PONNAIYAH RAMAJAYAM INSTITUTE OF SCIENCE & TECHNOLOGY (PRIST)

Declared as DEEMED-TO-BE-UNIVERSITY
U/s 3 of UGC Act, 1956

SCHOOL OF ARTS AND SCIENCE

Department of Microbiology
B.Sc. Microbiology Syllabus

Regulation 2023

Bachelor of Science in Microbiology

Our curriculum is intended to educate our majors in a diversity of significant microbiological disciplines, as well as to inspire and improve Language and communicative skills and capabilities that take persistent value beyond the teaching space.

B. Sc Graduate Attributes

- Research, inquiry and analytical thinking abilities.
- Capability and motivation for intellectual development.
- Ethical, social and professional understanding.
- Communication in intra and inter disciplinary
- Teamwork, collaborative and management skills in scientific research
- Information literacy in respective discipline

Programme Educational Objectives-PEO

- **PEO1**-To gain and apply knowledge of microorganisms concept to solve the problems.
- **PEO2**-To identify, analyze and understand the problems related to microbes.
- **PEO3**-Ability to design and develop solutions to the environment using the microbes.
- **PEO4**-Ability to design performs experiments, analyze, and interpret data for investigating complex problems.
- **PEO5**-To decide and apply appropriate tools and techniques for manipulations.

Programme Outcomes:

PO1: Disciplinary knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study.

PO2: Communication Skills: Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.

PO3: Critical thinking: Capability to apply analytic thought to a body of knowledge; analyze and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.

PO4: Problem solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.

PO5: Analytical reasoning: Ability to 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.

PO6: Research-related skills: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesizing and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation.

PO7: Cooperation/Teamwork: Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.

PO8: Scientific reasoning: Ability to analyze, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.

PO9: Reflective thinking: Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society.

PO10 Information/digital literacy: Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.

PO 11 Self-directed learning: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.

PO 12 Multicultural competence: Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.

PO 13: Moral and ethical awareness/reasoning: Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one‟s work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.

PO 14: Leadership readiness/qualities: Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.

PO 15: Lifelong learning: Ability to acquire knowledge and skills, including „learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

Programme Specific Outcomes (PSOs)

On successful completion of Bachelor of Physics with Computer Applications programme, the student should be able to:

PSO1: Disciplinary Knowledge: Understand the fundamental principles, concepts, and theories related to physics and computer science. Also, exhibit proficiency in performing experiments in the laboratory.

PSO2: Critical Thinking: Analyze complex problems, evaluate information, synthesize information, apply theoretical concepts to practical situations, identify assumptions and biases, make informed decisions and communicate effectively

PSO3: Problem Solving: Employ theoretical concepts and critical reasoning ability with physical, mathematical and technical skills to solve problems, acquire data, analyze their physical significance and explore new design possibilities.

PSO4: Analytical & Scientific Reasoning: Apply scientific methods, collect and analyze data, test hypotheses, evaluate evidence, apply statistical techniques and use computational models.

PSO5: Research related skills: Formulate research questions, conduct literature reviews, design and execute research studies, communicate research findings and collaborate in research projects.

PSO6: Self-directed & Lifelong Learning: Set learning goals, manage their own learning, reflect on their learning, adapt to new contexts, seek out new knowledge, collaborate with others and to continuously improve their skills and knowledge, through ongoing learning and professional development, and contribute to the growth and development of their field.

PO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1	✓					
PO2		✓				
PO3			✓			
PO4				✓		

PO5					✓	
PO6						✓

2. Highlights of the Revamped Curriculum:

- Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application oriented content wherever required.
- The Core subjects include latest developments in the education and scientific front, advanced programming packages allied with the discipline topics, practical training, devising statistical models and algorithms for providing solutions to industry / real life situations. The curriculum also facilitates peer learning with advanced statistical topics in the final semester, catering to the needs of stakeholders with research aptitude.
- The General Studies and Statistics based problem solving skills are included as mandatory components in the 'Training for Competitive Examinations' course at the final semester, a first of its kind.
- The curriculum is designed so as to strengthen the Industry-Academia interface and provide more job opportunities for the students.
- The Statistical Quality Control course is included to expose the students to real life problems and train the students on designing a mathematical model to provide solutions to the industrial problems.
- The Internship during the second year vacation will help the students gain valuable work experience that connects classroom knowledge to real world experience and to narrow down and focus on the career path.
- Project with a viva-voce component in the fifth semester enables the student, application of conceptual knowledge to practical situations. The state of art technologies in conducting an Explain in a scientific and systematic way and arriving at a precise solution is ensured. Such innovative provisions of the industrial training, project and internships will give students an edge over the counterparts in the job market.
- State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and interdisciplinary nature are incorporated as Elective courses, covering conventional topics to the latest DBMS and Computer software for Analytics.

Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I	**Foundation Course** To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning Literature and analysing the world through the literary lens gives rise to a new perspective.	❖ Instill confidence among students ❖ Create interest for the subject
I, II, III, IV	**Skill Enhancement papers** (Discipline centric / Generic / Entrepreneurial)	❖ Industry ready graduates ❖ Skilled human resource ❖ Students are equipped with essential skills tomake them employable
		❖ Training on language and communication skills enable the students gainknowledge andexposure in the competitive world.
		❖ Discipline centric skill will improve the Technical knowhow of solving real lifeproblems.
III, IV, V & VI	Elective papers	❖ Strengthening the domain knowledge ❖ Introducing the stake holders to the State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and interdisciplinary nature ❖ Emerging topics in higher education/ industry/ communication network / health sector etc. are introduced with hands-on-training.
IV	Elective Papers	➢ Exposure to industry moulds students into solution providers ➢ Generates Industry ready graduates ➢ Employment opportunities enhanced
V Semester	Elective Papers	➢ Self-learning is enhanced ➢ Application of the concept to real situation is conceived resulting in tangible outcome
VI Semester	Elective Papers	➢ Enriches the study beyond the course. ➢ Developing a research framework and presenting their independent and intellectual ideas effectively.
Extra Credits: For Advanced Learners / Honors degree		➢ To cater to the needs of peer learners / research aspirants

Skills acquired from the Courses	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferable Skill

SCHOOL OF ARTS AND SCIENCE
DEPARTMENT OF MICROBIOLOGY
B. Sc., MICROBIOLOGY-REGULATION 2023R1
COURSE STRUCTURE

SEMESTER I					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
THEORY					
23110AEC11/ 23111AEC11/ 23132AEC11/ 23135AEC11	Language-I (Tamil-I/ Advanced English-I/ Hindi-I/ French-I	3	1	0	3
23111AEC12	English-I	3	1	0	3
23116AEC13	Fundamentals of Microbiology and Microbial Diversity	4	1	0	3
23115GEC14	Biochemistry	4	1	0	3
PRACTICAL					
23116EC15L	Fundamentals of Microbiology and Microbial Diversity Lab	0	0	3	3
23115SEC16L	Biochemistry Lab	0	0	3	3
SKILL ENHANCEMENT COURSE					
23116SEC17	Social & Preventive Medicine	2	0	0	2
23116SEC18	FC (Foundation Course)	2	0	0	2
AUDIT COURSE					
231AECCINC	Indian Constitution	2	-	-	2
231LSCUV	Universal Human Values	-	-	-	1
	Total Credit	**20**	**4**	**6**	**25**
SEMESTER II					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
THEORY					
23110AEC21/ 23111AEC21/ 23132AEC21/ 23135AEC21	Language-II (Tamil-II/ Advanced English-II/ Hindi-II/ French-II	3	0	0	3
23111AEC22	English-II	3	1	0	3
23116AEC23	Microbial Physiology and Metabolism	4	1	0	3
23115GEC24	Bio Instrumentation	4	1	0	3
PRACTICAL					
23116SEC25L	Microbial Physiology and Metabolism Lab	0	0	3	3
23115SEC26L	Bio Instrumentation Lab	0	0	3	3
SKILL ENHANCEMENT COURSE					
23116SEC27	Nutrition & Health Hygiene	2	0	0	2
23116SEC28	Sericulture	2	0	0	2
Ability Enhancement					
231AECCCMS	Communication English	2	0	0	2
AUDIT COURSE					

