5
Discipline Specific Elective Course (DSE 3) (IDC) Health & Hygiene (Theory)	23PYN1	4	24	5
Discipline Specific Elective Course (DSE 4)/ Interdisciplinary Course Biosafety, Bioethico & UPR (Theory)	23PYEC	4	24	5
	Total	20	120	30

SEMESTER- III
(Credit Level- 6.5)

List of Courses	Sub. Code	Credits	Credit Points	No. of Hours
Core Course (Major) (CC 9) Soil, Agricultural & Environmental Microbiology (Theory)	23PY31	5	32.5	6
*Core Course (Major) (CC 10) Soil, Agricultural & Environmental Microbiology (Practical)	23PYP5	3	19.5	6
Core Course (Major) (CC 11) Research Project	23PYD1	6	39	6
Discipline Specific Elective Course (DSE 5) Bioinformatics & Research Methodology	23PYED	5	32.5	6
Discipline Specific Elective Course (DSE 6) Fermentation Technology & Pharmaceutical Microbiology	23PYEE	5	32.5	6
Internship**		4	26	-
	Total	28	182	30

SEMESTER- IV
(Credit Level- 6.5)

List of Courses	Sub. Code	Credits	Credit Points	No. of Hours
Core Course (Major) (CC 12) Molecular Biology & Recombinant DNA Technology (Theory)	23PY41	4	26	5

Core Course (Major) (CC 13) Food & Dairy Microbiology (Theory)	23PY42	4	26	5
Core Course (Major) (CC 14) Molecular Biology & Recombinant DNA Technology (Practical)	23PYP6	2	13	5
Core Course (Major) (CC 15) Food & Dairy Microbiology (Practical)	23PYP7	2	13	5
Discipline Specific Elective Course (DSE 7)	23PYEF	4	26	5
Discipline Specific Elective Course (DSE 8)	23PYEG	4	26	5
	Total	20	130	30

SEMESTER – I

Course Title : General Microbiology and Microbial Diversity

Course Type : Theory (CC – I)

Total hours : 75 Hours/week : 5 Credit : 4

Pass-out policy : Minimum contact hours = 45
Total score % :100 Int : 40; Ext : 60
Min. pass % :50 [No min. for Int.]

Course creator	Expert 1	Expert 2
Dr. Josephine Sheeba B Assistant professor, Department of Microbiology, Scott Christian College (Autonomous), Nagercoil. Mob: +91 9894931096 email: josephins2@gmail.com.	Dr. K. Jenitha Associate Professor, Department of Microbiology, Scott Christian College, Nagercoil – 3 Mob: +91 701093092 email: jenithascott@gmail.com	Dr Neeta V.M. Joshi Assistant Professor, Department of Microbiology, Scott Christian College , Nagercoil – 3 Mob: +91 9597617311 email: cutejo88@gmail.com

CO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)	
1	Acquire knowledge on the principles of different types of microscopes and their applications.	3[20%]	1,2,3	U	P	
2	Compare and contrast the structure of bacteria and fungi. Illustrate nutritional requirements and growth in bacteria.	6 [20%]	1,2,3,5	U	P	
3	Exemplify, isolate and cultivate microalgae from diverse environmental sources.	3[20%]	1,2,3,6,8	U	P	
4	Explain various pure culture techniques and discuss sterilization methods.	3[20%]	1,2,3	A	P	
5	Discuss the importance and conservation of microbial diversity.	3[20%]	1,2,3,5	U	P	
Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
1	basics of microbiology					
1.1	History and Scope of Microbiology	1	1 (20%)	Lec	Quiz	1,2
1.2	Microscopy					
1.3	Principles and applications	1	1 (20%)	Lec	Group discussion	1,2
1.4	Types of Microscopes					
1.4.1	Bright field,	1	1 (5%)	Lec	Quiz	1,2
1.4.2	Dark-field,	1	1 (5%)	Lec	Quiz	1,2
1.4.3	Phase-contrast,	1	1 (5%)	Lec	Group discussion	1,2
1.4.4	Fluorescence microscope,	1	1 (5%)	Lec	Quiz	1,2
1.4.5	Transmission electron microscope (TEM)	1	1 (10%)	Lec	Quiz	1,2

1.4.6	Scanning electron microscope (SEM).	1	1 (10%)	Lec	Quiz	1,2
1.4.6.1	Sample preparation for SEM & TEM	1	1 (5%)	Lec	Group discussion	1,2
1.4.7	Atomic force,	1	1 (5%)	Lec	Quiz	1,2
1.4.8	Confocal microscope	1	1 (5%)	Lec	Quiz	1,2
1.5	Micrometry – Stage, Ocular and its applications	1	1 (5%)	Lec	Quiz	1,2
2	Bacteria, Actinomycetes and Fungi .					
2.1	Bacterial Structure and properties	1	1 (5%)	Lec	Quiz	1,2,3
2.2	Biosynthesis of cellular components – Cell wall.	1	2 (5%)	Lec	Group discussion	1,2,3
2.3	Actinomycetes and Fungi		2 (5%)	Lec	Ass	1,2,3
2.4	Distribution	1	1 (5%)	Lec	Quiz	1,2,3
2.5	Morphology		2 (5%)	Lec	Ass	1,2,3
2.6	Classification		2 (5%)	Lec	Quiz	1,2,3
2.7	Reproduction	1	2 (5%)	Lec	Quiz	1,2,3
2.8	Economic importance	1	2 (5%)	Lec	Quiz	1,2,3
2.9	Sporulation	1	2 (5%)	Lec	Quiz	1,2,3
2.9.1	Streptomyces & Nocardia	1	2 (5%)	Lec	Group discussion	1,2,3
2.9.2	Yeast & Mold		2 (5%)	Lec	Quiz	1,2,3
2.10	Growth and nutrition of Bacteria	1	2 (5%)	Lec	Quiz	1,2,3
2.10.1	Nutritional requirements	1	2 (10%)	Lec	Quiz	1,2,3
2.10.2	Growth curve	1	2 (5%)	Lec	Group discussion	1,2,3
2.10.3	Kinetics of growth	1	2 (5%)	Lec	Quiz	1,2,3
2.10.4	Batch culture	1	2 (5%)	Lec	Group discussion	1,2,3
2.10.5	Synchronous growth	1	2 (5%)	Lec	Quiz	1,2,3

2.10.6	Measurement of growth	1	2 (5%)	Lec	Quiz	1,2,3
2.10.7	Factors affecting growth of microorganisms	1	2 (5%)	Lec	Quiz	1,2,3
3	Algae					
3.1	Distribution	1	3 (10%)	Lec	Quiz	1,2
3.1.1	Morphology		3 (10%)	Lec	Quiz	1,2
3.1.2	Classification		3 (10%)	Lec	Quiz	1,2
3.1.3	Reproduction	1	3 (10%)	Lec	Ass	1,2
3.2	Economic Importance	1	3 (10%)	Lec	Ass	1,2
3.2.1	Isolation of algae from soil and water	1	3 (5%)	Lec	Ass	1,2
3.2.2	Culture media	1	3 (5%)	Lec	Quiz	1,2
3.2.3	Cultivation methods	1	3 (5%)	Lec	Group discussion	1,2
3.2.4	Strain selection and large-scale cultivation.	1	3 (5%)	Lec	Quiz	1,2
3.2.5	Life cycle	1	3 (5%)	Lec	Quiz	1,2
3.2.5.1	<i>Chlamydomonas</i> ,	1	3 (5%)	Lec	Ass	1,2,4
3.2.5.2	<i>Volvox</i> , <i>Spirogyra</i> (Green algae)	1	3 (5%)	Lec	Ass	1,2,4
3.2.5.3	<i>Nostoc</i> (Cyanobacteria)	1	3 (5%)	Lec	Ass	1,2,4
3.2.5.4	<i>Ectocarpus</i>	1	3 (5%)	Lec	Group discussion	1,2,4
3.2.5.5	<i>Sargassum</i> (Brown algae)	1	3 (5%)	Lec	Ass	1,2,4
4	Microbiological techniques					
4.1.1	Safety guidelines in Microbiology Laboratories.	1	4 (10%)	Sem	Ass	1,2,3
4.1.2	Sterilization method, Disinfection and its validation.	1	4 (20%)	Sem	Ass	1,2,3
4.2	Staining methods					
4.2.1	Simple	1	4 (5%)	Sem	Ass	1,2,3
4.2.2	Differential		4 (10%)	Sem	Ass	1,2,3
4.2.3	Special Staining		4 (5%)	Sem	Ass	1,2,3

4.2.4	Automated Microbial identification systems		4 (10%)	Sem	Group discussion	1,2,3
4.3	Pure cultures techniques	1	4 (10%)	Sem	Ass	1,2,3
4.4	Cultivation of Anaerobic organisms.	1	4 (10%)	Sem	Ass	1,2,3
4.5	Maintenance and preservation of pure cultures.	1	4 (10%)	Sem	Ass	1,2,3
4.6	Culture collection centres -National and International.	1	4 (10%)	Sem	Ass	1,2,3
5	BIODIVERSITY					
5.1	Introduction to microbial biodiversity.	1	5 (5%)	Lec	Quiz	4,5
5.2	Thermophiles		5 (5%)	Lec	Quiz	4,5
5.2.1	Classification	1	5 (5%)	Lec	Group discussion	4,5
5.2.2	Thermophilic Archaeobacteria and its applications		5 (5%)	Lec	Ass	4,5
5.3	Methanogens		5 (5%)	Lec	Ass	4,5
5.3.1	Classification	1	5 (5%)	Lec	Group discussion	4,5
5.3.2	Habitats		5 (5%)	Lec	Ass	4,5
5.3.3	Applications	1	5 (5%)	Lec	Ass	4,5
5.4	Alkaliphiles and Acidophiles		5 (5%)	Lec	Ass	4,5
5.4.1	Classification	1	5 (5%)	Lec	Group discussion	4,5
5.4.2	Discovery basin	1	5 (5%)	Lec	Ass	4,5
5.4.3	Cell wall and membrane	1	5 (5%)	Lec	Ass	4,5
5.5	Barophiles - Classification and its applications	1	5 (5%)	Lec	Quiz	4,5
5.6	Halophiles		5 (5%)	Lec	Quiz	4,5
5.6.1	Classification	1	5 (5%)	Sem	Group discussion	4,5
5.6.2	Discovery basin		5 (5%)	Lec	Ass	4,5

5.6.3	Cell walls and membranes – purple membrane, compatible solutes	1	5 (5%)	Lec	Ass	4,5
5.6.4	Osmo adaptation / Halotolerance	1	5 (5%)	Sem	Quiz	4,5
5.6.5	Applications of halophiles	1	5 (5%)	Lec	Ass	4,5
5.7	Conservation of Biodiversity	1	5 (5%)	Lec	Quiz	4,5

Reference Books

1. Tortora G.J., Funke B.R. and Case C.L. (2015). Microbiology: An Introduction (12th Edition). Pearson, London, United Kingdom
2. Webster J. and Weber R.W.S. (2007). Introduction to Fungi. (3rd Edition). Cambridge University Press, Cambridge.
3. Schaechter M. and Leaderberg J. (2004). The Desk encyclopedia of Microbiology. Elsevier Academic Press, California.
4. Ingraham, J.L. and Ingraham, C.A. (2000) Introduction to Microbiology. (2nd Edition). Books / Cole Thomson Learning, UK.
5. Madigan M.T., Bender K.S., Buckley D.H. Sattley W.M. and Stahl (2018) Brock Biology of Microorganisms. (15th Edition). Pearson.
6. Kanunga R. (2017). Ananthanarayanan and Panicker's Text book of Microbiology. (10th Edition). Universities Press (India) Pvt. Ltd.
7. Chan E.C.S., Pelczar M. J. Jr. and Krieg N. R. (2010). Microbiology. (5th Edition). Mc.Graw Hill. Inc, New York.
8. Prescott L. M., Harley J. P. and Klein D. A. (2004). Microbiology. (6th Edition). McGraw - Hill company, New York.
9. White D. Drummond J. and Fuqua C. (2011). The Physiology and Biochemistry of Prokaryotes, Oxford University Press, Oxford, New York.
10. Dubey R.C. and Maheshwari D.K. (2009). Textbook of Microbiology. S. Chand, Limited

Semester I

Course Title :	Immunomics and Microbial Genetics
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Course Type :	Theory (CC - II)
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Total hours : 75	Hours/week : 5	Credit : 4
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Pass-out policy :	Minimum contact hours : 45
	Total score % :100 Int : 40; Ext : 60

Min. pass % : 50 [No min. for Int.]

Course creator	Expert 1	Expert 2
Dr. Jeba Malar P.W. Assistant professor, Department of Microbiology, Scott Christian College (Autonomous), Nagercoil. Mob: +91 9600450069 email: pwjeba@gmail.com	Dr. K. Jenitha Associate Professor, Department of Microbiology, Scott Christian College, Nagercoil – 3 Mob: +91 701093092 email: jenithascott@gmail.com	Dr. R. Bright Assistant Professor Department of Microbiology, Scott Christian College, Nagercoil – 3 Mob: +91 9488490047 email: brightyourfriend@gmail.com

CO. NO.	Expected learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
1	Discuss immunity, organs and cells involved in immunity. Compare the types of antigens and their properties.	2(20%)	1,2,3	U	M
2	Describe immunoglobulin and its types. Categorize MHC and understand its significance.	2(10%) 3(10%)	1,2,3,5	U	M
3	Elucidate the mechanisms of different hypersensitivity reactions. List out the Vaccines and discuss their development.	2(10%) 3(10%)	1,2,3,5	U	M
4	Acquire knowledge the structure DNA in prokaryotes and eukaryotes	2(20%)	1,2,3	U	M
5	Explain out gene transfer studies in microbes.	2(10%) 3(10%)	1,2,3,5	U	M

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
1	BASICS OF IMMUNOLOGY					
1.1	Introduction to biology of the immune system	1	1(5%)	Lec	Quiz	1,2
1.2	Cells and organs of Immune System.	1	1(5%)	Lec	Quiz	1,2
1.2.1	T and B lymphocytes – Origin, development, differentiation, lymphocyte subpopulation in humans.	1	1(5%)	Lec	Quiz	1,2

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
1.3	Innate immunity-	1	1(10%)	Lec	Quiz	1,2
1.3.1	Antigen processing and presentation to T-lymphocytes.	1	1(10%)	Lec	Quiz	1,2
1.4	Acquired immunity – Active and Passive immunity.	1	1(5%)	Lec	Quiz	1,2
1.4.1	Physiology of acquired immune response	1	1(5%)	Lec	Quiz	1,2,3
1.4.2	Various phases of HI, CMI	1	1(10%)	Lec	Quiz	1,2,3
1.4.3	Cell mediated cytotoxicity, DTH response.	1	1(5%)	Lec	Quiz	1,2,3
1.5	Antigens	1	1(10%)	Lec	Quiz	1,2
1.5.1	Features associated with antigenicity and immunogenicity.	1	1(5%)	Lec	Quiz	1,2
1.5.2	Basis of antigen specificity.	1	1(5%)	Lec	Quiz	1,2
1.6	MHC genes and products,	1	1(5%)	Lec	Quiz	1,2
1.6.1	Structure of MHC molecules,	1	1(5%)	Lec	Quiz	1,2
1.6.2	Genetics of HLA Systems	1	1(5%)	Lec	Quiz	1,2
1.6.3	Antigens and HLA typing.	1	1(5%)	Lec	Quiz	1,2
2	IMMUNOLOGICAL MOLECULES AND IMMUNITY					
2.1	Immunoglobulins.	1	2(10%)	Lec	Quiz	1,2,3
2.2	Theories of antibody production.	1	2(10%)	Lec	Ass	1,2,3
2.3	Class switching and generation of antibody diversity.	1	2(10%)	Lec	Ass	1,2,3
2.4	Monoclonal and polyclonal antibodies.	1	2(10%)	Lec	Quiz	1,2,3
2.5	Complement system	1	2(10%)	Lec	Ass	1,2,3
2.6	Mode of activation- Classical, Alternate and Lectin pathways, biological functions.	1	2(10%)	Lec	Quiz	1,2,3
2.7	Antigen recognition	1	2(10%)	Lec	Quiz	1,2,3