231SSCBE	Basic Behavioral Etiquette	-	-	-	1
	Total Credit	**20**	**4**	**6**	**25**
SEMESTER III					
Course Code	Course Title	L	T	P	C
THEORY					
23110AEC31/ 23111AEC31/ 23132AEC31/ 23135AEC31	Language-III (Tamil-III/ Advanced English-III/ Hindi-III/ French-III	3	1	0	3
23111AEC32	English-III	3	1	0	3
23116AEC33	Molecular Biology and Microbial Genetics	4	1	0	3
23116GEC34	Clinical Laboratory Technology	4	1	0	3
PRACTICAL					
23116SEC35L	Molecular Biology and Microbial Genetics Lab	0	0	3	3
23116SEC36L	Clinical Laboratory Technology Lab	0	0	3	3
SKILL ENHANCEMENT COURSE					
23116SEC37	Microbial marketable products	2	0	0	2
23116SEC38	Aquaculture	2	0	0	1
Ability Enhancement					
23116RMC39	Research Methodology	2	0	0	2
AUDIT COURSE					
231ACLSOAN	Office Automation	-	-	-	1
	Total Credit	**20**	**4**	**6**	**24**
SEMESTER IV					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
THEORY					
23110AEC41/ 23111AEC41/ 23132AEC41/ 23135AEC41	Tamil-IV/ Advanced English-IV/ Hindi-IV/ French-IV	3	0	0	3
23111AEC42	English-IV	3	0	0	3
23116AEC43	Immunology and Immunotechnology	4	1	0	3
23116GEC44	Biostatistics & Bioinformatics	4	1	0	3
PRACTICAL					
23116SEC45L	Immunology and Immunotechnology Lab	0	0	3	3
23116SEC46L	Biostatistics & Bioinformatics Lab	0	0	3	3
SKILL ENHANCEMENT COURSE					
23116SEC47	Vaccine Technology	2	0	0	2
23116SEC48	Apiculture	2	0	0	2
Ability Enhancement					
23116BRC49	Participation in Bounded Research	2	0	0	2
231AECCEVS	Environmental Studies	2	-	-	2
AUDIT COURSE					
231LSCLS	Leadership & Management Skills	-	-	-	1
	Total Credit	**22**	**2**	**6**	**27**
SEMESTER V					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
THEORY					
23116AEC51	Bacteriology and Mycology	5	1	0	4
23116AEC52	Virology and Parasitology	5	1	0	4

23116AEC53	Environmental and Agriculture Microbiology	5	1	0	4
23116DSE54_	Specific elective -I	4	0	0	3
PRACTICAL					
23116AEC55L	Bacteriology, Mycology Virology and Parasitology Lab	0	0	3	3
23116AEC56L	Environmental, Agriculture, Food and Probiotic Microbiology Lab	0	0	3	3
SKILL ENHANCEMENT COURSE					
23116SEC56	Internship/ Industrial Training/Field Visit	0	0	0	2
AUDIT COURSE					
231ACLSPSL	Professional Skills	-	-	-	1
231AECCVED	Value Education	2	0	0	2
	Total Credit	**22**	**3**	**6**	**26**
SEMESTER VI					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
THEORY					
23116AEC61	Food, Dairy and Probiotic Microbiology	5	0	0	4
23116AEC62	Recombinant DNA Technology	5	0	0	4
23116DSE63_	Specific elective -I	5	0	0	3
23116PRW64	Group Project & Viva Voice	0	0	13	4
23116SEC65	General Awareness for Competitive Exam	2	0	0	2
231EXACT	Extension activity	-	-	-	1
AUDIT COURSE					
231ACSIKWS	Indian Knowledge System	-	-	-	2
	Total Credit	**17**	**0**	**13**	**20**
	Total Credits -Programme	**140**			
	Total Credits - Audit Courses	**7**			
	Total Credits	**147**			

SEMESTER V	
Subject Code	**Discipline specific**
23116DSE54A	Biosafety & bioethics
23116DSE54B	Food Processing Technology
23116DSE54C	Disaster Management
23116DSE54D	Nano Biotechnology
23116DSE54E	Bioremediation and Waste Management
23116DSE54F	Microbiological Analysis of Air and Water
23116DSE54G	Biofertilizers and Biopesticides
SEMESTER VI	
Subject Code	**Discipline specific**
23116DSE65A	Pharmaceutical Microbiology
23116DSE65B	Entrepreneurship and Bio-business
23116DSE65C	Food Fermentation Techniques
23116DSE65D	Genomics and Proteomics
23116DSE65E	Plant Tissue Culture
23116DSE65F	Advances in Microbiology

Credit Distribution

Sem	AEC	SEC	GEC	DSC	AECC	Research	Others	Total
I	9	10	3	-	2	-	-	24
II	9	10	3	-	2	-	-	24
III	9	9	3	-	-	2	-	23
IV	12	10	-	-	2	2	-	26
V	12	8	-	3	2	-	-	25
VI	8	2	-	3	-	4	1	18
Total	**59**	**49**	**9**	**6**	**8**	**8**	**1**	**140**

Audit Course Credit Distribution

Sem	Audit
I	1
II	1
III	1
IV	1
V	2
VI	1
Total	**7**

HOD **DEAN**

Course Code	Course Title	L	T	P	C
23110AEC11	Tamil-I **இக்காலஇலக்கியம்**	3	1	0	3

முதல்பருவம்

பாடநோக்கம் :

இக்காலதமிழ்இலக்கியவகைகளின்மாதிரிகளைக்கற்பித்துஅவற்றில்ஈடுபாட்டையும், சுவைக்கும்திறனையும்ஏற்படுத்துதல்.

பயன்கள் :

CO1: மொழிஆளுமைத்திறன்பெறுதல்.

CO2:சமூகசிந்தனையைவளர்த்துக்கொள்ளுதல்.

CO3:படைப்பாளர்களாகஉருவாகும்திறனைப்பெறுதல்.

CO4:இலக்கியங்களின்அறிவைமேம்படுத்துதல்.

CO5:கவிதைஎழுதும்முறையைபுரிந்துக்கொள்ளுதல்

அலகு -1 மரபுக்கவிதை

1.பாரதியார்--விடுதலை, வந்தேமாதரம் ,காற்று

2.பாரதிதாசன் - அழகின்சிரிப்பு ,தமிழனுக்குவீழ்ச்சிஇல்லை

3.கவிமணிதேசியவிநாயகம்பிள்ளை-- தொழிலாளியின்முறையீடு

4.நாமக்கல்கவிஞர்-- தருணம்இதுவே ,

5.கண்ணதாசன்-- அனுபவம்

அலகு - 2 புதுக்கவிதைகள்

1.அப்துல்ரகுமான் -வெற்றி

2.அறிவுமதி-நட்புக்காலம்

3.வைரமுத்து- ருசி, சிற்பி- ஓடுஓடுசங்கிலி

4.மு.மேத்தா- வெளிச்சம்வெளியேஇல்லை

அலகு - 3 நாட்டுப்புறவியல்

1.பழமொழிகள்

2.விடுகதைகள்

3.தொழில்பாடல்

அலகு- 4 சிறுகதை

1.தடயம்- மா. ஜெயபிரகாசம்

2.எதார்த்தம் - சு. தமிழ்ச்செல்வி

3.நீதி - பூமணி

அலகு- 5 இலக்கியவரலாறு

கவிதை, சிறுகதைநாட்டுப்புறப்பாடல்

பொதுக்கட்டுரை :மனிதநேயம், வாழ்வியல்அறங்கள்

மனப்பாடப்பகுதி :பாரதியார்கவிதை- வேண்டும்,
பாரதிதாசன்கவிதை-செந்தாமரை

பார்வைநூல்கள் :

1.பாரதியார்கவிதைகள்- மணிவாசகர்பதிப்பகம்சென்னை

2.பாரதிதாசன்கவிதைகள்- பாரிநிலையம், சென்னை

3.தமிழ்இலக்கியவரலாறு- முவரதராஜன்சாகித்திய
அகாதெமி,சென்னை

4.நாட்டுப்புறவியல் - முனைவர். ஆறு. ராமநாதன்
,மணிவாசகர்பதிப்பகம், சென்னை

5.தமிழ்சிறுகதையும்தோற்றம்வளர்ச்சி - தமிழ்புத்தகநிலையம்,
சென்னை

Mapping with Programme Outcomes:

	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1 2
CO1	3	2	3	3	3	2	2	2	3	2	3	2
CO2	3	3	2	2	2	3	2	3	3	2	2	2
CO3	3	2	3	3	2	2	2	3	2	3	3	2
CO4	3	3	3	2	2	2	3	2	3	2	3	3
CO5	3	3	2	2	2	2	3	2	2	2	3	3

Course Code	Course Title	L	T	P	C
23111AEC11	Advanced English-I	3	1	0	3

Aim:

To improve the knowledge of English

Course Objective:

CO1: To familiarize the students with the glossary terms, figures of speech

CO2::To enhance vocabulary

CO3: To learn how to edit and proofread

CO4: To know the comparison and contrast and cause and effect forms

CO5: To understand the impact of the speeches of famous people

UNIT–I:

The Origin of Language - Development of Gesture, Sign, Words, Sounds, Speech and Writing Language History and the Process of Language Change Core Features of Human Language, Animals and Human Language

UNIT–II:

Nature of LanguagePure Vowels, Diphthongs and Consonants Language Varieties: Dialects, Idiolect, Pidgin and Creole Language and Gender, Language and Disadvantage

UNIT–III:

Linguistic Form Morphology, Grammar, Syntax Saussurean Dichotomies: Synchronic and Diachronic Linguistics Semantics, Pragmatics

UNIT–IV:

Branches of Linguistics Structural Linguistics, Sociolinguistics, Psycholinguistics, Neurolinguistics, Applied Linguistics

UNIT–V:

Stylistics and Discourse Analysis: Relationship between Language and Literature, Style and Function, Poetic Discourse, Narrative Discourse and Dramatic Discourse

Course Outcome:

CO1: Development of vocabulary

CO2: Learning to edit and do proof reading

CO3: Reading and comprehending literature

CO4: Comparison and contrast and cause and effect forms

CO5: The impact of the speeches of famous people

Author	Title of the book	Edition / Year	Publisher
Wren and Martin	English Grammar	2009	S.Chand & Company Ltd
Meenakshi Raman & amp; Sangeetha Sharma	Technical Communication	Second Edition 2011	Oxford University Press
Sudhir Kumar Sharma	The World's Great Speeches	-	Galaxy Publishers

Course Code	Course Title	L	T	P	C
23111AEC12	English-I	3	1	0	3

Course Objectives

CO1: To enable learners to acquire the linguistic competence necessarily required in various life situations.
CO2:To help them understand the written text and able to use skimming, scanning skills
CO3: To assist them in creative thinking abilities
CO4: To enable them become better readers and writers
CO5: To assist them in developing correct reading habits, silently, extensively and intensively

Course Content:

UNIT I: Poetry

1.1 A Patch of Land - Subramania Bharati
1.3 A Nation's Strength – Ralph Waldo Emerson
1.4 Love Cycle - Chinua Achebe

UNIT II: Prose

2.1 JRD - Harish Bhat
2.2 Us and Them - David Sedaris From Dress Your Family in Corduroy and Denim

UNIT III: Short Stories

3.1 The Faltering Pendulum - Bhabani Bhattacharya
3.2 How I Taught my Grandmother to Read - Sudha Murthy
3.3 The Gold Frame- R.K. Laxman

UNIT IV: Language Competency

4.1 Vocabulary : Synonyms, Antonyms, Word Formation
4.2 Appropriate use of Articles and Parts of Speech
4.3 Error correction

UNIT V: English for Workplace

5.1 Self - introduction, Greetings
5.2 Introducing others
5.3 Listening for General and Specific Information
5.4 Listening to and Giving Instructions / Directions

Course Outcomes

Course Outcomes	On completion of this course,students will;	
CO1	Develop and integrate the use of the four language skills i.e. Reading, Listening, Speaking and Writing	PO1
CO2	Understand the total content and underlying meaning in the context.	PO1, PO2
CO3	Form the habit of reading for pleasure and for information	PO4,PO6
CO4	Comprehend material other than the prescribed text	PO4, PO5, PO6
CO5	Develop the linguistic competence that enables them, in the future, to present the culture and civilization of their nation.	PO3, PO8

Text books (Latest Editions)	
1.	Steel Hawk and other stories by Bhattacharya, Bhabani, New Delhi: Sahitya Akademi, 1967
2.	How I taught my Grandmother to Read and other Stories, Murthy, Sudha,Penguin Books, India, 2004

Reference Books (Latest Editions, and the style given must be strictly adhered to)	
1.	English in use - A textbook for College Students (English ,Paper back, - T.Vijay Kumar, K Durga Bhavani, YL Srinivas
2.	Practical English Usage - 4th Edition By Michael Swan
3.	**The Art of Civilized Conversation: A Guide to Expressing Yourself with Style and Grace** -Margaret Shepherd,Penny Carter, (Illustrator), Sharon Hogan, 2005.

WebResources	
1.	A patch of land by Subramania Bharati translated by Usha Rajagoplan : https://books.google.co.in/books?id=iSHvOmXuvLMC&printsec=frontcover&dq=subramania+bharati+poems&hl=en&newbks=1&newbks_redir=0&source=gb_mobile_search&sa=X&redir_esc=y#v=onepage&q=subramania%20bharati%20poems&f=false
2.	The Sparrow by Paul Laurence Dunbar https://poets.org/poem/sparrow-0
3.	A Nation's Strength by Emerson https://poets.org/poem/nations-strength
4.	Love cycle by Chinua Achebe : https://www.best-poems.net/chinua-achebe/love-cycle.html
5.	JRD by Harish Bhat https://www.tata.com/newsroom/heritage/coffee-tea-jrd-tata-stories
.	Us and Them by David Sedaris From Dress Your Family in Corduroy and Denim https://legacy.npr.org/programs/morning/features/2004/jun/sedaris/usandthem.html
7.	Uncle Podger Hangs a Picture: http://rosyhunt.blogspot.com/2013/01/uncle-podger-hangs-picture.html
8.	The Gold Frame: https://fybaenglish.blogspot.com/2018/12/the-gold-frame-r-k-laxman.html

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	2	3	3	2	2	2
CO3	3	3	3	2	3	3	3	2	3	2
CO4	3	3	3	3	3	3	3	2	2	2
CO5	3	2	3	3	3	3	3	2	2	3

Mapping with Programme Specific Outcomes:

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Course Code	Course Title	L	T	P	C
23116AEC13	Fundamentals Of Microbiology And Microbial Diversity	4	1	0	3

Course Objectives

CO1: Learn the fundamental principles about different aspects of Microbiology including recent developments in the area.

CO2: Describe the structural organization, morphology and reproduction of microbes.

CO3: Explain the methods of cultivation of microbes and measurement of growth.

CO4: Understand the microscopy and other basic laboratory techniques – culturing, disinfection and sterilization in Microbiology.

CO5: Compare and contrast the different methods of sterilization.

Course Content:

UNIT I:

History and Evolution of Microbiology, Classification – Three kingdom, five kingdom, six kingdom and eight kingdom. Microbial biodiversity: Introduction to microbial biodiversity- ecological niche. Basic concepts of Eubacteria, Archaebacteria and Eucarya. Conservation of Biodiversity.