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
2.8	TCR	1	2(10%)	Lec	Quiz	1,2,3
2.9	Diversity of TCR	1	2(10%)	Lec	Quiz	1,2,3
2.10	T cell surface allo antigens	1	2(10%)	Lec	Quiz	1,2,3
3	HYPERSENSITIVITY AND DIAGNOSTIC IMMUNOLOGY					
3.1	Hypersensitivity					
3.1.1	Types and mechanisms	1	3(5%)	Lec	Quiz	1,2
3.2	Autoimmunity	1	3(5%)	Lec	Quiz	1,2
3.4	Transplantation Immunology	1	3(5%)	Lec	Ass	1,2
3.5	Immunodeficiency diseases					
3.5.1	Primary Immunodeficiency	1	3(5%)	Lec	Quiz	1,2
3.5.2	Secondary Immunodeficiency	1	3(5%)	Lec	Quiz	1,2
3.6	Genetics of Immunohematology					
3.6.1	Genetic basis and significance of ABO and other minor blood groups in humans	1	3(5%)	Lec	Quiz	1,2
3.6.2	Bombay blood group	1	3(5%)	Lec	Ass	1,2,4
3.6.3	Secretors and Non-secretors	1	3(5%)	Lec	Ass	1,2,4
3.6.4	Rh System and genetic basis of D- antigens.	1	3(5%)	Lec	Ass	1,2,4
3.7	Diagnostic Immunology					
3.7.1	Precipitation reaction	1	3(5%)	Lec	Ass	1,2,4
3.7.1.1	Immunodiffusion methods - SRID, ODD. Immunoelectrophoresis - Rocket and Counter current electrophoresis.	1	3(5%)	Lec	Ass	1,2,4
3.7.2	Agglutination - Hemagglutination - Hemagglutination inhibition. Labeled Assay- Immunofluorescence assay, Radio	1	3(5%)	Lec	Ass	1,2,4

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
	immunoassay, FISH, ELISA.					
3.7.3	Flow cytometry.	1	3(5%)	Lec	Ass	1,2,4
3.8	Immune regulation mechanisms – immun-induction, immuno- suppression, immuno-tolerance, immuno-potential, Immunomodulation.	1	3(5%)	Lec	Ass	1,2,4
3.9	Role of cytokines, lymphokines and chemokines.	1	3(5%)	Lec	Ass	1,2,4
3.10	Introduction to Vaccines and Adjuvants	1	3(5%)	Lec	Ass	1,2,4
3.10.1	Types of vaccines.	1	3(5%)	Lec	Ass	1,2,4
3.10.2	Development of vaccines and antibodies in plants.	1	3(5%)	Lec	Ass	1,2,4
3.11	Immunomics					
3.11.1	Introduction and Applications.	1	3(2.5%)	Lec	Ass	1,2,4
3.11.2	Antigen engineering for better immunogenicity and use for vaccine development	1	3(2.5%)	Lec	Ass	1,2,4
3.11.3	Multiepitope vaccines.	1	3(2.5%)	Lec	Ass	1,2,4
3.11.4	Reverse vaccinology.	1	3(2.5%)	Lec	Ass	1,2,4
4.	PROKARYOTIC AND EUKARYOTIC GENOME					
4.1	Structure of prokaryotic and eukaryotic genome.	1	4(20%)	Lec	Ass	1,2,3
4.2	Introduction to prokaryotic genomic structure	1	4(20%)	Lec	Ass	1,2,3
4.3	Eukaryotic Genome					
4.3.1	Structure of chromatin, chromosome, centromere, telomere, nucleosome.	1	4(20%)	Lec	Ass	1,2,3
4.3.2	Modifications- methylation, acetylation, phosphorylation and its effect on structure and function of chromatin	1	4(20%)	Lec	Ass	1,2,3
4.3.3	DNA methylation and gene imprinting	1	4(10%)	Lec	Ass	1,2,3
4.3.4	Organelle genome.	1	4(10%)	Lec	Ass	1,2,3

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
5	GENE TRANSFER MECHANISMS					
5.1	Conjugation and its uses.	1	5(10%)	Lec	Quiz	4,5
5.2	Transduction, Generalized and Specialized	1	5(10%)	Lec	Quiz	4,5
5.3	Transformation– Natural Competence and Transformation.	1	5(20%)	Lec	Ass	4,5
5.4	Transposition					
5.4.1	Types of Transposition reactions	1	5(10%)	Lec	Ass	4,5
5.4.2	Insertion sequences, complex and compound transposons – T10, T5, and Retroposon.	1	5(10%)	Lec	Quiz	4,5
5.4.3	Mechanism	1	5(10%)	Lec	Ass	4,5
5.4.4	Transposons of <i>E. coli</i> , Bacteriophage and Yeast.	1	5(20%)	Lec	Ass	4,5
5.4.5	Importance of transposable elements in horizontal transfer of genes and evolution	1	5(10%)	Lec	Ass	4,5

Reference Books

1. Travers J. (1997). Immunobiology - The Immune System in Health and Disease. (3rd Edition). Current Biology Ltd. New York.
2. Delves P.J., Martin S., Burton D. R. and Roitt I. M. (2006). Roitt's Essential Immunology. (11th Edition). Wiley-Blackwell.
3. Hay F. C. and Westwood O. M. R. (2002). Practical Immunology (4th Edition). Wiley-Blackwell.
4. Glick B. R. and Patten C.L. (2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. (5th Edition). ASM Press.
5. Russell P.J. (2010). Genetics - A Molecular Approach. (3rd Edition). Pearson New International Edition.
6. Coico R., Sunshine G. and Benjamini E. (2003). Immunology – A Short Course. (5th Edition). Wiley-Blackwell, New York.
7. Owen J.A., Punt J., Stranford S.A. and Kuby J. (2013). Immunology, (7th Edition). W. H. Freeman and Company, New York.
8. Abbas A.K., Lichtman A.H. and Pillai S. (2021). Cellular and Molecular Immunology. (10th Edition). Elsevier.
9. Malacinski G.M. (2008). Freifelder's Essentials of Molecular Biology. (4th Edition). Narosa Publishing House, New Delhi.

10. Gardner E.J. Simmons M.J. and Snusted D.P. (2006). Principles of Genetics. (8th Edition). Wiley India Pvt. Ltd.

Semester I

Course Title : General Microbiology and Microbial Diversity

Course Type : Practical (CC – III)

Total hours : 75 Hours/week : 5 Credit : 2

Pass-out policy : Minimum contact hours : 45
Total score % :100 Int : 40; Ext : 60
Min. pass %: 50 [No min. for Int.]

Course creator	Expert 1	Expert 2
Dr. Josephine Sheeba B Assistant professor, Department of Microbiology, Scott Christian College (Autonomous), Nagercoil. Mob: +91 9894931096 email: josephins2@gmail.com.	Dr. K. Jenitha Associate Professor, Department of Microbiology, Scott Christian College, Nagercoil – 3 Mob: +91 701093092 email: jenithascott@gmail.com	Dr Neeta V.M. Joshi Assistant Professor, Department of Microbiology, Scott Christian College, Nagercoil – 3 Mob: +91 9597617311 email: cutejo88@gmail.com

CLO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
1	Gain knowledge on the techniques fundamental, handling and applications of microscopy, sterilization methods. Identify microbes by different techniques	1(20%)	1,2,3,6,8	A	P
2	Acquire Knowledge about bacterial Staining Techniques	2 (20%)	1,2,3	U	P
3	.Prepare media for bacterial growth. Perform plating and growth measurement techniques	2 (20%)	1,2,3,5	U	P
4	Gain knowledge on Biochemical Tests	2 (20%)	1,2,6	U	P
5	Apply the knowledge gained in growth skills of Bacteria from extreme environment.	2 (20%)	1,2,3,5	U	P

Module	Course Description
1.	Safety Precautions in Microbiology Laboratory.
2.	Washing and cleaning of glass wares: Sterilization methods: moist heat, dry heat, filtration & Radiation
3.	Microscopic Techniques: Light microscopy: Hay infusion broth. Wet mount - hanging drop.
4.	Dark field microscopy – Motility of Spirochetes.
5.	Staining techniques
	Simple staining, Gram's staining,
	Acid fast staining,
	Meta chromatic granule staining
	Spore staining
	Capsule staining
	Flagellar staining
6.	Media Preparation: Preparation of liquid, solid and semisolid media. Agar deeps, slants, plates.
7.	Preparation of basal, enriched, selective and enrichment media.
8.	Pure culture Technique-Pour Plate, Spread Plate, Streak Plate Techniques
10.	Maintenance of cultures- slide culture technique. Aseptic transfer.
11.	Direct counts – Total cell count, Turbidometry.
12.	Viable count - pour plate, spread plate.
13.	Isolation of Salt tolerant microbes from marine environment.
14.	Isolation of Methanogenic Bacteria.

Reference Books

1. Dubey R.C. and Maheshwari D. K. (2010). Practical Microbiology. S. Chand.
2. Cappuccino, J. and Sherman, N. (2002). Microbiology: A Laboratory Manual, (6th Edition). Pearson Education, Publication, New Delhi.

3. Cullimore D. R. (2010). Practical Atlas for Bacterial Identification. (2nd Edition). - Taylor & Francis.
4. Prescott L. M., Harley J. P. and Klein D. A. (2004). Microbiology. (6th Edition). McGraw - Hill company, New York.
5. White D. Drummond J. and Fuqua C. (2011). The Physiology and Biochemistry of Prokaryotes, Oxford University Press, Oxford, New York.

Semester I

Course Title : Immunomics and Microbial Genetics

Course Type : Practical (CC – IV)
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Total hours : 75 Hours/week : 5 Credit : 2

Pass-out policy : Minimum contact hours : 45 Total score % :100 Int : 40; Ext : 60 Min. pass % : 50 [No min. for Int.]
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Course creator	Expert 1	Expert 2
Dr. Jeba Malar P.W. Assistant professor, Department of Microbiology, Scott Christian College (Autonomous), Nagercoil. Mob: +91 9600450069 email: pwjeba@gmail.com	Dr. K. Jentha Associate Professor and Head, Department of Microbiology, Scott Christian College (Autonomous), Nagercoil – 3 Mob: +91 7010930792 email: jenithascott@gmail.com	Dr R Bright Assistant Professor, Department of Microbiology, Scott Christian College, Nagercoil – 3 Mob: +91 9488490047 email: brightlyourfriend@gmail.com

CLO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
1	Perform and comprehend antigen-antibody interaction through agglutination and precipitation reactions	2(20%)	1,2,3	U	M
2	Isolate lymphocytes, purify immunoglobulins through ammonium sulphate fractionation column chromatography, analyze the purity through SDS-PAGE and check the quality of protein through western blotting technique	2(20%)	1,2,3,5	AP	M

CLO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
3	Isolate, purify and estimate genetic materials, DNA and RNA from microbial source	2(20%)	1,2,3,5	AP	M
4	Comprehend the effect of induced mutagenesis through UV mutation	2(20%)	1,2,3	AP	M
5	Execute experiments to understand the gene transfer mechanisms such as transformation and conjugation	2(20%)	1,2,3,5	AP	M

Module	Course Description
1	SLIDE AGGLUTINATION TEST
1.1	ABO blood grouping and Rh typing
1.2	ASO Test
2	TITRATION OF ANTIBODY
2.1	Qualitative Widal Test
2.2	Quantitative Widal Test
3	PRECIPITATION TEST
3.1	VDRL TEST
3.2	RID
3.3	Double Immunodiffusion
3.4	Immuno-electrophoresis
4	Enzyme Linked Immunosorbent Assay (ELISA)
5	Isolation of lymphocytes from peripheral blood
6	Purification of immunoglobulin– Ammonium Sulphate Precipitation.
7	Separation of IgG by chromatography using DEAE cellulose or Sephadex.
8	Western Blotting – Demonstration.
9	Isolation of genomic DNA from <i>E. coli</i> and analysis by agarose gel electrophoresis

Module	Course Description
10	Estimation of DNA using colorimeter (Diphenylamine reagent)
11	Separation of proteins by polyacrylamide gel electrophoresis (SDS-PAGE)
12	UV induced mutation and isolation of mutants by replica plating technique.
13	Plasmid DNA isolation from <i>E.coli</i> .
14	DNA isolation from yeast.
15	DNA estimation by Orcinol method
16	Transformation of genetic material in <i>E.coli</i>
17	Conjugation of F plasmid in <i>E.coli</i>

Reference Books

1. Travers J. (1997). Immunobiology - The Immune System in Health and Disease. (3rd Edition). Current Biology Ltd. New York.
2. Delves P.J., Martin S., Burton D. R. and Roitt I. M. (2006). Roitt's Essential Immunology. (11th Edition). Wiley-Blackwell.
3. Hay F. C. and Westwood O. M. R. (2002). Practical Immunology (4th Edition). Wiley-Blackwell.
4. Glick B.R. and Patten C.L. (2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. (5th Edition). ASM Press.
5. Russell P.J. (2010). Genetics - A Molecular Approach. (3rd Edition). Pearson New International Edition.
6. Coico R., Sunshine G. and Benjamini E. (2003). Immunology – A Short Course. (5th Edition). Wiley-Blackwell, New York.
7. Owen J.A., Punt J., Stranford S.A. and Kubly J. (2013). Immunology, (7th Edition). W. H. Freeman and Company, New York.
8. Abbas A.K., Lichtman A.H. and Pillai S. (2021). Cellular and Molecular Immunology. (10th Edition). Elsevier.
9. Malacinski G.M. (2008). Freifelder's Essentials of Molecular Biology. (4th Edition). Narosa Publishing House, New Delhi.
10. Gardner E.J. Simmons M. J. and Snusted D.P. (2006). Principles of Genetics. (8th Edition). Wiley India Pvt. Ltd.

Semester I

Course Title : General Biochemistry

Course Type : Theory (DSE – I)

Total hours : 75 Hours/week : 5 Credit : 4

Pass-out policy : Minimum contact hours : 45
Total score % :100 Int : 40; Ext : 60
Min. pass % : 50 [No min. for Int.]

Course creator	Expert 1	Expert 2
Dr. P.J. Beena Assistant Professor, Department of Microbiology, Scott Christian College (Autonomous), Nagercoil-3. Mobile 9486737136 Email id beena75pj@gmail.com	Dr. K. Jenitha Associate Professor, Department of Microbiology, Scott Christian College, Nagercoil – 3 Mob: +91 701093092 email: jenithascott@gmail.com	Dr. C.R. Shalini Mol Assistant Professor, Department of Microbiology, Scott Christian College (Autonomous), Nagercoil-3. Mobile 9487686711 Email id sm2516999@gmail.com

CLO. No.	Course Learning Outcomes (CLO) Upon completion of this course, students will be able to:	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
1	Get knowledge about the biomolecules and their advantages for our body function	1(20%)	1,6,8,2,3	U	F
2	Remaind the functions of biomolecules.	8(20%)	1,7	U	F
3	Understand the uses of enzymes.	6(20%)	2,5,10	U	F
4	Understand the functions of harmones.	3(20%)	1,2,3,5	U	F
5	Acquire knowledge about bioenergetics.	4(20%)	1,2,6,9,7	U	M

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
1	Biomolecules-I					
1.2	Carbohydrates-Classification- - monosaccharides (Glucose, Fructose, Ribose). Disaccharides (Lactose, Sucrose, Maltose)	1,2	1(10%)	Lec	Qui	10,1,2