UNIT II:

General characteristics of cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) and acellular microorganisms - (Viruses, Viroids, Prions), Differences between prokaryotic and eukaryotic microorganisms. Structure of Bacterial cell wall, cell membrane, capsule, flagella, pili, mesosomes, chlorosomes, phycobilisomes, spores, and gas vesicles. Structure of fungi (Mold and Yeast), Structure of microalgae.

UNIT III:

Bacterial culture media and pure culture techniques. Mode of cell division, Quantitative measurement of growth. Anaerobic culture techniques.

UNIT IV:

Microscopy – Simple, bright field, dark field, phase contrast, fluorescent, electron microscope – TEM & SEM, Confocal microscopy, and Atomic Force Microscopy. Stains and staining methods.

UNIT V:

Sterilization–moist heat - autoclaving, dry heat – Hot air oven, radiation – UV, Ionization, filtration – membrane filter and disinfection, antiseptic; Antimicrobial agents.

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Study the historical events that led to the discoveries and inventions and understand the Classification of Microorganisms.	**PO5, PO6, PO10**
CO2	Gain Knowledge of detailed structure and functions of prokaryotic cell organelles.	**PO10**
CO3	Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms.	**PO11**
CO4	Explain the principles and working mechanism of different microscopes/Microscope, their function and scope of application.	**PO4, PO11**
CO5	Understand the concept of asepsis and modes of sterilization and disinfectants**.**	**PO4, PO11**

	Text Books
1	Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7thEdition.,McGraw – Hill, New York.
2	Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott's Microbiology. 10th Edition., McGraw-Hill International edition.
3	Tortora, G.J., Funke, B.R., Case,C.L. (2013). Microbiology. An Introduction 11thEdition., A La Carte Pearson.
4	Salle. A.J (1992). Fundamental Principles of Bacteriology. 7thEdition., McGraw Hill Inc.New York.
5	Boyd, R.F. (1998). General Microbiology,2ndEdition., Times Mirror, Mosby CollegePublishing, St Louis.
	References Books
1	Jeffrey C. Pommerville., Alcamo's Fundamentals of Microbiology (9thEdition). Jones &Bartlett learning 2010.
2	Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5thEdition., MacMillan Press Ltd
3	Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction, 11thEdition., Benjamin Cummings.
4	Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5thEdition., McGraw Hill Publications.
5	Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - Biology of Microorganisms, 13th Edition Benjamin-Cummings Pub Co.

Web Resources	
1	https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology
2	https://www.keyence.com/ss/products/microscope/bz-x/study/principle/structure.jsp
3	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604941/#
4	https://bio.libretexts.org/@go/page/9188
5	https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-nutrition/

Mapping with Programme Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**
CO1					M	M				M	
CO2										M	M
CO3											S
CO4				M							S
CO5				M							S

Course Code	Course Title	L	T	P	C
23115GEC14	**Biochemistry**	4	1	0	3

Course Objectives:

CO1: Introduce the structure and classification of carbohydrates
CO2: Comprehend the metabolism of carbohydrates
CO3:Study the classification and properties of amino acids
CO4: Elucidate the various levels of organization of Proteins
CO5: Study functions and deficiency diseases of vitamins

Course Content:

UNIT I:

Definition and classification of carbohydrates, linear and cyclic forms (Haworth projection) for glucose, fructose and mannose and disaccharides (maltose, lactose, sucrose).General properties of monosaccharides and disaccharides. Occurrence and significance of polysaccharides.

UNIT II:

Metabolism- Catabolism and Anabolism. Carbohydrate metabolism- Glycolysis, TCA cycle, HMP shunt and glycogen metabolism and energetic

UNIT III:

Amino acids -Classifications, physical properties -amphoteric nature, isoelectric point and chemical reactions of carboxyl ,amino and both groups. Amino acid metabolism- transamination, deamination and decarboxylation.

UNIT IV:

:Proteins- classification - biological functions ,physical properties- ampholytes, iso electric point, salting in and salting out, denaturation, nature of peptide bond. Secondary structure, α-helix and β-pleated sheet, tertiary structure, various forces involved- quaternary structure.

UNIT V:

Vitamins- Fat(A,D,E and K) and water soluble vitamins(B complex and C)- sources, RDA, biological functions and deficiency diseases.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Explain the structure, classification , biochemical functions and significance of carbohydrates	**PO1**
CO2	Explain the metabolism of carbohydrates and its significance	**PO1**
CO3	Classify amino acids and its properties	**PO4, PO5, PO6**
CO4	Explain the classification and elucidate the different levels of structural organization of proteins	**PO4, PO5, PO6**
CO5	Identify the disease caused by the deficiency of vitamins	**PO5, PO6, PO9**

Text Books	
1	Satyanarayana, U. and Chakrapani, U(2014).Biochemistry,4th Edition, Made Simple Publisher.

2	Jain J L, Sunjay Jain and Nitin Jain (2016).Fundamentals of Biochemistry, 7th Edition, S Chand Company.
3	AmbikaShanmugam's (2016). Fundamentals of Biochemistry for Medical Students, 8th Edition. Wolters Kluwer India Pvt Ltd.
4	Vasudevan. D.M.Sreekumari.S, Kannan Vaidyanathan (2019). Textbook Of Biochemistry For Medical Students. Kindle edition, Jaypee Brothers Medical Publishers
5	Jeremy M. Berg,LubertStryer, John L. Tymoczko, Gregory J. Gatto (2015). Biochemistry, 8th edition. WH Freeman publisher.

References Books	
1	AmitKessel&Nir Ben-Tal (2018). Introduction to Proteins: structure, function and motion. 2ndEdition, Chapman and Hall.
2	David L. Nelson and Michael M. Cox (2017).Lehninger Principles of Biochemistry, 7thEdition W.H. Freeman and Co., NY.
3	LupertStyrer, Jeremy M. Berg, John L. Tymaczko, Gatto Jr., Gregory J (2019). Biochemistry. 9thEdition ,W.H.Freeman& Co. New York.
4.	Donald Voet, Judith Voet, Charlotte Pratt (2016). Fundamentals of Biochemistry: Life at the Molecular Level, 5th Edition, Wiley.
5.	Joy PP, Surya S. and AswathyC (2015). Laboratory Manual of Biochemistry, Edition 1.,Publisher:Kerala agricultural university.

Web Resources	
1	https://www.abebooks.com › plp
2	https://kau.in/document/laboratory-manual-biochemistry
3	https://metacyc.org
4	https://www.medicalnewstoday.com
5	https://journals.indexcopernicus.com

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M										
CO2	M										
CO3				S	S	S					
CO4				S	S	S					
CO5					S	S			S		

Course Code	Course Title	L	T	P	C
23116SEC15L	Fundamentals of Microbiology and Microbial Diversity Lab	0	0	3	3

Course Objectives:

CO 1: Acquire knowledge on Cleaning of glass wares, GLP and sterilization.
CO 2: Gain knowledge on media preparation and cultural characteristics.
CO 3: Learn the pure culture technique
CO 4: Learn the microscopic techniques and staining methods.
CO 5: Acquire knowledge on stain and staining methods

UNIT I:

- Cleaning of glass wares, Microbiological good laboratory practice and safety. Sterilization and assessment of sterility– Autoclave, hot air oven, and membrane filtration.

UNIT II:

- Media preparation: liquid media, solid media, semi-solid media, agar slants, agar deeps, agar plates.

UNIT III:

- Preparation of basal, differential, enriched, enrichment, transport, and selective media preparation- quality control of media, growth supporting properties, sterility check of media.
- Pure culture techniques: streak plate, pour plate, decimal dilution.

UNIT IV:

- Culture characteristics of microorganisms: growth on different media, growth characteristics, and description. Demonstration of pigment production.
- Microscopy: light microscopy and bright field microscopy.