1.3	Oligosaccharides, Polysaccharides (Cellulose, Glycogen, Starch)	3	1(10%)	Lec	CA	10,1,2
1.4	Isomerism, Anomers, Epimers	4	1(10%)	Lec	CA	10,1,2
1.5	Chemistry of DNA	5	1(10%)	Lec	CA	10,1,2
1.6	Forms of DNA-A,B & Zform	6,7	1(10%)	Lec	CA	10,1,2
1.7	Chemistry of RNA	8	1(10%)	Lec	CA	10,1,2
1.8	Types of RNA- mRNA,rRNA,tRNA	9,10	1(10%)	Lec	CA	10,1,2
1.9	Comparison between DNA & RNA	11	1(10%)	Lec	CA	10,1,2
1.10	Biological importance of nucleic acids.	12	1(20%)	Lec	CA	10,1,2
2	Biomolecules-II					
2.1	Physical & Chemical properties of aminoacids.	13	2 (10%)	Lec	CA	6,7,8
2.2	Classification of aminoacids based on structure, polarity, nutrition & metabolic fate.	14	2 (10%)	Lec	CA	6,7,8
2.3	Properties of protein	15	2 (10%)	Lec	CA	6,7,8
2.4	Classification of Proteins - based on function, chemical nature, nutrition.	16,17	2 (10%)	Lec	CA	6,7,8
2.5	Primary, secondary, tertiary structure of proteins.	18	2 (10%)	Lec	CA	6,7,8
2.6	Water soluble vitamins-Structure, properties, function & deficiencies.	19	2 (10%)	Lec	CA	6,7,8
2.7	Fat soluble vitamins- Structure, properties, function & deficiencies.	20	2 (10%)	Lec	CA	6,7,8
2.8	Lipids- Classification tree- Simple- Triglycerol.	21,22	2 (10%)	Lec	CA	6,7,8
2.9	Complex- Sphingomyelins, Gangliodes.	23	2 (10%)	Lec	CA	6,7,8
2.10	HDL, LDL, VLDL, Derived –Cholesterol.	24	2 (10%)	Lec	CA	6,7,8
3	Enzymes					
3.1	Classification	25,26	3(14%)	Lec	Qui	3,4,5,6
3.2	Mechanism of action-Fischers template theory, Induced theory, Substrate strain theory.	27,28	3(14%)	Lec	Qui	3,4,5,6
3.3	Factors affecting enzyme action	29	3(14%)	Lec	Qui	3,4,5,6

3.4	Characteristic features of active site	30	3(14%)	Lec	Qui	3,4,5,6
3.5	reversible, Irreversible, allosteric inhibition, Feedback inhibition	31,32	3(14%)	Lec	Qui	3,4,5,6
3.6	Coenzymes- Definition & Functions.	33,34	3(14%)	Lec	Qui	3,4,5,6
3.7	Applications of enzymes	35,36	3(16%)	Lec	Qui	3,4,5,6
4	Harmones					
4.1	Hypothalamic hormones (synthesis, Functions & abnormalities)	37,38	4(12.5%)	Lec	Qui	8,9,10
4.2	Thyrotropin- releasing hormone Corticotrophin – releasing harmones	39,40	4(12.5%)	Lec	Qui	8,9,10
4.3	Gonadotropin releasing harmones Growth harmones-releasing- inhibitory harmones.	41,42	4(12.5%)	Lec	Qui	8,9,10
4.4	Prolactin releasing, inhibitory hormone	43	4(12.5%)	Lec	Qui	8,9,10
4.5	Anterior pituitary harmones	44	4(12.5%)	Lec	Qui	8,9,10
4.6	Posterior pituitary harmones (ADH, Oxytoxin)	45	4(12.5%)	Lec	Qui	8,9,10
4.7	Sexharmones (Androgen, esterogen, progesterone)	46,47	4(12.5%)	Lec	Qui	8,9,10
4.8	Gasterointestinal harmones (Gastria, secretin)	48	4(12.5%)	Lec	Qui	8,9,10
5	Bioenergetics					
5.1	Free Energy & Law of Thermodynamics	49,50	5 (14%)	Lec	CT	5,6,7
5.2	Enthalpy, Entrophy, coupling of undergone to exergonic process	51,52	5 (14%)	Lec	CT	5,6,7
5.3	High energy phosphate molecules	53	5 (14%)	Lec	CT	5,6,7
5.4	ATP- ADP cycle	54,55	5 (14%)	Lec	CT	5,6,7
5.5	Biological Oxidation	56,57	5 (14%)	Lec	CT	5,6,7
5.6	Redox potential, Enzymes & Coenzymes involved in redox reaction	58,59	5 (14%)	Lec	CT	5,6,7
5.7	Electron transport chain	60	5 (16%)	Lec	CT	5,6,7

Reference Books

1. Conn and Stump, Outlines of Biochemistry (5th edition) BRUENING & DOI.
2. Donald Voet and Judith G. Voet (1995). Biochemistry – Second Edition. John Willey and Sons, Inc.
3. Geofferey, L and Zubay (1998). Biochemistry. (Fourth Edition) Wm. C. Brown Publishers.

4. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer (2002). Biochemistry. (5th edition). W. H. Freeman and company, New York.
5. Lubert Stryer. (1995). Biochemistry. (4th edition). W.H. Freeman and company, New York.
6. Lehninger (2000) Principles of Biochemistry, 3rd edition, NELSON & COX (Worth) Publ.
7. Martin, Mayer and Roadwell Harper's Review of Biochemistry (2006).
8. Thomas M. Devlin. (2002). Textbook of Biochemistry with clinical correlations. (5th Edition). A John Wiley and sons, Inc., publication, New York.
9. Trudy McKee and James R. McKee. (1999). Biochemistry-An Introduction. (2nd Edition). WCB McGraw- Hill, U.S.A
10. U. Satyanarayana U. Chakrapani (2005) Biochemistry, 3rd Edition, Books and allied Publications.

Semester I

Course Title : Bioinstrumentation

Course Type : Theory (DSE – II)

Total hours : 75 Hours/week: 5 Credit: 4

Pass-out Policy: Minimum contact hours: 45

Total score % :100 Int: 40; Ext: 60

Min. pass %: 50 [No min. for Int.]

Course creator	Expert 1	Expert 2
Dr. P. Jasmine Beula Assistant professor, Department of Microbiology, Scott Christian College (Autonomous), Nagercoil. Mob: +91 9944737747 email: jasbeula@yahoo.com.	Dr. K. Jenitha Associate Professor, Department of Microbiology, Scott Christian College, Nagercoil – 3 Mob: +91 701093092 email: jenithascott@gmail.com	Dr. D.K. Helen Sheeba Assistant Professor Department of Microbiology, Scott Christian College Nagercoil - 3 Mob: +91 9488887300 email: helensheeba30@gmail.com

CLO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
1	Perform basic instrumentation techniques	1(20%)	1,2,3,5	AP	P

2	Perform chromatography techniques	1(20%)	1,2,3,5	AP	P
3	Perform Electrophoresis techniques	1(20%)	1,2,3,5	AP	P
4	Perform Spectroscopic techniques	1(20%)	1,2,3,5	AP	P
5	Perform Radioisotopic techniques	1(20%)	1,2,3,5	AP	P

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
1	Basic laboratory Instruments	2	1(25%)	Lec	Quiz	1,2
1.1	Aerobic and anaerobic incubator –	2	1 (25%)	Lec	Quiz	1,2
1.2	Biosafety Cabinets - Fume Hood, pH meter, Lyophilizer, Flow cytometry.	1	1(25%)	Lec	Quiz	1,2
1.2.1	Centrifugation techniques: Basic principles of centrifugation - Standard sedimentation coefficient - measurement of sedimentation coefficient; Principles, methodology and applications of differential, rate zonal and density gradient centrifugation	3	1 (15%)	Lec	Quiz	1,2
1.3	Applications in determination of molecular weight.	1	1(10%)	Lec	Quiz	1,2
2.1	General principles of chromatography	1	2(5%)	Lec	Ass	1,2,3
2.2	Chromatographic Performance parameters; Types-	1	2(5%)	Lec	Ass	1,2,3
2.3	Thin layer chromatography,	1	1(10%)	Lec	Quiz	1,2,3
2.4	Paper Chromatography,	1	2(10%)	Lec	Ass	1,2,3
2.5	Liquid chromatography (LPLC & HPLC),	1	2(10%)	Lec	Quiz	1,2,3
2.6	Adsorption,	1	2(10%)	Lec	Quiz	1,2,3
2.7	ion exchange,	1	2(5%)	Lec	Quiz	1,2,3
2.8	Gel filtration,	1	2(5%)	Lec	Quiz	1,2,3
2.9	affinity,	1	2(5%)	Lec	Quiz	1,2,3
2.10	Gas liquid (GLC).	1	2(5%)	Lec	Quiz	1,2,3
2.11	Flash Chromatography and Ultra Performance convergence chromatography.	1	2(5%)	Lec	Quiz	1,2,3

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
2.12	Two dimensional chromatography.	1	2(5%)	Lec	Quiz	1,2,3
2.13	Stimulated moving bed chromatography (SEC).	1	2(10%)	Lec	Quiz	1,2,3
3	Electrophoresis: General principles	1	3(5%)	Lec	Quiz	1,2
3.1	- moving boundary electrophoresis -	1	3(5%)	Lec	Quiz	1,2
3.2	electrophoretic mobility – supportive materials –	1	3(5%)	Lec	Quiz	1,2
3.3	electro endosmosis – types (horizontal, vertical and two dimensional electrophoresis) - Principle and applications	1	3(5%)	Lec	Quiz	1,2
3.4	paper electrophoresis	1	3 (5%)	Lec	Ass	1,2
3.5	Serum electrophoresis	1	3(5%)	Lec	Ass	1,2
3.6	starch gel electrophoresis	1	3(20)	Lec	Ass	1,2
3.7	Disc gel electrophoresis	1	3(5%)	Lec	Quiz	1,2
3.8	Agarose gel electrophoresis	1	3(5%)	Lec	Quiz	1,2
3.9	SDS – PAGE	1	3(20)	Lec	Ass	1,2
3.10	Immuno electrophoresis.	1	3(3%)	Lec	Quiz	1,2
3.11	Blotting techniques -Southern, northern and western blotting.	1	3(3%)	Lec	Ass	1,2,4
4.1	Spectroscopic techniques: Principle, simple theory of absorption of light by molecules	1	3 (3%)	Lec	Ass	1,2,4
4.2	electromagnetic spectrum, instrumentation and application of UV- visible	1	3 (3%)	Lec	Ass	1,2,4
4.3	Raman spectroscopy	1	3(20)	Lec	Ass	1,2,4
4.4	FTIR spectrophotometer	1	3 (5%)	Lec	Ass	1,2,4
4.5	spectrofluorimetry	1	3 (5%)	Lec	Ass	1,2,4
4.6	Atomic Absorption Spectrophotometer	1	3 (5%)	Lec	Ass	1,2,4
4.7	Flame spectrophotometer	1	3 (3%)	Lec	Ass	1,2,4
4.8	NMR	1	3 (15%)	Lec	Ass	1,2,4
4.9	ESR	1	3 (15%)	Lec	Ass	1,2,4
4.10	Emission Flame Photometry and GC-MS.	1	3 (5%)	Lec	Ass	1,2,4

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
4.11	Detection of molecules in living cells - FISH and GISH.	1	3 (5%)	Lec	Ass	1,2,4
4.12	Biophysical methods: Analysis of biomolecules by Spectroscopy UV/visible.	1	3 (5%)	Lec	Ass	1,2,4
5.1	Radioisotopic techniques: Principle and applications of tracer techniques in biology.	2	3(25)	Lec	Ass	1,2,4
5.2	Radioactive isotopes - radioactive decay	3	3 (25%)	Lec	Ass	1,2,4
5.3	Detection and measurement of radioactivity using ionization chamber, proportional chamber, Geiger- Muller and Scintillation counters, auto radiography and its applications.	4	3 (25%)	Lec	Ass	1,2,4
5.4	Commonly used isotopes in biology, labeling procedures and safety aspects.	3	3 (25%)	Lec	Ass	1,2,4

Reference Books

1. Tortora G.J., Funke B. R. and Case C.L. (2015). Microbiology: An Introduction (12th Edition). Pearson, London, United Kingdom
2. Webster J. and Weber R.W.S. (2007). Introduction to Fungi. (3rd Edition). Cambridge University Press, Cambridge.
3. Schaechter M. and Leaderberg J. (2004). The Desk encyclopedia of Microbiology. Elsevier Academic Press, California.
4. Ingraham, J.L. and Ingraham, C.A. (2000) Introduction to Microbiology. (2nd Edition). Books / Cole Thomson Learning, UK.
5. Madigan M.T., Bender K.S., Buckley D.H. Sattley W.M. and Stahl (2018) Brock Biology of Microorganisms. (15th Edition). Pearson.
6. Kanunga R. (2017). Ananthanarayanan and Panicker's Text book of Microbiology. (10th Edition). Universities Press (India) Pvt. Ltd.
7. Chan E.C.S., Pelczar M. J. Jr. and Krieg N. R. (2010). Microbiology. (5th Edition). Mc.Graw Hill. Inc, New York.
8. Prescott L. M., Harley J. P. and Klein D. A. (2004). Microbiology. (6th Edition). McGraw - Hill company, New York.
9. White D. Drummond J. and Fuqua C. (2011). The Physiology and Biochemistry of Prokaryotes, Oxford University Press, Oxford, New York.
10. Dubey R.C. and Maheshwari D. K. (2009). Textbook of Microbiology. S. Chand, Limited.

SEMESTER II

Course Title : Medical Microbiology

Course Type : Theory (CC – V)

Total hours : 75 Hours/week : 5 Credit : 4

Pass-out Policy: Minimum contact hours: 45
Total score % :100 Int: 40; Ext: 60
Min. pass %: 50 [No min. for Int.]

Course creator	Expert 1	Expert 2
Dr. D. K. Helen Sheeba Assistant Professor, Department of Microbiology, Scott Christian College, Nagercoil – 3 SCC,NGL,9488887300, helensheeba30@gmail.com	Dr. K. Jenitha Associate Professor, Department of Microbiology, Scott Christian College, Nagercoil – 3 Mob: +91 701093092 email: jenithascott@gmail.com	Dr Neeta V.M. Joshi Assistant Professor, Department of Microbiology, Scott Christian College, Nagercoil - 3 Mob: +91 9597617311 email: cutejo88@gmail.com

CLO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
1	Understand about historical events and various types of infection and disease causing organism	2(20%)	1,2,3	U	M
2	Analyse about pathogenicity of fungi & bacteria	2(20%)	1,2,3	An	M
3	Understand about pathogenicity of parasites	2(20%)	1,2,3	U	M
4	Understand about Pathogenicity and control of virus	2(20%)	1,2,3	U	M
5	To analyse about national programmes for the eradication of disease.	2(20%)	1,2,3	U	M

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References

Module	Course Description	Hours	Objectives	Mapping with Learning Activities	Assessment	References
1.	Historical events and Epidemiology					
1.1	History of Medical Microbiology	1	1(10%)	Lec	Quiz	1-6
1.2	Host microbe's interaction -Disease Cycle-Entry, attachment and colonization of pathogen, production of enzymes and toxins.	2	1(10%)	Lec	Quiz	1-6
1.3	Transmission of infection	1	1(10%)	Lec	Quiz	1-6
1.4	Sources of infection	1	1(10%)	Lec	Quiz	1-6
1.5	Types of infection	1	1(10%)	Lec	Quiz	1-6
1.6	Nosocomial infection	1	1(10%)	Lec	Quiz	1-6
1.7	Multidrug resistant pathogen	2	1(10%)	Lec	Quiz	1-6
1.8	Non communicable Disease					
1.8.1	Asthma	1	1(05%)	Lec	Quiz	1-6
1.8.2	Coronary Heart Disease	1	1(05%)	Lec	Quiz	1-6
1.8.3	Malignancy	1	1(05%)	Lec	Quiz	1-6
1.8.4	Diabetes Mellitus	1	1(05%)	Lec	Quiz	1-6
1.8.5	Respiratory Disease	1	1(05%)	Lec	Quiz	1-6
1.8.6	Eye and Dental Disorder	1	1(05%)	Lec	Quiz	1-6
2	Morphology pathogenicity and laboratory Diagnosis of bacteria					
2.1	<i>Staphylococcus aureus</i>	1	2(10%)	Lec	Quiz	1-6
2.2	<i>Streptococcus pyogens</i>	1	2(10%)	Lec	Quiz	1-6
2.3	<i>Escherichia coli</i>	1	2(10%)	Lec	Quiz	1-6
2.4	<i>Salmonella typhi</i>	1	2(10%)	Lec	Quiz	1-6
2.5	Systemic infection a) <i>Histoplasmosis</i> b) <i>Maduramycosis</i>	2	2(10%)	Lec	Quiz	1-6
2.6	Morphology pathogenicity and laboratory Diagnosis of fungi	2	2(10%)	Lec	Quiz	1-6
2.7	Superficial infection a) <i>Black and white Piedra</i> b) <i>Tinea nigra</i> c) <i>Pityriasis versicolor</i>	2	2(10%)	Lec	Quiz	1-6