UNIT V:

- Staining techniques: smear preparation, simple staining, Gram's staining and endospore staining.
- Study on Microbial Diversity using Hay Infusion Broth-Wet mount to show different types of microbes, hanging drop.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Practice sterilization methods; learn to prepare media and their quality control.	**PO4, PO7, PO8, PO9, PO11**
CO2	Learn streak plate, pour plate and serial dilution and pigment production of microbes.	**PO4, PO7, PO8, PO9**
CO3	Understand Microscopy methods, different Staining techniques and motility test.	**PO4, PO7, PO8, PO9, PO11**
CO4	Observe Culture characteristics of microorganisms.	**PO4, PO7, PO8, PO9**
CO5	Study on Microbial Diversity using Hay Infusion Broth-Wet mount.	**PO4, PO7, PO8, PO9**

Text Books	
1	James G Cappucino and N. Sherman MB(1996). A lab manual Benjamin Cummins, New York 1996.

2	Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.
3	Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.
4	Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi.
5	R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing.
References Books	
1	Atlas.R (1997). Principles of Microbiology, 2nd Edition, Wm.C.Brown publishers.
2	Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India
3	Talib VH (2019). Handbook Medical Laboratory Technology. (2nd Edition). CBS
4	Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication.
5	Lim D. (1998). Microbiology, 2ndEdition, WCB McGraw Hill Publications.
Web Resources	
1	http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403.
2	https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635
3	https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf
4	https://microbiologyinfo.com/top-and-best-microbiology-books/
5	https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO1 0	PO11
CO1				M			L	M	L		M
CO2				S			L	L	L		
CO3				S			M	M	L		M
CO4				S			M	L	L		
CO5				S			M	L	L		

Course Code	Course Title	L	T	P	C
23115SEC16L	**Biochemistry Lab**	0	0	3	3

Course Objectives:
CO 1: Identify carbohydrates by qualitative test
CO 2: Estimate biomolecules volumetrically
CO 3: Estimate protein quantitatively

I Qualitative analysis of carbohydrates
a) Monosaccharides-Glucose, Fructose
b) Disaccharides- Lactose, Maltose, Sucrose
c) Polysaccharides-Starch

II Volumetric analysis
a) Estimation of ascorbic acid using 2,6 dichlorophenolindophenol as link solution
b) Estimation of Glucose by Benedicts method
c)Estimation of Glycine by Sorenson Formal titration

III Quantitative analysis(Demonstration Expt)
a) Colorimetric estimation of protein by Biuret method

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Qualitatively analyze and report the type of carbohydrate based on specific tests	**PO1,PO2.PO3**
CO2	Quantitatively estimate the carbohydrates, amino acids and ascorbic acid	**PO1,PO2.PO3**
CO3	Estimate protein by colorimetric method	**PO1,PO2.PO3**

References Books	
1	Varley's practical clinical biochemistry, Alan. H. Gowen clock, 6th Edition, 1988, CBS publishers & distributors,India.
2	Practical manual of Biotechnology, Lab Manual, Dr.RituMahajan, Dr.Jitender Sharma & Dr. R.K. Mahajan, 1st Edition, 2010, Vayu education of India, New Delhi.
3	Laboratory manual and Practical biochemistry, T.N.Pattabiraman, 4th Edition, 2010. All India Publisher's & Distributors limited, New Delhi.42
4	Practical text book of biochemistry for MBBS students, D.M.Vasudevan, 1st Edition, 2007, Jaypee brothers, New Delhi
5	An introduction to practical biochemistry, David. T. Plummer, 3rd Edition, 1998, TataMc.Grawhill education private limited, NewDelhi

Web Resources	
1	https://www.uchealth.org/professionals/uch-clinical-laboratory/specimen-collectinghandling-guide/specimen-collection-procedures/
2	https://www.rcpath.org/discover-pathology/news/fact-sheets/haematology.html 3.

3	https://labtestsonline.org/tests/urinalysis4.https://www.nablindia.org/nabl/index.php?c=pu blicaccredationdoc&m=index&docType=both&Itemid=199
4	https://www.cdc.gov/nchs/data/nhanes/nhanes_03_04/l13_c_met_lipids.pdf
5	https://www.testing.com/tests/alkaline-phosphatase-alp/

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	**S**	**S**					**S**	**S**	**S**	**S**
CO2	M	**S**	**S**					**S**	**S**	**S**	**S**
CO3	M	**S**	**S**					**S**	**S**	**S**	**S**

Course Code	Course Title	L	T	P	C
23116SEC17	Social & Preventive Medicine	2	0	0	2

Course Objectives:

CO 1: Describe the concepts of health and disease and their social determinant**s**

CO 2: Summarize the health management system

CO 3: Know about the various health care services

CO 4: Outline the goals of preventive medicine

CO 5: Gain knowledge about alternate medicine

Course Content:

UNIT I:

Introduction to social medicine:

History of social medicine-concepts of health and disease-social determinants of health and disease - Health and quality of life-Health information system- measures of population health-health policies.

UNIT II:

Health management:

Applications of behavioral sciences and psychology in health management- nutritional programs for health management-water and sanitation in human health-national programs for communicable and non-communicable diseases- environmental and occupational hazards and their control.

UNIT III:

Health care and services:

Health care of the community-information, education, communication and training in health-maternal & child health-school health services- Geriatrics-care and welfare of the aged-mental health-health services through general practitioners.

UNIT IV:

Preventive medicine:

Introduction- role of preventive medicine- levels of prevention-Risk assessment in communities and vulnerable population –surveillance, monitoring and reporting of disease outbreaks - forecasting and control measures in community setting – early detection methods.

UNIT V:

Prevention through alternate medicine:

Unani, Ayurveda, Homeopathy, Naturopathy systems in epidemic and pandemic outbreaks. International health regulations. Infectious disease outbreak case studies and precautionary response during SARS and MERS coronavirus, Ebola and novel SARS-COV2 outbreaks.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Identify the health information system	PO1,PO5, PO6
CO2	Associate various factors with health management system	PO1,PO2, PO3,PO5, PO6, PO9
CO3	Choose the appropriate health care services	PO1,PO5, PO6
CO4	Appraise the role of preventive medicine in community setting	PO4,PO5, PO6
CO5	Recommend the usage of alternate medicine during outbreaks	PO1,PO5, PO6

Text Books	
1.	Park.K (2021). Textbook of preventive and social medicine, 26th edition. BanarsidasBhanot publishers.
2.	Mahajan& Gupta (2013). Text book of preventive and social medicine, 4thedition. Jaypeebrothers medical publishers.
3.	Chun-Su Yuan, Eric J. Bieber, Brent Bauer (2006). Textbook of Complementary and Alternative Medicine. Second Edition. Routledge publishers.
4.	Vivek Jain (2020). Review of Preventive and Social Medicine: Including Biostatics. 12th edition, Jaypee Brothers Medical Publishers.
5.	Lal Adarsh Pankaj Sunder (2011). Textbook of Community Medicine: Preventive and Social Medicine, CBS publisher.
References Books	
1	Howard Waitzkin, Alina Pérez, Matt Anderson (2021). Social Medicine and the coming Transformation. First Edition. Routledge publishers.
2	GN Prabhakara (2010). Short Textbook of Preventive and Social Medicine. Second Edition. Jaypee publishers.
3	Jerry M. Suls, Karina W. Davidson, Robert M. Kaplan (2010).Handbook of Health Psychology and BehavioralMedicine.Guilford Press.
4	Marie Eloïse Muller, Marie Muller, MarthieBezuidenhout, KarienJooste (2006).Health Care Service Management. Juta and Company Ltd.
5	Geoffrey Rose (2008).Rose's Strategy of Preventive Medicine: The Complete.OUP Oxford.

Web Resources	
1	https://www.omicsonline.org/scholarly/social--preventive-medicine-journals-articles-ppts-list.php
2	https://www.teacheron.com/online-md_preventive_and_social_medicine-tutors
3	https://www.futurelearn.com
4	https://www.healthcare-management-degree.net
5	https://www.conestogac.on.health-care-administration-and-service-management

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	**S**				**S**	**S**					
CO2	**S**	**S**		M	**S**	**S**			M		
CO3				M	**S**	**S**					
CO4	**S**			**S**	**S**	M					
CO5	**S**				**S**	**S**					

Course Code	Course Title	L	T	P	C
23116SEC18	FC (Foundation Course)	2	0	0	2

Course Objectives:

CO 1: To get the basic knowledge of microbiology

CO2: To describe the relationship of microbes between plants and animals, advance infectious agent (virus) and immunology

CO 3: To get the knowledge parasitology and microbes in human welfare

CO 4: To get the basic knowledge of genetics and molecular Biology

CO 5: Introduction to Basic Instruments, Glassware, Instruments and Preparation of reagents and media

Course Content:

UNIT I:

Basics of Microbiology:Comparison of General Biology and Microbiology, Definition, Branches of Microbiology, and Its Importance in Science

Physiology: Basic Concept, Discussion of the Physiology of Plants, Animals, and Bacteria, Basic Components, and Their Relevance to Microbiology

Building block molecules: Discussion of four major biomolecules studied in general biology and their importance in microbiology, metabolism, and enzymes.

UNIT II:

Relationship of microbes between plants and animals:Discussion of microbes role in plant growth, photosynthesis, nitrogen fixation, biofertilizer, Discussion of microbes role in animals, good and bad bacteria, normal flora, and infections (typhoid, dysentery, food poisoning, etc.)

Advance infectious agent (virus):Definitions,physiology, classification (bacterial, plant, and animal viruses), diseases (Pandemic Corona), vaccines

Immunology: General concept of immunology, discussion on immunity, and terminology used in immunology in general, including antigens and antibodies and their roles.

UNIT III:

Parasitology: General Discussion on Parasites: Definition, Types, and Diseases Malaria, filariasis, amoebiasis, etc.

Microbes in human welfare: Microbes in household food processing, microbes in industries, and microbes in waste management, in brief, Microbes as biocontrol agents, Microbes in biogas production.

UNIT IV:

Genetics and Molecular Biology:Discussion of the specific role of genetics and molecular biology in general biology and its comparison with bacteria and viruses, Discussion of gene, genome, plasmid, genetic code, replication, transcription, and translation roles in bacteria

Advances in microbiology: Discussion of Recombinant DNA Technology, PCR, and Transgenic Plants and Animals.

UNIT V:

Introduction to Basic Instruments and Glassware: Glassware:conical flask, volumetric flask, beaker, pipette, burette, measuring cylinder, etc., their ranges, uses, and calibrations.

Instruments: Incubator, oven, balance (single pan and digital), BOD incubator, microscope, water bath, pH metre, colorimeter, autoclave, etc., uses, handling, and calibrations.

Preparation of reagents and media:percent, normal, and molar solution preparations, broth and media preparations, slant and plate preparations, storage and maintenance of culture.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Study and understand the basic of Microbiology	PO1,PO5, PO6
CO2	Gain Knowledge of relationship of microbes between plants and animals	PO1,PO2, PO3,PO5, PO6, PO9
CO3	Understand the parasitology and microbes in human welfare	PO1,PO5, PO6
CO4	Understand the concept of basic genetics and molecular Biology	PO4,PO5, PO6
CO5	Recommend the usage of basic instruments, glassware, instruments and preparation of reagents and media	PO1,PO5, PO6

Text Books	
1	Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7th Edition.,McGraw –Hill, New York.
2	Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott's Microbiology. 10th Edition., McGraw-Hill International edition.
3	Tortora, G.J., Funke, B.R., Case,C.L. (2013). Microbiology. An Introduction 11th Edition., A La Carte Pearson.
4	Salle. A.J (1992). Fundamental Principles of Bacteriology. 7th Edition., McGraw Hill Inc.New York.
5	Boyd, R.F. (1998). General Microbiology,2nd Edition., Times Mirror, Mosby CollegePublishing, St Louis.
References Books	
1	Jeffrey C. Pommerville., Alcamo's Fundamentals of Microbiology (9th Edition). Jones & Bartlett learning 2010.
2	Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5th Edition., MacMillan Press Ltd
3	Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction, 11th Edition., Benjamin Cummings.
4	Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5th Edition., McGraw Hill Publications.
5	Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - Biology of Microorganisms, 13th Edition Benjamin-Cummings Pub Co.

Web Resources	
1	https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology
2	https://www.keyence.com/ss/products/microscope/bz-x/study/principle/structure.jsp

Web Resources	
3	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604941/#
4	https://bio.libretexts.org/@go/page/9188
5	https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial- nutrition/

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	**S**				**S**	**S**					
CO2	**S**	**S**		M	**S**	**S**			M		
CO3				M	**S**	**S**					
CO4	**S**			**S**	**S**	M					
CO5	**S**				**S**	**S**					

Course Code	Course Title	L	T	P	C
231AECCINC	Indian Constitution	2	0	0	2

Course Objectives:

CO1: To make the students understand about the democratic rule and parliamentarian administration

CO2: To appreciate the salient features of the Indian constitution

CO3: To know the fundamental rights and constitutional remedies

CO4: To make familiar with powers and positions of the union executive,union parliament and the supreme court

CO5: To exercise the adult franchise of voting and appreciate the electoral system of Indian democracy.

Course Content:

Unit I:**The making of Indian constitution**

The constitution assembly organization –character -work salient features of the constitution-written and detailed constitution -socialism –secularism-democracy and republic.

Unit II: **Fundamental rights and fundamental duties of the citizens**

Right of equality -right of freedom- right against exploitation -right to freedom of religion-cultural and educational rights -right to constitutional remedies -fundamental duties .

Unit III:Directive principles of state policy

Socialistic principles-Gandhi an principles-liberal and general principles -differences between fundamental rights and directive principles

Unit IV: **The union executive, union parliament and Supreme Court**

Powers and positions of the president -qualification _method of election of president and vice president -prime minister -Rajya Sabah -Lok Sabah .the supreme court -high court -functions and position of supreme court and high court

Unit V: **State council -election system and parliamentary democracy in India**

State council of ministers -chief minister -election system in India-main features election commission-features of Indian democracy.

Outcome

CO1- To gain Democratic values and citizenship Training

CO2- To know the Awareness on fundamental Rights are established

CO3- To learn the functions of union Government and State Government

CO4- To learn the Power and functions of the Judiciary thoroughly

CO5- To learn the Appreciation of Democratic Parliamentary Rule

References:

1) Palekar.s.a. Indian constitution government and politics, ABD publications, India

2) Aiyer, alladi krishnaswami, Constitution and fundamental rights 1955.

3) Markandan. k.c.directive Principles in the Indian constitution 1966.

4) Kashyap. Subash c, Our parliament ,National book trust , New Delhi 1989

Course Code	Course Title	L	T	P	C
231LSCUV	Universal Human Values	-	-	-	1

Aim:

This course aims at making learners conscious about universal human values in an integral manner, without ignoring other aspects that are needed for learner's personality development.

Course Objectives :

The present course deals with meaning, purpose and relevance of universal human values and how to inculcate and practice them consciously to be a good human being and realiseone's potentials.