Module	Course Description	Hours	Objectives	Mapping with Learning Activities	Assessment	References
2.8	Cutaneous infection a) <i>Microsporium</i> b) <i>Trichophyton</i> c) <i>Epidermophyton</i>	2	2(10%)	Lec	Quiz	1-6
2.9	Subcutaneous infection a) <i>Chromomycosis</i> b) <i>Phaeohiphomycosis</i> b) <i>Rhinosporidiosis</i>	2	2(10%)	Lec	Quiz	1-6
2.10	Opportunistic Infection a) <i>Candida albicans</i> b) <i>Aspergillus</i> c) <i>Mucor</i>	2	2(10%)	Lec	Quiz	1-6
3	Morphology pathogenicity ,life cycle and laboratory Diagnosis of parasites					
3.1	<i>Entamoeba histolytica</i>	2	3(10)	Lec	Quiz	1-6
3.2	<i>Plasmodium vivax</i>	2	3(10)	Lec	Quiz	1-6
3.3	<i>Ascaris lumbricoides</i>	1	3(10)	Lec	Quiz	1-6
3.4	<i>Toxoplasma</i>	1	3(10)	Lec	Quiz	1-6
3.5	<i>Trypanosoma</i>	1	3(10)	Lec	Quiz	1-6
3.6	<i>Giardia lamblia</i>	1	3(10)	Lec	Quiz	1-6
3.7	<i>Taenia saginata</i>	1	3(10)	Lec	Quiz	1-6
3.8	<i>Taenia solium</i>	1	3(10)	Lec	Quiz	1-6
3.9	<i>Wuchereria bancrofti</i>	1	3(10)	Lec	Quiz	1-6
3.10	WHO Listed Emerging parasite of India	2	3(10)	Lec	Quiz	1-6
4	Morphology pathogenicity and laboratory Diagnosis of DNA and RNA virus					
4.1	Pox virus	2	4(10%)	Lec	Quiz	1-6
4.2	Herpes virus	1	4(10%)	Lec		1-6
4.3	Adeno virus	1	4(10%)	Lec	Quiz	1-6
4.4	Hepadna virus	1	4(10%)	Lec	Quiz	1-6
4.5	Picorna virus	1	4(10%)	Lec	Quiz	1-6
4.6	Rhabdo virus	1	4(10%)	Lec	Quiz	1-6
4.7	HIV	1	4(10%)	Lec	Quiz	1-6

Module	Course Description	Hours	Objectives	Mapping with Learning Activities	Assessment	References
4.6	WHO list out Emerging and reemerging viral infection of India	1	4(10%)	Lec	Quiz	1-6
4.7	Dengue	1	4(10%)	Lec	Quiz	1-6
4.8	SARS	1	4(05%)	Lec	Quiz	1-6
4.9	COVID-19	1	4(05%)	Lec	Quiz	1-6
5	National programme related to communicable and non-communicable disease					
5.1	National Malaria Eradication programme	1	5(10%)	Lec	Quiz	1-6
5.2	Revised National Tuberculosis control	1	5(10%)	Lec	Quiz	1-6
5.3	Vector Borne Disease control programme	1	5(10%)	Lec	Quiz	1-6
5.4	National AIDS control programme	1	5(10%)	Lec	Quiz	1-6
5.5	National cancer control programme	1	5(10%)	Lec	Quiz	1-6
5.6	National Diabetes control programme	1	5(10%)	Lec	Quiz	1-6
5.7	Communicable and Non Communicable Disease control programme	1	5(10)	Lec	Quiz	1-6
5.8	Hospital Waste Management	1	5(10)	Lec	Quiz	1-6
5.9	Immunization schedule currently followed in India	1	5(20)	Lec	Group Discussion	1-6

Reference Books

1. College J.G., Fraser A.G. Marmion B.P. and Simmons A. (1996). Mackie & McCartney Microbiology. (14th Edition). Elsevier, New Delhi. ISBN-0443047219/ISBN-13-978-0443047213
2. Tille P.M. (2021). Bailey and Scott's Diagnostic Microbiology. (15th Edition). Elsevier. ISBN:9780323
3. Jawetz E., Melnick J.L. and Adelberg E.a. (2000). Review of Medical Microbiology. (19th Edition) Publication, U.S.A
4. Mukerjee K.L. (2000). Medical Laboratory Technology. Vol.1-3. (2nd Edition). Tata Mc Graw-Hill J10:0074632604
5. Sood R. (2009). Medical Laboratory Technology-Methods and Interpretations. (6th Edition). Jaypee Publishers (p) Ltd. New Delhi.ISBN:97881844844496.
6. Ananthanarayan and Panikers (2020). Textbook of Microbiology (11th Edition). Universities Press, Private Limited.

Semester II

Course Title : Microbial Physiology

Course Type : Theory (CC – VI)

Total hours : 75 Hours/week :5 Credit : 4

Pass-out Policy: Minimum contact hours: 45
Total score % :100 Int: 40; Ext: 60
Min. pass %: 50 [No min. for Int.]

Course creator

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CLO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
1	Understand the growth pattern of microbes, major features of nutrition, their types & mode of transport of nutrients	1(20%)	1,2,3,6,8	U	AP
2	Understand the factors influencing the growth of microorganisms, apply methods of measurement of growth of microbes, Quorum sensing, Bioluminescence	2(20 %)	1,2,3	U	AP
3	Understand the microbial aerobic respiratory energy yield & fermentative pathways	3(20 %)	1,2,3,5	U	AP
4	Understand anaerobic respiration, catabolic pathways, methanogenesis, Acetogenesis	4(20 %)	1,2,6,7,9	U	AP
5	Understand oxygenic, anoxygenic, halobacterial, photosynthetic pathways	5(20 %)	1,2,6	U	AP

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
1	Microbial nutrition & growth					
1.1	Nutritional requirements of microorganism	1	1(10 %)	Lec	Quiz	1,2
1.1.1	Macro nutrients	1	1(10 %)	Lec	Quiz	1,2
1.1.2	Micro nutrients	1	1(10 %)	Lec	Quiz	1,2
1.2	Nutritional types of microorganisms	1	2(10 %)	Lec	Quiz	1,2
1.3	Transport of nutrients					
1.3.1	Active transport	1	1(10 %)	Lec	Quiz	1,2
1.3.2	Passive transport	1	1(5 %)	Lec	Quiz	1,2
1.3.3	Facilitated diffusion	1	1(5 %)	Lec	Quiz	1,2
1.3.4	Group translocation	1	2(5 %)	Lec	Quiz	1,2
1.3.5	Iron transport	1	1(5 %)	Lec	Quiz	1,2
1.4	Growth curve	1	1(5 %)	Lec	Quiz	1
1.4.1	Different phases of growth	1	2(5 %)	Lec	Quiz	1
1.4.2	Determination of generation time	1	2(5 %)	Lec	Quiz	1
1.4.3	Continuous culture of microorganisms	1	1(5 %)	Lec	Quiz	1
1.4.3.1	Turbidostat	1	2(5 %)	Lec	Quiz	1,2
1.4.3.2	Chemostat	1	2(5 %)	Lec	Quiz	1,2
2	Measurement of microbial growth & its cultivation factors & methods					
2.1	Measurement of microbial growth	1	2(20 %)	Lec	Quiz	1,2
2.1.1	Cell mass determination	1	2(10 %)	Lec	Quiz	1,2
2.1.2	Cell number determination	1	2(10 %)	Lec	Quiz	1,2
2.2	Factors influencing the growth of microorganisms					
2.2.1	pH	1	1(10 %)	Lec	Quiz	1,2

2.2.2	Temperature	1	1(5%)	Lec	Quiz	1,2
2.2.3	O ₂ concentration	1	1(5 %)	Lec	Quiz	1,2
2.2.4	Radiation	1	1(5 %)	Lec	Quiz	1,2
2.2.5	Water activity	1	1(5 %)	Lec	Quiz	1,2
2.2.6	Pressure	1	1(5 %)	Lec	Quiz	1,2
2.3	Microbial quorum sensing	1	2(5 %)	Lec	Quiz	1,2
2.4	Cultivation of anaerobic microorganism	1	2(5%)	Lec	Quiz	1,2
2.5	Gaspak anaerobic system	1	1(5 %)	Lec	Quiz	1,2
2.5.1	Wright's tube method	1	1(5 %)	Lec	Quiz	1,2
2.6	Bioluminescence	1	2(5%)	Lec	Quiz	1,2
3	Microbial respiration & its types					
3.1	Aerobic respiration	1	1(5 %)	Lec	Quiz	1,2,3
3.1.1	EMP pathway	1	2(5 %)	Lec	Quiz	1,2,3
3.1.2	ED pathway	1	2(5 %)	Lec	Quiz	1,2,3
3.1.3	PP pathway	1	2(5 %)	Lec	Quiz	1,2,3
3.1.4	TCA cycle	1	2(5 %)	Lec	Quiz	1,2,3
3.1.5	Electron transport chain	1	1(5 %)	Lec	Quiz	1,2,3
3.1.6	Oxidative phosphorylation	1	1(5 %)	Lec	Quiz	1,2,3
3.2	Fermentation	1	1(5 %)	Lec	Quiz	1,2,3
3.2.1	Alcoholic fermentation	1	2(5 %)	Lec	Quiz	1,2,3
3.2.2	Acid fermentation	1	1(5 %)	Lec	Quiz	1,2,3
3.2.2.1	Lactic acid fermentation	1	2(5 %)	Lec	Quiz	1,2,3
3.2.2.1.1	Homolactic fermentation	1	1(5 %)	Lec	Quiz	1,2,3
3.2.2.1.2	Heterolactic fermentation	1	1(20 %)	Lec	Quiz	1,2,3
3.3	Energy yield & Pasteur effect	1	1(20 %)	Lec	Quiz	1,2,3
4	Anaerobic respiration					

4.1	Nitrate as electron acceptor	1	2(20 %)	Lec	Quiz	4
4.2	Sulfate as electron acceptor	1	2(10 %)	Lec	Quiz	4
4.3	CO ₂ as electron acceptor	1	2(10 %)	Lec	Quiz	4
4.4	Catabolism of carbohydrates	1	3(10 %)	Lec	Quiz	4
4.5	Catabolism of lipids – β oxidation pathway	1	2(10 %)	Lec	Quiz	4
4.6	Catabolism of proteins and aminoacids	1	2(10 %)	Lec	Quiz	4
4.7	Oxidation of inorganic molecules – sulfur, ammonia	1	3(10 %)	Lec	Quiz	4
4.8	Methanogenesis	1	2(10 %)	Lec	Quiz	4
4.9	Acetogenesis	1	2(10 %)	Lec	Quiz	4
5	Photosynthesis					
5.1	Pigments involved in photosynthesis					
5.1.1	Chlorophyll, Bacteriochlorophyll	1	2(10 %)	Lec	Quiz	4,5
5.1.2	Carotenoids & Phycobilliprotein	1	2(10 %)	Lec	Quiz	4,5
5.2	Oxygenic photosynthesis – light reaction (cyanobacteria)	1	2(10 %)	Lec	Quiz	4,5
5.3	Anoxygenic photosynthesis – light reaction (green & purple bacteria)	1	3(10 %)	Lec	Quiz	4,5
5.4	Photosynthetic fixation of CO ₂ (Dark reaction)	1	3(10 %)	Lec	Quiz	4,5
5.4.1	Carboxylation phase	1	2(10 %)	Lec	Quiz	4,5
5.4.2	Reduction phase	1	2(10 %)	Lec	Quiz	4,5
5.4.3	Regeneration phase	1	2(10 %)	Lec	Quiz	4,5
5.5	Halobacterial photosynthesis	1	2(20 %)	Lec	Quiz	4,5

Reference Books

1. Lansing M. Prescott., John P. Harley., Donald A. Klein., Tata McGraw hill publication, New York, eight edition.
2. Larry McKane and Judy Kandel, Microbiology- Essentials and Applications, Mc Graw Hill Inc, New York, 1996.
3. Nester, E.W., Roberts, C.V. and Nester, M.T. Microbiology- A Human Perspective. IWOA, U.S.A., 1995.
4. Pelczar Jr, M.J., Chan, E.C.S. and Kreig, N.R., Microbiology. Mc. Graw Hill Inc, New York, 1993.

5. Salle, A.J, Fundamental Principles of Bacteriology, Tata McGraw Hill publishing company Ltd, New Delhi, 1996.

Semester II

Course Title : Medical Microbiology

Course Type : Practical (CC – VII)

Total hours : 75 Hours/week : 5 Credit : 4

Pass-out Policy: Minimum contact hours: 45
Total score % :100 Int: 40; Ext: 60
Min. pass %: 50 [No min. for Int.]

Course creator

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CLO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
1	Perform about isolation & identification of Clinical samples.	1(20)	1,2,3,6,8	U	P
2	Determination of MIC and MBC	2(20)	1,2,3	An	P
3	Perform Antimicrobial activity of KB method	3(20)	1,2,3,5	U	P
4	To develop knowledge about blood count	4(20)	1,2,6,7,9	An	P
5	Estimation of urine sample	5(20)	1,2,6	U	P

Module	Course Description
1.	Laboratory safety precaution to be followed in the lab
2	Isolation and Identification of bacterial pathogen from clinical samples (throat, pus and dental swab) urine sample
3	Antibacterial sensitivity test-Kirby Bauer method
4	Determination of MIC
5	Determination of MBC
6	Cultivation of virus -Egg Inoculation method
7	Examination of parasite from faecal contaminants by Iodine wet mount technique
8	Total Count of RBC
9	Total Count of WBC
10	Total count of platelets
11	Estimation of Haemoglobin
12	Estimation of urine sugar
13	Estimation of Urine Bile salt
14	Estimation of Urine Albumin
15	Estimation of SGOT
16	Estimation of SGPT
17	Estimation of Cholestrol from blood

Reference Books

- 1.Murray P.R., Baron E.J., Jorgenson J.H., Pfaller M.A and Tenover F.C. (2003). Manual of Clinic (8th Edition). America Society for Microbiology
- 2.Bennett J.E., Dolin R. and Blaser M.J. (2019). Principle and practice of infectious Disease (9th EBook ISBN:9780323550277. Hardcover ISBN :9780323482554
- 3.Ridgway G.L., Stokes E.J., and Wren M.W.D.(1987).Clinical Microbiology 7th Edition. Hodder.A1 ISBN-10:0340554231/ISBN-13:9780340554234
- 4.Koneman E.W., Allen S.D., Schreckenber P.C. and Winn W.C. (2020). Koneman's Color Atlas Diagnostic Microbiology (7th Edition). Jones & Bartlett Learning : ISBN : 1284322378 9781284322378
- 5.Cheesbrough, M (2004) District Laboratory Practice in Tropical Countries -Part-2, (2nd Edition) University Press. ISBN -13:978-0-521-67631-1/ISBN-10:0-521-67631-2

Semester II

Course Title : Microbial Physiology

Course Type : Practical (CC – VIII)

Total hours : 75 Hours/week : 5 Credit : 4

Pass-out Policy: Minimum contact hours: 45
Total score % :100 Int: 40; Ext: 60
Min. pass %: 50 [No min. for Int.]

Course creator	Expert 1	Expert 2
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CLO. No.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
1	Acquire knowledge about measurement of growth and growth curve	1(20 %)	1,2,3,6,8	U&AP	F
2	Acquire knowledge about biochemical tests.	2(20 %)	1,2,3	AP	F
3	Acquire knowledge about effect of temperature and pH	3(20 %)	1,2,3,5	AP	F
4	Acquire knowledge about anaerobic cultivation	4(20 %)	1,2,6,7,9	U & AP	F
5	Acquire knowledge about pigment extraction	5(20 %)	1,2,6	AP	F

Module	Course Description
1	Measurement of growth and growth curve.
2	Effect of temperature on growth of bacteria
3	Effect of pH on growth of bacteria
	Biochemical Tests
4	Indole Test
5	Methyl Red Test
6	VP Test
7	Citrate Utilization Test
8	Catalase Test
9	Oxidase Test
10	TSI Test
11	Casein Hydrolysis Test
12	Lipid Hydrolysis Test
13	Nitrate Reduction Test
14	Urease Test
15	Oxidative fermentative test
16	Starch hydrolysis
17	Anaerobic cultivation (Pyrogallol method)
18	Extraction of chlorophyll from algae

Reference Books

1. James. G. Cappuccino and Natalic Sherman, Microbiology - A laboratory manual, Pearson edition, Inc., 2005.
2. Rajan, S., Selvi, R., Christy, Experimental Procedures in Life Science, Anjana Book House, Chennai, 5th edition.
3. Kannan, N., Laboratory Manual in General Microbiology, B. Palani Paramount Publications, Chennai, Current edition.

Semester II

Course Title : Health and Hygiene

Course Type : Theory (IDEC – I)

Total hours : 75 Hours/week : 5 Credit : 4

Pass-out Policy: Minimum contact hours: 45
Total score % :100 Int: 40; Ext: 60
Min. pass %: 50 [No min. for Int.]

Course creator	Expert 1	Expert 2
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CLO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
1	Acquire knowledge on hygiene and live healthy.	3(20%)	1,2,3,5	U	F
2	Provide insights on health laws for food safety and hygiene.	2(20%)	1,2,3	U	C
3	Explain health, physical exercises and their importance.	4(20%)	1,2,6,7,9	U, Ap	F, M
4	Illustrate mental hygiene and involved in mental hygiene.	4(20%)	1,2,6,7,9	Ap, An	F, M
5	Describe the various health and health education programmes by the government.	5(20%)	1,2,6	Ap, An, E	F, M

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
1	Introduction to hygiene and healthful live.	3	1(25%)	Lec	Qui	1
1.1	Factors affecting health, health habits and practices.	3	1(25%)	Lec	Qui	1
1.2	Recognizing positive & negative practices in the community.	3	1(25%)	Lec	CA	1
1.2.1	Scientific principles related to health.	3	1(25%)	SI	ST	1
2.0	Nutrition and Health – Balanced diet, Food surveillance, food Fortification, adulteration and preventive measures.	3	2(50%)	Lec	Qui	2
2.1	Health laws for food safety.	5	2(25%)	Lec	ST	2
2.2	Environmental and housing hygiene. Ventilation and lighting.	2	2(25%)	GT	CT	2
3.1	Physical health, physical exercises and their importance – Walking, jogging, yoga and meditation, stress relief.	4	3(50%)	Qui	Lec	3
3.2	International control of health, WHO. Personal hygiene, Sun bathing, Colon Hygiene.	4	3(25%)	Soc	Qui	3
3.3	Health destroying habits and addictions - Pan, supari, ganja, drinking, smoking, tea and coffee.	5	3(25%)	WSQ	HrA	3
4.0	Mental hygiene - factors responsible, developmental tasks, basic needs, emotional stability.	6	4(50%)	Lec	Lec	4
4.1	Mental hygiene and health in infancy, early childhood, adolescence, adulthood and old age.	4	4(25%)	Lec	HrA, HoA	4

4.2	Mental health occupational hazards.	2	4(25%)	SI	HrA, HoA	4
5.0	Health programme and health education – Malaria control, Tuberculosis control, AIDS control programmes and Immunization Programmes.	6	5(50%)	SI	HrA, HoA	5
5.1	Family planning, Reproductive and Child health programmes (RCH).	6	5(50%)	KWL	HrA, HoA	5

Reference Books

1. Bamji M.S., Krishnaswamy K. and Brahmam G.N.V. (2019). Textbook of Human Nutrition. (4th Edition). Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
2. Swaminathan (1995) Food & Nutrition (vol. I) (2nd Edition). The Bangalore Printing & Publishing Co Ltd., Bangalore.
3. Paniker J.C.K. and Ananthanarayan R. (2017). Textbook of Microbiology. (10th Edition). Universities Press (India) Pvt. Ltd
4. Lindsay Dingwall. (2010). Personal Hygiene Care, Print ISBN:9781405163071 |Online ISBN:9781444318708 |DOI:10.1002/9781444318708
5. Walter C.C. Pakes (1900). The Science of Hygiene: a Text-book of Laboratory Practice. (London: Methuen and Co.,).

Semester II

Course Title : Biosafety, Bioethics and IPR

Course Type : Theory (DSE – III)

Total hours : 75 Hours/week : 5 Credit : 4

Pass-out Policy: Minimum contact hours: 45
Total score % :100 Int: 40; Ext: 60
Min. pass %: 50 [No min. for Int.]

Course creator	Expert 1	Expert 2
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CLO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
1	Execute the role of IPR, Patent, Trademarks and its importance.	2 (10%) 5(10%)	1,2,3,6	U	C
2	Develop patent procedure, patent filling and its mapping.	2 (10%) 5(10%)	1,2,3,6	U	C
3	Become Patent attorneys and Patent officers.	2 (10%) 5(10%)	1,2,3,6	U	C
4	Apply bioethics in Genetically modified organisms food crops and its biodiversity.	2 (10%) 5(10%)	1,2,3,6	Ap	C
5	Analyze the importance of bioethics in research associated with HGP, clinical research, stem cell therapy.	2 (10%) 5(10%)	1,2,3,6	An	C

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
1	Intellectual Property Rights					
1.1	Different forms of Intellectual Property Rights – their relevance, importance to industry, Academia.	2	1(20%)	Lec	Quiz	1-2
1.2	Role of IPR's in Biotechnology	1	1(20%)	Lec	Quiz	1-2
1.3	Patent Terminology a. Patents b. Trademarks c. Copyrights d. Industrial designs e. Geographical indications f. Trade secrets g. Non-disclosure agreements	4	1(20%)	Lec	Quiz	1-2
1.4	Patent life and geographical boundaries.	2	1(20%)	Lec	Quiz	1-2

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
1.5	International organizations and IPR a. Over view of WTO b. TRIP c. WIPO d. GATT e. International conventions f. Trade agreements g. Implication of TRIPS for developing countries	3	1(20%)	Lec	Quiz	1-2
2	Process involved in patenting					
2.1	Patent Search	2	2(10%)	Lec	Ass	3-5
2.2	Procedural steps in patenting	2	2(10%)	Lec	Ass	3-5
2.3	Process of filing, PCT application,	2	2(10%)	Lec	Ass	3-5
2.4	Pre-grant & post-grant opposition	2	2(10%)	Lec	Ass	3-5
2.5	PCT and patent harmonization including Sui-generis system	2	2(10%)	Lec	Ass	3-5
2.6	Patent search methods, patent databases and libraries	1	2(10%)	Lec	Ass	3-5
2.7	Online tools	2	2(10%)	Lec	Ass	3-5
2.8	Country-wise patent searches (USPTO, EPO, India etc.),	2	2(10%)	Lec	Ass	3-5
2.9	Patent mapping	2	2(20%)	Lec	Ass	3-5
3	Patentability of biotechnology inventions					
3.1	Patentability of biotechnology inventions in India	1	3(10%)	Lec	Sem	6-8
3.2	Statutory provisions regarding biotechnological inventions under the current Patent Act 1970 (as Amended 2005).	2	3(10%)	Lec	Sem	6-8
3.3	Biotechnological inventions as patentable subject matter	1	3(20%)	Lec	Sem	6-8

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
3.4	Territorial nature of patents - from territorial to global patent regime	2	3(10%)	Lec	Sem	6-8
3.5	Interpreting trips in the light of biotechnology inventions	1	3(10%)	Lec	Sem	6-8
3.6	Feasibility of a uniform global patent system, merits and demerits of uniform patent law	2	3(20%)	Lec	Sem	6-8
3.7	Relevance of the existing international patent, tentative harmonisation efforts	1	3(10%)	Lec	Sem	6-8
3.8	Implications of setting up a uniform world patent system	1	3(10%)	Lec	Sem	6-8
4	Introduction to bioethics					
4.1	Need of bioethics	1	4(20%)	Lec	Ass	9,10
4.2	Applications and issues related to bioethics, Social and cultural issues.	2	4(20%)	Lec	Ass	9,10
4.3	Bioethics and biodiversity - conserving natural biodiversity, convention on protecting biodiversity	2	4(20%)	Lec	Ass	9,10
4.4	Protocols in exchanging biological material across borders.	1	4(20%)	Lec	Ass	9,10
4.5	Bioethics & GMO's - issues and concerns pertaining to genetically modified foods and food crops, organisms and their possible health implications and mixing up with the gene-pool.	1	4(20%)	Lec	Ass	9,10
5	Bioethics in medicine					
5.1	Protocols of ethical concerns related to prenatal diagnosis	2	5(20%)	Lec	Quiz	7-10

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
5.2	Gene therapy	1	5(20%)	Lec	Quiz	7-10
5.3	Organ transplantation, xeno transplantation	2	5(10%)	Lec	Quiz	7-10
5.4	Ethics in patient care, informed consent	1	5(10%)	Lec	Quiz	7-10
5.5	Bioethics and cloning	2	5(10%)	Lec	Quiz	7-10
5.6	Permissions and procedures in animal cloning, human cloning, risks and hopes.	2	5(10%)	Lec	Quiz	7-10
5.7	Bioethics in research: stem cell research, human genome project, use of animals in research, human volunteers for clinical research, studies on ethnic races	2	5(10%)	Lec	Quiz	7-10
5.8	He Nuremberg code	1	5(10%)	Lec	Quiz	7-10

Reference Books

1. Usharani B., Anbazhagi S. and Vidya C. K. (2019). Biosafety in Microbiological Laboratories. (1st Edition). Notion Press. ISBN-101645878856
2. Satheesh M.K. (2009). Bioethics and Biosafety. (1st Edition). J.K International Publishing House Pvt. Ltd: Delhi. ISBN: 9788190675703
3. Goel D. and Parashar S. (2013). IPR, Biosafety and Bioethics. (1st Edition). Pearson education: Chennai. ISBN-13: 978-8131774700
4. Raj Mohan joshi. Biosafety and Bioethics. Wiley Publications.
5. Sibi. GIntellectual, Property Rights, Bioethics, Biosafety and Entrepreneurship in biotechnology. (2021). Wiley Publications.
6. Nithyananda K.V. (2019). Intellectual Property Rights: Protection and Management, India, IN: Cengage Learning India Private Limited.
7. Neeraj, P. and Khusdeep, D. (2014). Intellectual Property Rights, India, IN: PHI learning Private Limited,
8. Ahuja, VK. (2017). Law relating to Intellectual Property Rights, India, IN: Lexis Nexis.
9. Tony Hope (2004). Medical Ethics: A very Short introduction, Oxford Publication.
10. Goel Parashar. IPR, Biosafety and Bioethics (2013). Pearson Publications.

SEMESTER - III

Course Title : Soil, Agricultural and Environmental Microbiology

Course Type : Theory (CC - IX)

Total hours : 90 Hours/week : 6 Credit : 5

Pass-out policy: Minimum contact hours: 54
Total score % :100 Int: 40 Ext: 60
Min. pass %: 50 [No min. for Int.]

Course creator	Expert 1	Expert 2
Dr. Josephine Sheeba B Assistant professor, Department of Microbiology, Scott Christian College (Autonomous), Nagercoil. Mob: +91 9894931096 email: josephins2@gmail.com.	Dr. K. Jenitha Associate Professor, Department of Microbiology, Scott Christian College, Nagercoil – 3 Mob: +91 701093092 email: jenithascott@gmail.com	Dr. C. R. Shalinimol Assistant professor Department of Microbiology, Scott Christian College (Autonomous), Nagercoil. Mob: +91 9487686711 email: sm2516999@gmail.com.

CLO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
1	Explain the role of microorganisms in soil fertility.	3[20%]	1,2,3,6	U	P
2	Discuss the benefits of interactions among soil microbes and acquire awareness about microbes as biofertilizers and biocontrol agents.	6 [20%]	1,2,3,6	U	P
3	Explain the components of Environment, Potability of water,Space Microbiology.	3[20%]	1,2,3,6	U	P
4	Learn the importance of Waste management & Composting	3[20%]	1,2,3,6	U	P
5	Develop knowledge about organic matter degradation, bioremediation, and the environment risk assessment	3[20%]	1,2,3,6	U	P

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
1	Soil Microbiology	75		lec	Quiz	Ref
1.1	Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversity, and distribution of major group of microorganisms in soil	2	1 (20%)	lec	Quiz	1,2
1.2	Quantification of soil microflora, role of microorganism in soil fertility	2	1(20%)	lec	Quiz	1,2
1.3	Mineralization of Organic & Inorganic Matter in Soil.	2	1(10%)	lec	Quiz	
1.4	Biological Nitrogen fixation- Chemistry and Genetics of BNF	2	1(10%)	lec	Quiz	1,2
1.5	Phytopathology and Disease cycle of Plant pathogens	2	1(10%)	lec	Quiz	
1.5.1	Tikka, Citrus canker and Blight of Paddy.	2	1(10%)	lec	Quiz	1,2
1.6	Types of disease symptoms, Structural and Inducible biochemical defense	3	1(5%)	lec	Quiz	1,2
1.7	Systemic Acquired Resistance (SAR)	1	1(5%)	lec	Quiz	1,2
1.8	Plantibodies, Phenolics, Phytoalexins	2	1(10%)	lec	Quiz	1,2
2	Microbial Interactions & Biofertilizers					1,2
2.1	Mutualism, Commensalism, Amensalism, Synergism, Competition,	2	2(20%)	lec	Quiz	1,2,3
2.2	Rhizosphere- Rhizosphere effect	2	2(10%)	lec	Quiz	1,2,3
2.3	Mycorrhizae – Types	1	2(5%)	lec	Quiz	1,2,3
2.4	Endophytes	2	2(10%)	lec	Quiz	1,2,3
2.5	PGPR- Plant growth promoting bacteria	1	2(10%)	lec	Quiz	1,2,3
2.5.1	symbiotic (<i>Bradyrhizobium</i> , <i>Rhizobium</i> , <i>Frankia</i>)	2	2(10%)	lec	Quiz	1,2,4
2.6	Non-Symbiotic (<i>Azospirillum</i> , <i>Azotobacter</i> , Mycorrhizae, MHBs,	2	2(5%)	lec	Quiz	1,2,3

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
	Phosphate solubilizers, algae)					
2.7	Novel combination of microbes as biofertilizers, PGPRs	2	2(10%)	lec	Quiz	1,2,3
2.8	Biofertilizers and Biocontrol agents – Types, benefits and application					
2.9	Advantages, social and environmental aspects - Bt crops, golden rice.	2	2(20%)	lec	Quiz	1,2,3
3	Components of Environment					1,2,3
3.1	Hydrosphere, lithosphere, atmosphere, and biosphere – definitions with examples	2	3(20%)	lec	Quiz	1,2,3
3.2	Energy flow in the ecosystem	2	3(10%)	lec	Quiz	1,2,4
3.2.1	Carbon, Nitrogen, Sulfur and Phosphorous cycles	2	3(10%)	lec	Quiz	1,2,3
3.3	Physical factors affecting distribution of microorganisms in various environments	1	3(10%)	lec	Quiz	1,2,3
3.4	Predisposing factors for Environmental diseases	1	3(10%)	lec	Quiz	1,2,3
3.4.1	Infectious (water and air borne) and pollution related, spread and control of these diseases	1	3(10%)	lec	Quiz	1,2,3
3.4.2	Treatment and safety of drinking (potable) water, methods to detect portability of water samples.	2	3(10%)	lec	Quiz	1,2,3
3.5	Space microbiology	1	3(10%)	lec	Quiz	1,2,3
3.6	Microbiological research in space environment.	1	3(10%)	lec	Quiz	1,2,3
4	Waste management					1,2,3
4.1	Solid waste - Types - management - Factors affecting solid waste generation rates	2	4(20%)	lec	Quiz	1,3,4
	Industrial effluent treatment,	2	4(20%)	lec	Quiz	1,2,3

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
4.2	primary, secondary, tertiary, and advanced treatment process.					
4.3	Quality assessment of decontaminated matters and other biological effluents	2	4(10%)	lec	Quiz	1,2,3
4.4	Biological reference standards	1	4(10%)	lec	Quiz	1,2,3
4.5	Utilization of Solid Waste as Food, Feed and Fuel	2	4(10%)	lec	Quiz	1,2,3
4.5.1	Composting, Vermicomposting	2	4(10%)	lec	Quiz	1,2,4
4.5.2	Bio manure and Biogas production	1	4(10%)	lec	Quiz	1,2,3
4.6	E waste management.	1	4(10%)	lec	Quiz	1,2,3
5	Biodegradation & Bioremediation			Ass & Sem		1,2,3
5.1	lignin, cellulose, hemicellulose, pectin	2	5(20%)	Ass & Sem	Quiz	1,2,3
5.2	common pesticides	2	5(10%)	Ass & Sem	Quiz	1,2,4
5.2.1	herbicides (2,4-D) and pesticides (DDT)	2	5(10%)	Ass & Sem	Quiz	1,2,3
5.3	heavy metals	1	5(10%)	Ass & Sem	Quiz	1,2,3
5.4	Biodegradation of Xenobiotics	1	5(10%)	Ass & Sem	Quiz	1,2,4
5.4.1	Recalcitrant Halocarbons, Recalcitrant TNTs, PCBs and Synthetic polymers	2	5(10%)	Ass & Sem	Quiz	1,2,3
5.5	Biodegradation of Hydrocarbons	1	5(10%)	Ass & Sem	Quiz	1,2,3
5.6	Biodeterioration of Textiles and Leather	1	5(10%)	Ass & Sem	Quiz	1,2,3

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
5.7	Pollution Control Bodies and Environmental laws in India	1	5(5%)	Ass & Sem	Quiz	1,2,3
5.8	Environmental impact assessment, EIA guidelines, US Environment protection Agency norms.	2	5(5%)	Ass & Sem	Quiz	1,3,4

Reference Books

1. Subba Rao. N.S. (2017). Soil Microbiology. (5th Edition). MedTech Publishers.
2. Daniel. C. J. (2006). Environmental Aspects of Microbiology. (2nd Edition). Bright Sun Publications.
3. Rangaswami. G. and Mahadevan. A. (2006). Diseases of Crop Plants in India. (4th Edition). Prentice–Hall of India Pvt. Ltd.
4. Sharma P. D. (2010). Microbiology and Plant pathology. (2nd Edition). Rastogi Publications.
5. Subba Rao. N.S. (2005). Soil microorganisms and Plant Growth. (4th Edition). Oxford and IBH Publishing Pvt. Ltd.
6. Pepper I. L., Gerba C. P. and Gentry T. J. (2014). Environmental Microbiology (1st Edition). Academic Press, Elsevier.
7. Bitton, G. (2011). Wastewater Microbiology. (4th Edition). Wiley-Blackwell.
8. Bridgewater L. (2012). Standard Methods for the Examination of Water and Wastewater. American Public Health Association.
9. Shrivastava A.K. (2003). Environment Auditing. A. P. H. Publishing Corporation.
10. Tinsley, S. and Pillai, I. (2012). Environmental Management Systems – Understanding Organizational Drivers and Barriers. Earthscan.