Course Content:

Unit I

- Introduction:What is love? Forms of love—for self, parents, family, friend, spouse, community, nation, humanity and other beings, both for living and non-living
- Love and compassion and inter-relatedness
- Love, compassion, empathy, sympathy and non-violence
- Individuals who are remembered in history for practicing compassion and love.
- Narratives and anecdotes from history, literature including local folklore
- Practicing love and compassion: What will learners learn gain if they practice love and compassion? What will learners lose if they don't practice love and compassion?
- Sharing learner's individual and/or group experience(s)
- Simulated Situations
- Casestudies

Unit II

- Introduction: What is truth? Universal truth, truth as value, truth as fact (veracity, sincerity, honesty among others)
- Individuals who are remembered in history for practicing thisvalue
- Narratives and anecdotes from history, literature including localfolklore
- Practicing Truth: What will learners learn/gain if they practice truth? What will learners lose if they don't practiceit?
- Learners' individual and/or group experience(s)
- Simulated situations
- Casestudies

Unit III

- Introduction: What is non-violence? Its need. Love, compassion, empathy sympathy for others as pre-requisites for non-violence
- Ahimsa as non-violence and non-killing
- Individuals and organisations that are known for their commitment to non-

violence

- Narratives and anecdotesaboutnon-violence from history,and literature including local folklore
- Practicingnon-violence: What will learners learn/gain if they practice non-violence? What will learners lose if they don't practice it?
- Sharing learner's individual and/or group experience(s) about non-violence
- Simulated situations
- Casestudies

Unit IV

- Introduction: What is righteousness?
- Righteousness and *dharma*, Righteousness and Propriety
- Individuals who are remembered in history for practicing righteousness
- Narratives and anecdotes from history, literature including local folklore
- Practicing righteousness: What will learners learn/gain if they practice righteousness? What will learners lose if they don't practice it?
- Sharing learners' individual and/or group experience(s)
- Simulated situations
- Casestudies

Unit V

- Introduction: What is peace? Its need, relation with harmony and balance
- Individuals and organisations that are known for their commitment to peace
- Narratives and Anecdotes about peace from history, and literature including local folklore
- Practicing peace: What will learners learn/gain if they practice peace? What will learners lose if they don't practice it?
- Sharing learner's individual and/or group experience(s) about peace
- Simulatedsituations
- Casestudies

Unit VI

- Introduction: What is service? Forms of service for self, parents, family, friend, spouse, community, nation, humanity and other beings—living and non-living, persons in distress ordisaster.
- Individuals who are remembered in history for practicing this value.
- Narratives and anecdotes dealing with instances of service from history, literature including local folklore
- Practicingservice: What will learners learn/gain gain if they practice service? What will learners lose if they don't practice it?
- Sharing learners' individual and/or group experience(s) regarding service
- Simulated situations
- Casestudies

Unit VII

- Introduction: What is renunciation? Renunciation and sacrifice. Self-restrainand

Ways of overcoming greed. Renunciation with action as true renunciation

- Individuals who are remembered in history for practicing this value.
- Narratives and anecdotes from history and literature,including local folklore about individuals who are remembered for their sacrifice and renunciation.
- Practicing renunciation and sacrifice: What will learners learn/gain if they practice Renunciation and sacrifice? What will learners lose if they don't practiceit?
- Sharing learners' individual and/or group experience(s)
- Simulated situations
- Casestudies

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Learn to introduce about Love and compassion and inter-relatedness	PO1
CO2	Know about universal human values and understand the importance of values in individual, social circles, career path, and national life.	PO1
CO3	Learn from case studies of lives of great and successful people who followed and practiced human values and achieved self-actualisation.	PO5,PO7
CO4	Become conscious practitioners of human values.	PO11, PO13
CO5	Realize their potential as human beings and conduct themselves properly in the ways of the world.	PO5,PO9

SEMESTER II

Course Code	Course Title	L	T	P	C
23110AEC21	**Tamil-II - பக்தி இலக்கியம்**	3	1	0	3

இரண்டாம் பருவம்

நோக்கம் :

- காலந்தோறும் பக்தி இலக்கியம் வளர்ந்துள்ள தன்மையைக் கற்பித்தல்.
- நாயன்மார்கள், ஆழ்வார்களின் பக்திச் சிறப்பை அறிய செய்தல்.

பயன்கள்:

CO1: நாயன்மார்கள் பக்திச் சிறப்பை அறிதல்.

CO2: ஆழ்வார்களின் பக்தி நெறியை உணர்தல்.

CO3: பக்தி இலக்கியம் காலம் தோறும் வளர்ந்ததே அறிதல்.

CO4: பாடல்களில் இசை இன்பம், ஓசை நயம் அறிதல்.

அலகு - 1 பன்னிரு திருமுறைகள்

1. திருஞானசம்பந்தர்- திருத்தில்லைப் பதிகம்
2. திருநாவுக்கரசர் - திருநீற்றுப் பதிகம்
3. சுந்தரர் - திருவெண்ணைநல்லூர்
4. திருமூலர்- திருமந்திரம்(இளமை நிலையாமை)

அலகு - 2 பன்னிரு ஆழ்வார்கள்

1. ஆண்டாள் - திருப்பாவை
2. பெரியாழ்வார்- மூன்றாம் திருமுறை(பத்து பாடல்கள்)
3. மதுரகவியாழ்வார் - கண்ணின் நுண் சிறு தாம்பு

அலகு - 3 சிற்றிலக்கியங்கள்

1. மீனாட்சியம்மைப் பிள்ளைத்தமிழ்- செங்கீரை பருவம், அம்புலி பருவம்
2. நந்திக்கலம்பகம்
3. குற்றால குறவஞ்சி- குறத்தி நகர்வளம் கூறுதல்
4. காளமேகப்புலவர் பாடல்கள்

அலகு - 4 புதினம்

1. நா .பார்த்தசாரதியின்- குறிஞ்சி மலர்

அலகு-5 தமிழ் இலக்கிய வரலாறு

1. பக்தி இலக்கியங்கள்
2. சைவமும் தமிழும்

3. வைணவ சமயம் போற்றி வளர்த்த தமிழ்
4. சிற்றிலக்கியங்கள்
5. நாவல் இலக்கியம்

பார்வை நூல்கள் :

1. தேவாரம் - மணிவாசகர் பதிப்பகம் சென்னை
2. நாலாயிர திவ்ய பிரபந்தம் - வர்த்தமான பதிப்பகம் சென்னை
3. தமிழ் இலக்கிய வரலாறு - முனைவர் ச சுபாஷ் சந்திர போஸ், இயல் வெளியீடு ,தஞ்சாவூர
4. தமிழ் நாவல் இலக்கியம் -கா கைலாசபதி- தமிழ் புத்தக,நிலையம், சென்னை

இணையதளம் - www.tamilvu.org, www.noolulagam.com

Course Code	Course Title	L	T	P	C
23111AEC21	Advanced English-II	3	1	0	3

Aim:

To improve communication skills in English

Course Objective:

To understand the format of e-mail, fax and memos

To write itinerary, checklist, invitation, circular, instruction, recommendations

To understand the impact of the biographies of famous people

Course Content:

Unit I

Introduction Test of vocabulary range; test of verbal speed; test of verbal responsiveness; affixation-

prefix, suffix; synonyms.

Unit II

Homonyms and homographsWords of foreign origin; antonyms; redundant words; phrases; acronyms; words commonly confused; slang and new words.

Unit III

Technical termsPersonality types; relationships; medicines; science; business, education, law, technology, and the humanities.

Unit IV

Vocabulary for professional examsTOEFL; IELTS; SAT; GRE; CAT; MAT; TANCET; BEC; GMAT

Unit V

Vocabulary games synonyms; antonyms; compound word; homophone; idioms; literature; oxymoron; parts of speech; prefix; suffix; root word; spelling; word play.