Semester III

Course Title : Soil, Agriculture and Environmental Microbiology

Course Type : Practical (CC – X)

Total hours : 90 Hours/week : 6 Credit : 3

Pass-out policy: Minimum contact hours: 54
Total score % :100 Int: 40 Ext: 60
Min. pass %: 50 [No min. for Int.]

Course creator	Expert 1	Expert 2
Dr. Josephine Sheeba B Assistant professor, Department of Microbiology, Scott Christian College (Autonomous), Nagercoil. Mob: +91 9894931096 email: josephins2@gmail.com.	Dr. K. Jenitha Associate Professor, Department of Microbiology, Scott Christian College, Nagercoil – 3 Mob: +91 701093092 email: jenithascott@gmail.com	Dr. C. R. Shalinimol Assistant professor Department of Microbiology, Scott Christian College (Autonomous), Nagercoil. Mob: +91 9487686711 email: sm2516999@gmail.com.

CLO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
1	Acquire Knowledge about soil microbes	1(10%) 5(10%)	1,2,3,6,8	An	C
2	Develop Knowledge about symbiotic, non symbiotic N ₂ fixers	3(10%) 5(10%)	1,2,3,6	An	C
3	Gain Knowledge about Antagonistic and phylloplane microbes.	2(10%) 5(10%)	1,2,3,6	An	M
4	Acquire Knowledge about Plant Pathogens	2(10%) 5(10%)	1,2,3,6	An	M
5	Develop knowledge about Estimation of soil minerals contents	5(20%)	1,2,3,6	An	C

Module	Course Description
1.	Enumeration of heterotrophic microbes from soil
2.	Isolation of Rhizobium from Root Nodules

Module	Course Description
3.	Isolation of Azotobacter from soil.
4.	Isolation of Azospirillum from Root.
5.	Isolation of phosphate solubilizers
6.	Estimation of R:S ratio of Rhizosphere
7.	Isolation of Antagonistic microbes from soil.
8.	Study of phylloplane microflora by leaf impression method
9.	Isolation of cellulose degrading bacteria
10.	Isolation of VAM fungi from soil
11.	Cultivation of edible mushroom from solid waste
12.	Cultivation of <i>Azolla</i>
13.	<i>Study of Anabena, Nostoc and Oscillatoria</i>
14.	Preparation of a vermicompost
15.	Isolation of plant pathogen - <i>Alternaria & Curvulariaspps</i>
16.	Visual examination, observation, and identification of some common plant infections.
17.	Collection of 5 herbarium specimens of infected leaves.
18.	Estimation of soil mineral contents.
	pH Nitrate Nitrite Sulphate Phosphate Calcium Magnecium Chloride Fluride Silica Ammona

Reference Books

1. Gunasekaran P. (2007). Laboratory Manual in Microbiology. New Age International.
2. James G Cappucino and Natalie Sherman (2016). Microbiology – A laboratory manual. (5th Edition). The Benjamin publishing company. New York.
3. Hurst, C.J., Crawford R.L., Garland J.L., Lipson D.A., Mills A.L. and Stetzenbach L.D. (2007). Manual of Environmental Microbiology. (3rd Edition). American Society for Microbiology.

Semester III

Course Title : Project

Course Type : CC - XI

Total hours : 90 Hours/week : 6 Credit : 6

Pass-out policy: Minimum contact hours: 54
Total score % :100 Int: 40 Ext: 60
Min. pass %: 50 [No min. for Int.]

Students have to perform a research work and submit a dissertation / thesis at the end of the research. Review meeting (atleast one) to be conducted for the candidate under research during the period of work. Dissertation format should adhere to the format of Manonmaniam Sundaranar University.

Semester III

Course Title : Bioinformatics and Research Methodology

Course Type : Theory (DSE – IV)

Total hours : 75 Hours/week : 5 Credit : 4

<p>Pass-out policy : Minimum contact hours : 45</p> <p>Total score % :100 Int : 40 Ext : 60</p> <p>Min. pass % : 50 [No min. for Int.]</p>
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Course creator	Expert 1	Expert 2
<p>Dr Jeba Malar P.W., Assistant Professor, Department of Microbiology, Scott Christian College, Nagercoil – 3 Mob: +91 9600450069 email: pwjeba@gmail.com</p>	<p>Dr. K. Jenitha Associate Professor, Department of Microbiology, Scott Christian College, Nagercoil – 3 Mob: +91 701093092 email: jenithascott@gmail.com</p>	<p>Dr P.J. Beena, Assistant Professor, Department of Microbiology, Scott Christian College, Nagercoil - 3 Mob: +91 9486737136 email: beena75pj@gmail.com</p>

CLO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
1	Exploration of the web and able to find, recognize, download, install and use software in various areas useful to the research in Biology.	2(10 %) 3(10 %)	1,2,3,5	Ap, An	P
2	Familiarization of academic data bases INFLIBNET, NICNET, and BRNET.	3(10 %) 3(10 %)	1,2,3	Ap, An	M
3	Deposition and accession of genomic and proteomic sequences through Nucleic acid databases Eg: EMBL, Gen Bank and Protein structure databank- PDB.	4(10%) 3(110%)	1,2,3,5,6	Ap, An	P, M
4	Visualization of molecular structure through Molecular visualization tools such as Rasmol. Alignment of single and multiple nucleic acid sequences using BLAST, Clustal W	4(10%) 3(10%)	1,2,3,5,6	Ap, An	P, M
5	Creation of Molecular models using Molecular docking for computer aided drug design. Statistical analysis through SPSS [statistical Package for Social Sciences] programme.	7(10%) 3(10%)	1,2,3,4,5,6,7	Ap, An, E	P, M

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
1	Bioinformatics					

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
1.1	Introduction and Definition	1	1,3(10%)	Lec	Qui	1
1.2	Origin of concept of Bioinformatics	1	1,3(10%)	Lec	CA	1
1.3	Brief history of bioinformatics.	1	1(10%)	Lec	ST	1
1.4	Importance of bioinformatics & Web lab	1	1(10%)	SI	MCQ	1
1.5	Biological databases	1	1(10%)	GD	Qui	1
1.5.1	Brief account on Model/organism databases	1	1(10%)	KWL	HoA	1
1.5.2	Biodiversity databases	1	1(10%)	KWL	HoA	1
1.5.3	Biomolecular databases	1	1(10%)	KWL	HoA	1
1.5.3.1	Nucleic acid databases Eg: EMBL, Gen Bank	1	1(10%)	OT	CT	1
1.5.3.2	Protein sequence databases. Eg: PIR, SWISS PROT.	1	1(10%)	OT	CT	1
2	Biomolecular structure prediction					
2.1	Protein structure databank- PDB	1	2(20%)	SI	ST	2
2.2	Protein structure prediction	1	2(20%)	SI	OT	2
2.3	Molecular modeling.	1	2(20%)	SI	OT	2
2.4	Molecular docking and computer aided drug design	1	2(20%)	SI	OT	2
2.5	Molecular visualization- use of Rasmol	1	2(20%)	SI	OT	2
3	Basics of Genomics and Proteomics					
3.1	Comparative genomics and Pharmacogenomics.	3	3(10%)	BS	CT	3
3.2	Sequence analysis and alignment	3	3(10%)	OT	Qui	3
3.2.1	Pair wise sequence alignment.	3	3(10%)	SI	HrA	3
3.2.2	Multiple sequence alignment.	2	3(20%)	SI	HrA	3
3.3	Molecular Phylogeny and Phylogenetic trees.	2	3(20%)	SI	HrA	3

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
3.3.1	Advantages of Molecular phylogeny and phylogenetic analysis.	2	3(10%)	GD	CT	3
3.4	Bioinformatics Tools: BLAST, CLUSTAL X	4	3(20%)	SI	HrA	3
4	Internet as a knowledge repository					
4.1	Academic search techniques	1	4(10%)	Soc	Qui	4
4.2	Creating cyber presence	1	4(10%)	GT	Qui	4
4.3	Open access initiatives	1	4(10%)	Lec	Qui	4
4.4	Open access publishing models	1	4(10%)	KWL	CT	4
4.5	Basic concepts of IPR	1	4(10%)	KWL	CT	4
4.6	Copy rights and patents	1	4(20%)	Soc	CT	4
4.7	Plagiarism	1	4(10%)	Soc	CT	4
4.8	Academic services-INFLIBNET, NICNET and BRNET.	1	4(20%)	SI	HrA	4
5	Experimentation in Science and Data Handling					
5.1	Design of an experiment; experimentation; observation; data collection; interpretation and deduction	1	5(10%)	Soc	CT	5
5.2	Necessity of units and dimensions	1	5(5%)	BS	Qui	5
5.3	Repeatability and replication	1	5(5%)	GT	CT	5
5.4	Documentation of experimental results	1	5(5%)	RT	CT	5
5.5	Record keeping	1	5(5%)	RT	CT	5
5.6	Connection between measurements and underlying theory	1	5(5%)	Lec	Qui	5
5.7	Nature and types of data -typical examples	1	5(10%)	Lec	Qui	5

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
5.7.1	Data acquisition	1	5(10%)	KWL	HrA	5
5.7.2	Treatment of data	1	5(5%)	KWL	HrA	5
5.7.3	Data interpretation	1	5(5%)	KWL	HrA	5
5.8	Significance of statistical tools in data interpretation: graphs, tables, histograms and pi diagrams	1	5(10%)	SI	HrA	5
5.9	Statistical testing of hypothesis, null hypothesis	1	5(10%)	SI	HrA	5
5.9.1	Significance test -Statistics based acceptance or rejection of a hypothesis	1	5(10%)	SI	HrA	5
5.10	Deduction of scientific correlation	1	5(10%)	SI	HrA	5

Reference Books

1. C.A. Orengo, D.T. Jones and J.M. Thornton (2005) Bioinformatics, Genes, Proteins and Computers. Taylor & Francis e-Library, London
2. Zhumur Ghosh, Bibekanand Mallick (2008). Bioinformatics, principles and Applications, OUP India.
3. Anderson J.B. and Poole M. (2011). Assignment and Thesis Writing. 4th edn. Wiley India Private Limited.
4. Rao P.S.S. and Richard J. (2006). Introduction to Biostatistics & Research methods. Prentice-Hall, New Delhi.
5. Ahuja V.K. (2017) Laws Relating to Intellectual Property Rights. Lexis Nexis.

Semester III

Course Title : Fermentation Technology and Pharmaceutical Microbiology

Course Type : Theory (DSE – V)

Total hours : 90 Hours/week : 6 Credit : 5

Pass-out policy : Minimum contact hours :54
Total score % :100 Int : 40; Ext : 60
Min. pass % : 50 [No min. for Int.]

Course creator	Expert 1	Expert 2
Dr. P. Jasmine Beula Assistant professor, Department of Microbiology, Scott Christian College (Autonomous), Nagercoil. Mob: +91 9944737747 email: jasbeula@yahoo.com.	Dr. K. Jenitha Associate Professor, Department of Microbiology, Scott Christian College, Nagercoil – 3 Mob: +91 701093092 email: jenithascott@gmail.com	Dr D.K. Helen Sheeba Assistant Professor Department of Microbiology Scott Christian College Nagercoil - 3 Mob: +91 9488887300 email: helensheeba30@gmail.com

CLO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
1	Develop microbial strains, carry out fermentation and recover the products of the process	2(20%)	1,2,3	AP	F
2	Design fermenters according to needs for various products.	2(20%)	1,2,3	AP	F
3	Recover the end products of the fermentation process economically.	2(20%)	1,2,3	AP	F
4	Utilize the knowledge on pharmaceutical microbiology for industrial production of products.	2(20%)	1,2,3	AP	F
5	Produce therapeutic products from microbes employing technology and analyze the quality the products.	2(20%)	1,2,3	AP	F

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References

1.1	Bioprocesses concepts and design	2	1(10)	Lec	Quiz	1
1.2	Industrially important microorganisms Isolation	4	1(20)	Lec	Quiz	1
1.3	Primary screening and Secondary screening					
1.4	Preservation and improvement of industrially important strains	4	1(10)	Lec	Quiz	1
1.5	Upstream processing Development of inoculums for fermentation process	3	1(10)	Lec	Quiz	1
1.6	Media for industrial fermentation Formulation Optimization Sterilization	4	1(10)	Lec	Quiz	1
1.7	Stages of upstream Growth of inoculums	2	1(10)	Lec	Quiz	1
1.8	fermenter pre-culture production fermentation	3	1(10)	Lec	Quiz	1
1.9	Types of fermentation Batch	4	1(20)	Lec	Quiz	1
1.10	Continuous					
1.11	dual or multiple					
1.12	surface					
1.13	submerged					
1.14	aerobic and anaerobic.					
2.1	Fermenter Design	8	2(60)	Lec	Quiz	1
2.2	Types and construction					
2.3	Instrumentation and control					
2.4	Productivity					
2.5	Yield coefficients					
2.6	Heat production					
2.7	Aeration and agitation					
2.8	Gas exchange and					
2.9	Mass transfer					
2.2	Computer applications in fermentation technology	2	2(20)	Lec	Quiz	1,3
2.3	Fermentation Economics	2	2(20)	Lec	Quiz	3
3.1	Downstream Processing - Recovery and Purification (intracellular and extracellular Products) Biomass separation	3	3(20)	Lec	Quiz	3
3.2	Centrifuge					
3.3	filtration					
3.4	flocculation and other recent developments					
3.5	Cell disintegration	5	3(40)	Lec	Quiz	3
3.6	Physical					
3.7	Chemical and					

	Enzymatic methods.					
3.8 3.9 3.10 3.11 3.12	Extraction Solvent, Two phase, Liquid extraction, Whole broth, Aaqueous multiphase extraction.	5	3(20)	Lec	Quiz	3
3.13 3.14 3.15	Purification by different methods Concentration (precipitation, ultra-filtration, reverse osmosis) Drying and Crystallization.	3	3(20)	Lec	Quiz	3
4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9	Overview of pharmaceutical microbiology Ecology of microorganisms Atmosphere Water Skin Respiratory flora of workers Raw materials Packaging Building Equipment And Their control measures	4	4(60)	Lec	Quiz	8
4.10	Design and layout of sterile manufacturing unit	2	4(20)	Lec	QU	8
4.11 4.12 4.13	Contamination and Spoilage of Pharmaceutical products Sterile injectable and non-injectable Ophthalmologic preparation And Implants	2	4(20)	Lec	Quiz	8
5.1 5.2 5.3 5.4 5.5 5.6	Production of pharmaceutical products And quality assurance Vaccines Immunodiagnostics Immuno-sera Immunoglobulin .Antibiotics (Penicillin, Griseofulvin, Metronidazole) Enzymes (Streptokinase,Streptodornase)	6	5(50)	Lec	Quiz	8
5.7 5.8	Quality assurance and quality management in pharmaceuticals In-Process, Final-Product Control and sterility tests	3	5(20)	Lec	Quiz	8
5.9 5.10 5.11 5.12 5.13	Regulatory aspects BIS (IS) ISI ISO WHO and US certification	4	5(30)	Lec	Quiz	8

Reference Books

1. Patel A. H. (2016). Industrial Microbiology. (2nd Edition). Laxmi Publications, New Delhi.
2. Casida L.E.J.R. (2019). Industrial Microbiology. New Age International Publishers.
3. Sathyanarayana U. (2005). Biotechnology. (1st Edition). Books and Allied (P) Ltd.
Reed G. (2004). Prescott and Dunn's Industrial Microbiology. (4th Edition). CBS Publishers & Distributors
4. Waites M. J., Morgan N. L., Rockey J. S. and Higton G. (2013). Industrial Microbiology: An Introduction. Wiley Blackwell Publishers.
5. Stanbury P. T. and Whitaker. (2016). Principles of Fermentation Technology. (3rd Edition). Pergamon Press. NY.
6. Handa S. S. and Kapoor V. K. (2022). Pharmacognosy, (4th Edition). Vallabh Prakashan Publishers, New Delhi
7. Kokate C.K., Durohit A. P. and Gokhale S. R. Pharmacognosy. (2002). (12th Edition). Nirali Prakasham Publishers, Pune
8. Hugo W. B. and Russell A. D. (2004). Pharmaceutical Microbiology. (7th Edition). Blackwell Scientific Publication, Oxford
9. Wallis, T.E. (2005). Text book of Pharmacognosy. (5th Edition). CBS publishers and distributors, New Delhi

SEMESTER IV

Course Title : Molecular Biology and Recombinant DNA Technology

Course Type : Theory (CC – XII)

Total hours : 75 Hours/week : 5 Credit : 4

Pass-out policy : Minimum contact hours : 45
Total score % :100 Int : 40 Ext : 60
Min. pass % : 50 [No min. for Int.]

Course creator	Expert 1	Expert 2
Dr. C.R. Shalini Mol Assistant Professor, Department of Microbiology, Scott Christian College (Autonomous), Nagercoil-3. Mobile 9487686711 Email id	Dr. K. Jenitha Associate Professor, Department of Microbiology, Scott Christian College, Nagercoil – 3 Mob: +91 701093092 email: jenithascott@gmail.com	Dr Neeta V.M. Joshi Assistant Professor Department of Microbiology Scott Christian College Nagercoil - 3 Mob: +91 9597617311 email: cutejo88@gmail.com

sm2516999@gmail.com		
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CLO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
1	Analyze, demonstrate and appreciate DNA replication and protein synthesis.	2 (10%) 5 (10%)	1,2,3,6	U	C
2	Investigate the types of mutation and its impact on microbes. Illustrate various strategies on gene cloning.	2 (10%) 5(10%)	1,2,3,6	U	C
3	Analyze, modify and characterize DNA modifying enzymes.	2 (10%) 5(10%)	1,2,3,6	An	C
4	Illustratively assess the molecular techniques for DNA and protein analysis.	2(10%) 5(10%)	1,2,3,6	An	M
5	Adopt the applications of Genetic Engineering in the field of agriculture and medicine towards scientific research.	2(10%) 5(10%)	1,2,3,6	Ap	M

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
1.	DNA replication, transcription and translation					
1.1	DNA replication – modes and enzymes involved. Detailed mechanism of semi-conservative replication	3	1(12%)	GD	Quiz	1-2
1.2	Prokaryotic and eukaryotic transcription.	2	1(10%)	GD	Quiz	1-2
1.3	Structure and processing of m-RNA, r-RNA and t-RNA.	2	1(15%)	GD	Quiz	1-2
1.4	Ribosomes.	1	1(20%)	GD	Quiz	1-2
1.5	Genetic Code and Wobble hypothesis	1	1(10%)	GD	Quiz	1-2
1.6	Translation in prokaryotes and eukaryotes	1	1(20%)	GD	Quiz	1-2
1.7	Post translational modifications	1	1(13%)	GD	Quiz	1-2
2.	Gene regulation and expression					
2.1	Lac operon, arabinose and tryptophan operons.	2	2(20%)	Lec	CA	3-4
2.2	Gene regulation in eukaryotic systems - repetitive DNA, gene rearrangement,	2	2(10%)	Lec	CA	3-4

	promoters, enhancer elements.					
2.3	Molecular basis of gene mutation	1	2(10%)	Lec	CA	3-4
2.4	Types of mutations – a. base substitutions b. frame shift c. deletion insertion d. duplication e. inversion.	3	2(10%)	Lec	CA	3-4
2.5	Silent, conditional and lethal mutation.	1	2(15%)	Lec	CA	3-4
2.6	Chemical mutagenesis.	1	2(10%)	Lec	CA	3-4
2.7	Repair of DNA damage. a. Photoreactivation b. SOS repair mechanism c. Base excision repair d. Nucleotide excision repair.	1	2(15%)	Lec	CA	3-4
2.8	Detection and analysis of mutations a. Replica plating b. Antibiotic enrichment c. Ames test	1	2(10%)	Lec	CA	3-4
3.	Tools and methods in gene cloning					
3.1	Restriction endonucleases – nomenclature, classification and characteristics	1	3(10%)	Sem	SA	5-6
3.2	DNA methylases, DNA polymerases, Ligases	1	3(7%)	Sem	SA	5-6
3.3	Adapters, linkers and homopolymer tailing.	1	3(8%)	Sem	SA	5-6
3.4	Artificial gene transfer techniques a. Electroporation b. Microinjection c. protoplast fusion and d. microparticle bombardment	1	3(10%)	Sem	SA	5-6
3.5	Screening for recombinants	1	3(10%)	<u>Sem</u>	SA	5-6
3.6	Gene cloning vectors for prokaryotes and eukaryotes	1	3(10%)	Sem	SA	5-6
3.7	cloning properties and types of plasmids vectors a. pBR322 and derivatives b. pUC vectors and c. pGEM3Z	1	3(10%)	Sem	SA	5-6
3.8	Phage Vectors a. M13 and b. Lambda	1	3(10%)	Sem	SA	5-6

3.9	Cosmids, phasmids, phagemids	1	3(5%)	Sem	SA	5-6
3.10	BACs	1	3(5%)	Sem	SA	5-6
3.11	Eukaryotic vectors - Yeast vectors – Animal and plant vectors	1	3(5%)	Sem	SA	5-6
3.12	Expression vectors, Shuttle vectors	1	3(5%)	Sem	SA	5-6
3.13	Expression of foreign genes in bacteria, animal, plant, algae and fungi – merits and demerits.	1	3(5%)	Sem	SA	5-6
4.	Genomic Library and Protein engineering					
4.1	Genomic DNA and cDNA library - Construction and Screening. Substrative hybridization for tissue specific DNA libraries.	2	4(9%)	FC	Ess	7-9
4.2	Techniques in genetic engineering Characterization of cloned DNA: Hybrid arrested translation (HAT)	1	4(9%)	FC	Ess	7-9
4.3	Restriction mapping - restriction fragment length polymorphism (RFLP)	1	4(9%)	FC	Ess	7-9
4.4	Polymerase chain reaction (PCR) – Principles, types and their applications	1	4(9%)	FC	Ess	7-9
4.5	DNA sequencing - Primer walking, Sanger's method and automated sequencing methods, Pyrosequencing	1	4(9%)	FC	Ess	7-9
4.6	DNA chips and micro array.	1	4(9%)	FC	Ess	7-9
4.7	Protein engineering and techniques, Site directed mutagenesis methods	1	4(9%)	FC	Ess	7-9
4.8	Design and construction of novel proteins and enzymes	1	4(9%)	FC	Ess	7-9
4.9	Basic concepts in enzyme engineering, engineering for kinetic properties of enzymes	1	4(9%)	FC	Ess	7-9
4.10	Protein folding, Protein sequencing	1	4(9%)	FC	Ess	7-9
4.11	Protein crystallization, Applications of protein engineering.	1	4(10%)	FC	Ess	7-9
5.	Plant biotechnology and Animal biotechnology					
5.1	Plant biotechnology - constituents and concepts of sterilization, Preparation, isolation and selection of explant	1	5(10%)	PT	Ass	8-10
5.2	Suspension cell culture, callus culture, protoplast isolation, culture & fusion,	1	5(7%)	PT	Ass	8-10

	Anther and pollen culture for production					
5.3	Animal biotechnology – equipment and media used for animal cell culture technology.	1	5(8%)	PT	Ass	8-10
5.4	Primary and established cell line culture and culture media - transgenic animals, Applications of animal cell cultures	1	5(10%)	PT	Ass	8-10
5.5	Serum protein media viability and cytotoxicity	1	5(10%)	PT	Ass	8-10
5.6	Applications of Genetic Engineering, Recombinant Cytokines and their use in the treatment of animal infections	1	5(10%)	PT	Ass	8-10
5.7	Monoclonal Antibodies in Therapy, Vaccines and their Applications in Animal Infections	1	5(10%)	PT	Ass	8-10
5.8	Human Gene Therapy, Germline and Somatic Cell Therapy	2	5(10%)	PT	Ass	8-10
5.9	Ex-vivo Gene Therapy and In-vivo Gene Therapy	1	5(5%)	PT	Ass	8-10
5.10	Vectors in Gene Therapy, Viral and Non-Viral Vectors	1	5(10%)	PT	Ass	8-10
5.11	Transgenic Plants	1	5(10%)	PT	Ass	8-10

Reference Books

1. Malacinski G.M. (2008). Freifelder's Essentials of Molecular Biology. (4th Edition). Narosa Publishing House, New Delhi.
2. Snusted D.P. and Simmons M. J. (2019). Principles of Genetics. (7th Edition). John Wiley and Soms, Inc.
3. Dale J. W., Schantz M.V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. (3rd Edition). John Wileys and Sons Ltd.
4. Primrose S.B. and Twyman R. M. (2006). Principles of Gene Manipulation and Genomics. (7th Edition). Blackwell Publishing.
5. Maloy S. R. Cronan J.E. Jr. and Freifelder D. (2011). Microbial Genetics. (2nd Edition). Narosa Publishing House Pvt. Ltd.
6. Brown T. A. (2016). Gene Cloning and DNA Analysis- An Introduction. (7th Edition). John Wiley and Sons, Ltd.
7. Glick B. R. and Patten C.L. (2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. (5th Edition). ASM Press.
8. Russell P.J. (2010). Genetics - A Molecular Approach. (3rd Edition). Pearson New International Edition.
9. Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria. (4th Edition). ASM Press Washington-D.C. ASM Press.

10. Dale J. W., Schantz M.V. and Plant N. (2012). From Gene to Genomes – Concepts and Applications of DNA Technology. (3rd Edition). John Wileys and Sons Ltd.

Semester VI

Course Title : Food and Dairy Microbiology

Course Type : Theory (CC – XIII)

Total hours : 75 Hours/week : 5 Credit : 4

Pass-out policy : Minimum contact hours : 45
Total score % :100 Int : 40 Ext : 60
Min. pass % : 50 [No min. for Int.]

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CLO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)			
1	Discuss microorganisms involved in food spoilage.	2(10%) 5(10%)	1,2,3,6	U	F			
2	Illustrate bacterial and nonbacterial food borne infections important in public health.	2(10%) 5(10%)	1,2,3,6	U	F			
3	Familiarize various national and international aspects of food safety and quality assurance.	2(10%) 5(10%)	1,2,3,6	U	C			
4	Elaborate on microbiology of milk, preservation techniques and production of dairy products.	2(10%) 5(10%)	1,2,3,6	AP	C			
5	Explain Dairy plant hygiene, quality control and waste disposal.	2(10%) 5(10%)	1,2,3,6	U	C			
Module	Course Description	Hours	Mapping with CLO	Mapping with GA	Cognitive level	Knowledge Category (KC)	Assessment	References

1.	Microorganisms of food					
1.1 1.2	Scope of food Microbiology. Food as a substrate for microorganisms a. pH b. Moisture c. Oxidation reduction potential d. Nutrient content e. Inhibitory substances f. Combined effects of factors	2	1(35%)	Lec	Quiz	1-5
1.3	Contamination and spoilage of food a. vegetables b. fruits c. poultry d. fish e. eggs f. meat, meat products and g. canned foods	5	1(35%)	Lec	Quiz	1-5
1.4	Food Preservation – a. Temperature (low and high), b. Drying c. radiation and d. Additives	3	1(30%)	Lec	Quiz	1-5
2.	Food microbiology and public health.					
2.1	Food hazards	2	2(35%)	Lec	Ass	1-5
2.2	Food infections a. <i>Bacillus cereus</i> b. <i>Vibrio parahaemolyticus</i> c. <i>Escherichia coli</i> , d. <i>Salmonella</i> sp. e. <i>Shigella</i> sp. f. <i>Yersinia enterocolitica</i> , g. <i>Listeria monocytogenes</i> and h. <i>Campylobacter jejuni</i> .	6	2(35%)	Lec	Ass	1-5
2.3	Nonbacterial food borne illness a. Helminthes b. Nematodes c. Protozoa	5	2(30%)	Lec	Ass	1-5

	d. Toxigenic fungi and e. food borne virus.					
3.	Quality assurance of food					
3.1	International aspects of Quality and safety assessment of foods.	3	3(25%)	Lec	Sem	1-5
3.2	Microbiological quality standards for food.	3	3(25%)	Lec	Sem	1-5
3.3	Government regulatory practices and policies –					
	a. FDA b. HACCP c. BIS (IS) d. FSSAI-2014.	5	3(25%)	Lec	Sem	1-5
3.4	Food adulteration and common food additives.	4	3(25%)	Lec	Sem	1-5
4.	Introduction to Dairy microbiology					
4.1	Milk production and hygiene.	1	4(10%)	Lec	Quiz	6-10
4.2	Microorganisms associated with milk.	1	4(15%)	Lec	Quiz	6-10
4.3	Microbial metabolites and their role in spoilages- a. Souring b. Curdling c. Gassiness d. Ropiness e. Proteolysis f. Lipolysis g. Abnormal flavour and colour.	6	4(15%)	Lec	Quiz	6-10
4.4	Antimicrobial systems in raw milk.	1	4(10%)	Lec	Quiz	6-10
4.5	Microbiological grading of raw milk.	1	4(20%)	Lec	Quiz	6-10
4.6	Milk borne diseases and their control.	1	4(15%)	Lec	Quiz	6-10
4.7	Bacteriological aspects of milk processing a. Thermization b. Pasteurization c. Boiling d. Sterilization e. UHT f. bactofugation, and g. membrane filtration.	7	4(15%)	Lec	Quiz	6-10
5.	Composition and chemistry of dairy products					
5.1	Production, composition and spoilage of	8	5(10%)	Lec	Ass	6-10

	a. cream b. butter c. ghee d. ice-cream e. cheese f. kefir g. koumiss h. rennin i. condensed and dried milks j. infant food.					
5.2	Uses of antioxidants in milk products	1	5(10%)	Lec	Ass	6-10
5.3	Chemistry of milk fermentation.	1	5(10%)	Lec	Ass	6-10
5.4	Chemistry of rennin coagulation of milk and changes occurring during ripening of cheese	2	5(10%)	Lec	Ass	6-10
5.5	Physico-chemical changes in the manufacture and storage of milk powder, lactose	2	5(10%)	Lec	Ass	6-10
5.6	Crystallization and its significance	1	5(10%)	Lec	Ass	6-10
5.7	Dairy plant hygiene and sanitation.	1	5(10%)	Lec	Ass	6-10
5.8	Disposal of dairy waste	1	5(10%)	Lec	Ass	6-10
5.9	Microbiological standards for Milk and Milk products- PFA BIS, Codex/ ISO standards.	2	5(20%)	Lec	Ass	6-10

Reference Books

1. Adams M. R. and Moss M. O. (1996). Food Microbiology, New Age International (P) Limited Publishers, New Delhi.
2. Frazier W.C., Westhoff. D. C. and Vanitha K.N. (2013). Food Microbiology. (6th Edition). McGraw Hill Education.
3. Jay J. M., Loessner M. J. and Golden D.A. (2006). Modern Food Microbiology. (7th Edition). Springer.
4. Doyle M. P., Buchanan R. L. (2012). Food Microbiology: Fundamentals and Frontiers. (4th Edition). American Society for Microbiology Press.
5. Ray B. and Bhunia A. (2013). Fundamentals of Food Microbiology. (5th Edition). CRC Press.
6. Robinson R. K. (2000). Dairy Microbiology, Elsevier Applied Science, London.
7. Adams M.R, and Moss M.D, (2005). Food Microbiology 4thedn, New Age International Pvt. Ltd., Publishers. First edition.
8. Banwarst. G.J. (2003). Basic Food Microbiology 2nd edn, CBS Publishers and distributors.

9. Hobbs, B.C. and Roberts, D, (1968), Food Poisoning and Food Hygiene 7th edn. Edward Arnold: London.
10. Vijaya R K, (2004). Food Microbiology 1st edn. MJP Publishers, Chennai.

Semester VI

Course Title : Molecular Biology and Recombinant DNA Technology

Course Type : Practical (CC – XIV)

Total hours : 75 Hours/week : 5 Credit : 2

Pass-out policy : Minimum contact hours : 45
Total score % :100 Int : 40 Ext : 60
Min. pass % : 50 [No min. for Int.]

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CLO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
1	Illustrate the significance of artificial transformation, Conjugation, Transduction and mutation methods	2 (20%)	1,2,3	An	P
2	To get expertise in isolation and purification of DNA and plasmids	2 (20%)	1,2,3	An	P
3	To gain hands on experience in gene isolation and cloning by PCR and blotting techniques.	2 (20%)	1,2,3	An	P
4	To perform the gene expression analysis	2 (20%)	1,2,3	An	P

5	To learn to sequence the DNA	2 (20%)	1,2,3	An	P
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Module	Course Description
1	Artificial transformation
2.	Conjugation
3.	Transduction
4.	Detection of antibiotic resistant mutant
5.	Identification of mutants by replica plating method
6.	Physical (UV) and chemical Mutation (NTG and ethidium bromide) methods
7.	Isolation of genomic DNA from bacteria
8.	Isolation of plasmid DNA
9.	Determination of purity of DNA by agarose gel electrophoresis
10.	Restriction enzyme digestion, ligation
11.	PCR analysis- demonstration
12.	Western blotting
13.	Southern Blotting
14.	Restriction Fragment Length Polymorphism
15.	Randomly Amplified Polymorphic DNA
16.	DNA Sequencing methods

Reference books

1. Russel P.J. (2019). Genetics- A molecular approach (3rd edition), Pearson Education, Inc.
2. Glick B.R. and Patten C. L. (2018). Molecular Biotechnology- principles and application of recombinant DNA (5th edition.). ASM press.
3. Sambrook J and Russell D.W. (2001). Molecular cloning. A laboratory Manual (7th edition). Cold spring harbor, NY. Cold Spring Harbor Laboratory Press.

4. Brown T. A. (2016). Gene cloning and DNA analysis. (7th edition). John Wiley and Jones Ltd.
5. Dale J.W., Schantz M.V. and Plant N. (2012). From Gene to Genomes. Concepts and application of DNA technology. (3rd edition). John Wiley and Sons Ltd.

Semester VI

Course Title : Food and Dairy Microbiology

Course Type : Practical (CC – XV)

Total hours : 75 Hours/week : 5 Credit : 2

Pass-out policy : Minimum contact hours : 45
Total score % :100 Int : 40 Ext : 60
Min. pass % : 50 [No min. for Int.]

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CLO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
1	Perform isolation of microorganisms from various food products and utensils by standard plating methods	2(10%) 5(10%)	1,2,3,6	An	P
2	Analyse toxic components from food	2(10%) 5(10%)	1,2,3,6	An	P
3	Understand the different preservation techniques of food	2(10%) 5(10%)	1,2,3,6	An	P
4	Process and prepare various fermented food products	2(10%) 5(10%)	1,2,3,6	An	P
5	Prepare and check the quality of milk and milk products	2(10%) 5(10%)	1,2,3,6	An	P

Module	Course Description
1.	Examination of microbial load in soft drinks, ice creams, packaged and canned foods
2.	Isolation and identification of spoilage causing fungus from foods a. Cereals b. Spices
3.	Isolation of food poisoning bacteria from contaminated foods and dairy products
4.	Isolation of food borne fungi from food products
5.	Detection and enumeration of microbes present in utensils
6.	Microbial examination of Mushroom
7.	Extraction and detection of aflatoxin from infected foods
8.	Effect of temperature on spoilage of food products
9.	Wine production
10.	Fermentation of Sauerkraut
11.	Standard plate count for milk and milk products
12.	Qualitative analysis of milk a. Methylene blue reductase test b. Resazurine reductase test
13.	Production of fermented milk by <i>Lactobacillus acidophilous</i>
14.	Estimation of fat and lactic acid in milk

Reference Books

1. Roberts D. and Greenwood M. (2003). Practical food microbiology. Third edition. Blackwell publishing.
2. Ismail Mohamed Al Bulushi. (2018). The hand book of Food Microbiological analytical methods. First edition. Nova publishers.
3. Osman Erkmen. (2015). Basic methods for the Microbiological Analysis of foods. Third edition. Nobel Publishing.
4. Photis Papademas. (2001). Dairy Microbiology A Practical Approach. First edition. CRC Press.

5. Richard K. Robinson (2005). Dairy Microbiology Handbook, the microbiology of milk and milk products. Third edition, John Wiley and sons publishers.

Semester VI

Course Title : Clinical & Diagnostic Microbiology

Course Type : Theory (DSE – VI)

Total hours : 75 Hours/week : 5 Credit : 4

Pass-out policy : Minimum contact hours : 45
Total score % :100 Int : 40 Ext : 60
Min. pass % : 50 [No min. for Int.]

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CLO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
1	Apply Laboratory safety procedures and hospital waste disposal strategies.	5(10%) 6(10%)	1,2,5,6,10	U	F
2	Collect various clinical specimens, handle, preserve and process safely.	6(10%) 7(10%)	1,2,4,5,10	U	M
3	Identify the causative agents of diseases by conventional and molecular methods following standard protocols.	6(10%) 7(10%)	1,2,5,6,10	1,2,4,5,10 U	M
4	Assess the antimicrobial susceptibility pattern of pathogens.	7(10%) 9(10%)	1,2,5,6,10	U1,2,5,7,8 ,9	M
5	Trace the sources of nosocomial infection and recommend control measures.	5(10%) 7(10%)	1,2,5,6,10	U1,2,4,5,6	M

Module	Course Description	Hours	% of CLO mapping with module	Learning Activities	Assessment Tasks	References
1	Microbiology Laboratory Safety Practices					
1.1	General Safety Guidelines	3	1(20%)	GD	CA	1,2,3,4
1.2	Handling of Biological Hazards	3	1(20%)	LEC	CA	1,2,3,4
1.3	Infectious health care waste disposal - Biomedical waste management	3	1(20%)	GD	CA	1,2,3,4
1.4	Emerging and Re-emerging infections.	3	1(40%)	GD	CA	1,2,3,4
2	Diagnostic procedures					
2.1	General concept of Clinical specimen collection, transport, storage and general processing in Microbiology laboratory	6	2(50%)	Lec	Assign	7,8,9,
2.2	Specimen acceptance and rejection criteria	6	2(50%)	Lec	Assign	7,8,9
3	Diagnosis of microbial diseases					
3.1	Clinical, differential, Microbiological, immunological and molecular diagnosis of microbial diseases.	4	3(33%)	Lec	Assign	3,5,9
3.2	Modern and novel microbial diagnostic methods.	4	3(33%)	Lec	Qui	3,5,9
3.3	Automation in Microbial diagnosis	4	3(34%)	Lec	Qui	3,5,9
4	Antibiotic sensitivity tests					
4.1	Disc diffusion - Stokes and Kirby Bauer methods, Agar dilution & broth dilution bauerBauer Bauer Bauer	4,	4 (33%)	Lec	Qui	1,1 0,2
4.2	E test - Dilution -MBC/MIC	4	4 (33%)	Lec	Qui	1,1 0,2
4.3	Quality control for antibiotics and standard strains.	4	4 (34%)	Lec	Qui	1,1 0,2
5	Nosocomial infections					
5.1	Common types, sources, reservoir and mode of transmission,	6	5(50%)	Lec	Assign	7,8,9

Module	Course Description	Hours	Mapping with Learning Activities	Assessment Tasks	Reference
	pathogenesis and control measures.				
5.2	Hospital Infection Control Committee (HICC) – Functions.	6	5(50%)	Lec Assign	7,8,9

Reference Books

1. Collee J. G., Fraser A.G. Marmion B. P. and Simmons A. (1996). Mackie & McCartney Practical Medical Microbiology. (14th Edition). Elsevier, New Delhi. ISBN-10:0443047219 / ISBN-13-978-0443047213.
2. Tille P. M. (2021). Bailey and Scott's Diagnostic Microbiology. (15th Edition). Elsevier. ISBN:9780323681056.
3. Jawetz E., Melnick J. L. and Adelberg E. A. (2000). Review of Medical Microbiology. (19th Edition). Lange Medical Publications, U.S.A.
4. Mukherjee K.L. (2000). Medical Laboratory Technology. Vol. 1-3. (2nd Edition). Tata McGraw-Hill Education. ISBN-10:0074632604.
5. Sood R. (2009). Medical Laboratory Technology – Methods and Interpretations. (6th Edition). Jaypee Brothers Medical Publishers (P) Ltd. New Delhi. ISBN:9788184484496.
6. Murray P. R., Baron E. J., Jorgenson J. H., Pfaller M. A. and Tenover F.C. (2003). Manual of Clinical Microbiology. (8th Edition). American Society for Microbiology, Washington, DC. ISBN:1-555810255-4.
7. Bennett J.E., Dolin R. and Blaser M.J. (2019). Principles and Practice of Infectious Diseases. (9th Edition). Elsevier. EBook ISBN:9780323550277. Hardcover ISBN:9780323482554.
8. Ridgway G.L., Stokes E.J. and Wren M.W.D. (1987). Clinical Microbiology 7th Edition. Hodder Arnold Publication. ISBN-10:0340554231 / ISBN-13:9780340554234.
9. Koneman E.W., Allen S.D., Schreckenber P.C. and Winn W.C. (2020). Koneman's Color Atlas and Textbook of Diagnostic Microbiology. (7th Edition). Jones & Bartlett Learning. ISBN:1284322378 9781284322378.
10. Cheesbrough, M. (2004). District Laboratory Practice in Tropical Countries - Part 2, (2nd Edition). Cambridge University Press. ISBN-13:978-0-521-67631-1 / ISBN-10:0-521-67631-2.

Semester VI

Course Title : Life Science for Competitive Examinations

Course Type : Theory (DSE – VII)

Total hours : 75 Hours/week : 5 Credit : 4

Pass-out policy : Minimum contact hours : 45
Total score % :100 Int : 40 Ext : 60
Min. pass % : 50 [No min. for Int.]

Course creator	Expert 1	Expert 2
Dr. R. Bright Assistant professor, Department of Microbiology, Scott Christian College (Autonomous), Nagercoil. Mob: +91 9488490047 email: brightyourfriend@gmail.com .	Dr. K. Jenitha Associate Professor, Department of Microbiology, Scott Christian College, Nagercoil – 3 Mob: +91 701093092 email: jenithascott@gmail.com	Dr. Josephine Sheeba B Assistant professor, Department of Microbiology, Scott Christian College (Autonomous), Nagercoil. Mob: +91 9894931096 email: josephins2@gmail.com .

CLO. NO.	Course learning outcomes [upon completion of this course, students will be able to]	% of PLO Mapping with CLO	PLO Mapped with GA	Cognitive level	Knowledge Category (KC)
1	Define, classify and assess the structure, biological functions and interactions of Biomolecules.	1(20%)	1,2,3,6,8	U	F
2	Validate the knowledge of collective and progressive notions of cellular organization.	2(20%)	1,2,3	AP	C
3	Assess and describe the importance of inheritance biology.	3(20%)	1,2,3,5	U	F
4	Establish acquaintance and understanding of ecology & Biodiversity in a broader sense.	4(20%)	1,2,6,7	U	F
5	Understand the processes of evolution, relate with natural selection, adaptation and speciation.	5(20%)	1,2,6	U	F

Module	Course Description	Hours	%of CLO mapping with module	Learning Activities	Assessment Tasks	References
1	Biomolecules					
1.1	Composition, structure and function of biomolecules (carbohydrates, lipids,	2	1(20%)	Lec	Quiz	1,2

Module	Course Description	Hours	OS mapping with	Assessment	Task	Reference
	proteins, nucleic acids and vitamins).					
1.2	Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA).	2	1(20%)	Lec	Quiz	
1.3	Metabolism of carbohydrates, lipids, amino acids, nucleotides and vitamins	2	1(15%)	Lec	Quiz	
1.4	Structure of atoms, molecules and chemical bonds	2	1(15%)	Lec	Quiz	
1.5	Stabilizing interactions (Vander Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.).	2	1(15%)	Lec	Quiz	
1.6	Bioenergetics	2	1(15%)	Lec	Quiz	
2	Cellular Organisation					
2.1	Cell division and cell cycle	2	2(20%)	Lec	Quiz	1,2,3
2.2	Membrane structure and function	1	2(20%)	Lec	Quiz	
2.3	Organization of genes and chromosomes	2	2(15%)	Lec	Quiz	
2.4	Structural organization and function of intracellular organelles.	4	2(15%)	Lec	Quiz	
2.5	DNA replication, repair and recombination	2	2(15%)	Lec	Quiz	
2.6	Protein synthesis and processing.	1	2(15%)	Lec	Quiz	
3	Inheritance Biology					
3.1	Mendelian principles- Dominance, segregation, independent assortment	2	3(20%)	Lec	Quiz	3
3.2	Linkage and Gene mapping,	2	3(20%)	Lec	Quiz	
3.3	Karyotyping	2	3(15%)	Lec	Quiz	
3.4	Extrachromosomal inheritance - Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.	3	3(15%)	Lec	Quiz	

Module	Course Description	Hours	Mapping with Outcome	Assessment	Task	Reference
3.5	Human genetics-Pedigree analysis, lod score for linkage testing, karyotypes	3	3(15%)	Lec	Quiz	
3.6	Genetic disorders.		3(15%)	Lec	Quiz	
4	Ecology					
4.1	Habitat and Niche, biotic and abiotic interactions, Biome- biogeographical zones of India	3	4(20%)	Lec	Quiz	4
4.2	Ecological Succession, Population Ecology- Characteristics of a population; population growth curves	2	4(20%)	Lec	Quiz	
4.3	Environmental pollution-global environmental change,	2	4(20%)	Lec	Quiz	
4.4	Biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches	3	4(20%)	Lec	Quiz	
4.5	Indian case studies on Conservation/Management strategy (Project Tiger, Biosphere Reserves).	2	4(20%)	Lec	Quiz	
5	Evolution and Behaviour					
5.1	Evolution - Theories- Darwin's, Lamarck's, Oparin Haldane. Paleontological, Embryological and Molecular evidences.	3	5(25)	Lec	Quiz	5
5.2	Hardy Weinberg's Law.	1	5(10)	Lec	Quiz	
5.3	Speciation; Allopatricity and Sympatricity	1	5(15)	Lec	Quiz	
5.4	Adaptive radiation and Convergent evolution; Sexual selection; Co-evolution	2	5(10)	Lec	Quiz	
5.5	Altruism, Biological clocks, Migration and Parental care.	2	5(20)	Lec	Quiz	
5.6	Molecular Evolution- Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny.	3	5(20)	Lec	Quiz	

Reference Books

1. Nelson D. L. and Cox M. M. (2008). Lehningers Principles of Biochemistry. (5th Edition). W.H. Freeman and Company
2. Chapman J.L. (1998).Ecology: Principles and Applications. (2nd Edition). Cambridge University Press
3. Krishnamurthy V.K. (2003). Textbook of Biodiversity. Science Publishers.
4. Rogers A.L. (2011). Evidence of Evolution. University of Chicago Press. Chicago.
5. Stites D.P., Abba I. Terr, Parslow T.G. (1997). Medical Immunology. 9th **Edn**, **Prentice**-Hall Inc.