Outcome:

Developing technological skill

Able to write in a variety of formats

Read biographies and develop personality

Author	Title of the book	Edition / Year Publisher	Edition / Year Publisher
Meenakshi Raman & Sangeetha Sharma	Technical Communication	2011	Oxford University Press

Rajendra Pal & J.S.Korlahalli	Business Communication	2015	Sultan

Course Code	Course Title	L	T	P	C
23111AEC22	**Paper II - General English**	3	1	0	3

Course Objectives

CO1: To introduce learners to the essential skills of communication in English
CO2: To enable them use these skills effectively in academic and non-academic contexts
CO3: To enable them use these skills effectively in academic and non-academic contexts
CO4: To enable them use various business communication strategies and to use advanced vocabulary
CO5: To familiarize them in writing descriptive essays and respond to arguments orally and in writing

Course Content:

UNIT I :

Poetry

1.1Very Indian Poem in Indian English - Nissim Ezekiel
1.2 Still I Rise - Maya Angelou
1.3 On Killing a Tree - Gieve Patel

UNIT II :

Prose

2.1 If You Are Wrong Admit it- Dale Carnegie
2.2 Kindly Adjust Please - Shashi Tharoor
2.3 The Spoon-fed Age- W.R. Inge

UNIT III :

Fiction

Alchemist - Paulo Coelho

UNIT IV :

Language Competency

4.1 Homonyms, Homophones, HomographsPortmanteau words
4.2 Subject Verb Agreement

UNIT V :

English in the Workplace

5.1 Reading for General and Specific information [Charts, tables, schedules, graphs etc]
5.2 Reading news and weather reports
5.3 Writing paragraphs
5.4 Taking and making notes

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Learn to introduce themselves and talk about everyday activities confidently	PO1
CO2	Be able to write short paragraphs on people, places and events	PO1, PO2

CO3	Identify the purpose of using various tenses and effectively employ them in speaking and writing	PO4, PO6
CO4	Gain knowledge to write subjective and objective descriptions	PO4, PO5, PO6
CO5	Identify and use their skills effectively in formal contexts.	PO3, PO8

TextBooks(LatestEditions)	
1.	The Alchemist - Paulo CoelhoHarper – 2005

ReferencesBooks (Latest editions,and the style as given below must be strictly adhered to)	
1.	Advanced English Grammar. Martin Hewings. Cambridge University Press, 2000
2.	Descriptive English. SP Bakshi, Richa Sharma · 2019, Arihant Publications (India) Ltd.
3.	The Reading Book: A Complete Guide to Teaching Reading. Sheena Cameron, Louise Dempsey, S & L. Publishing, 2019.
4.	Skimming and Scanning Techniques, Barbara Sherman, Liberty University Press, 2014
5.	Brilliant Speed Reading: Whatever you need to read, however ...Phil Chambers, Pearson, 2013.
6.	The Archer, Paulo Coelho. Penguin Viking, 2020.

WebResources	
1.	Very Indian poem by Nissim Ezekiel http://econtent.in/pacc.in/admin/contents/40_%20_2020103001102714.pdf
2.	Still I Rise by Maya Angelou https://www.poetryfoundation.org/poems/46446/still-i-rise
3.	The Flower by Tennyson: https://www.poemhunter.com/poem/the-flower-2/
4.	On Killing a tree by Gieve Patel: https://www.poemhunter.com/poem/on-killing-a-tree/
5.	If you are wrong, admit it: https://www.tbr.fun/if-youre-wrong-admit-it/
6.	Kindly Adjust please - Shashi Tharoor https://www.theweek.in/columns/shashi-tharoor/2018/05/25/kindly-adjust-to-our-english.html?fbclid=IwAR3IhtdXqvuV4ySECn9S7SA6HmCEYISyd1QHd3BlwKgiNKKwdkeSg3qWp-U/
7.	The Spoon Fed Age: https://www.nrkacademy.com/2016/04/spoon-feeding-by-wringe.html
8.	The Alchemist: https://www.youtube.com/watch?v=lxBYpmxjeDU

Mapping with Programme Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	2	3	3	2	2	2
CO3	3	3	3	2	3	3	3	2	3	2
CO4	3	3	3	3	3	3	3	2	2	2

CO5	3	2	3	3	3	3	3	2	2	3

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	**PSO 1**	**PS O2**	**PS O3**	**PS O4**	**PS O5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Course Code	Course Title	L	T	P	C
23116AEC23	Microbial Physiology and Metabolism	4	1	0	3

Course Objectives

CO1: Study the basic principles of microbial growth.
CO2: Understand the basic concepts of aerobic and anaerobic metabolic pathways.
CO3: Analyze the role of individual components in overall cell function.
CO4: Provide information on sources of energy and its utilization by microorganisms.
CO5: Study the different types of metabolic strategies.

Course Content:

UNIT I:

Physiology of microbial growth: Batch – continuous - synchronous cultures; Growth Curve and measurement method (turbidity, biomass, and cell count). Control of microbial growth.

UNIT II:

Nutrition requirements - Photoautotrophs, Photoorganotrophs, Chemolithotrophs (Ammonia, Nitrite, Sulfur, Hydrogen, Iron oxidizing Bacteria), Chemoorganotrophs. Nutrition transport mechanisms – Passive diffusion and Active transport. Factors affecting microbial growth.

UNIT III:

An overview of Metabolism - Embden Meyerhof Pathway, Entner-Doudoroff Pathway, Pentose Phosphate Pathway, Tricarboxylic Acid Cycle. Electron Transport Chain and Oxidative Phosphorylation. ATP synthesis. Fermentation-Homolactic Fermentation, Heterolactic Fermentation, Mixed Acid Fermentation, Butanediol Fermentation.

UNIT IV:

Photosynthesis - An Overview of chloroplast structure. Photosynthetic Pigments, Light Reaction-Cyclic and non-cyclic Photophosphorylation. Dark Reaction - Calvin Cycle.

UNIT V:

Bacterial reproduction - Binary fission, Budding, Reproduction through conidia, cyst formation, endospore formation. Fungi asexual and sexual reproduction, Microalgae reproduction. Asexual and sexual reproduction of protozoa.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Describe microorganisms based on nutrition.	PO6, PO9
CO2	Know the concept of microbial growth and identify the factors affecting bacterial growth.	PO6, PO7, PO9
CO3	Explain the methods of nutrient uptake.	PO6, PO9

CO4	Describe anaerobic and aerobic energy production.	PO6, PO9
CO5	Elaborate on the process of bacterial photosynthesis and reproduction.	PO6, PO9

Text Books	
1	Schlegal, H.G. (1993). General Microbiology.,7th Edition, Press syndicate of the University of Cambridge.
2	RajapandianK.(2010). Microbial Physiology, Chennai: PBS Book Enterprises India.
3	MeenaKumari. S. Microbial Physiology, Chennai 1st Edition MJP Publishers 2006.
4	Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co.
5	S. Ram Reddy, S.M. Reddy (2008). Microbial Physiology. Anmol Publications Pvt Ltd.
References Books	
1	Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.
2	Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.
3	Daniel R. Caldwell. (1995). Microbial Physiology & Metabolism Wm.C. Brown Communications, Inc. USA.
4	Moat, A.G and J.W Foaster (1995). Microbial Physiology, 3rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications.
5	BhanuShrivastava. (2011). Microbial Physiology and Metabolism: Study of Microbial Physiology and Metabolism. Lambert academic Publication.
Web Resources	
1	https://sites.google.com/site/microbial physiologyoddsem/teaching-contents
2	https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition
3	https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
4	http://web.iitd.ac.in/~amittal/2007_Addy_Enzymes_Chapter.pdf
5	https://www..frontiersin.org.microbial-physiology-and-metabolism

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1						M			M		
CO2						M	L		M		
CO3						M			M		
CO4						M			M		
CO5						M			M		

Course Code	Course Title	L	T	P	C
23115GEC24	Bio Instrumentation	4	1	0	3

Course Objectives:

CO1: Understand the analytical instruments and study the basic principles in the field of sciences.
CO2: To gain knowledge about principles of spectroscopy
CO3: Understand the analytical techniques of Chromatography and electrophoresis
CO4: To understand the principle of different types of scans used in medical diagnosis
CO5: To gain information about the principles of radioactivity and its measurements

Course Content:

UNIT I:

Basic instruments: pH meter, Buffer of biological importance, Centrifuge- Preparative, Analytical and Ultra, Laminar Air Flow, Autoclave**,** Hot Air Oven and Incubator. Biochemical calculations-preparations of Molar solutions - Buffers- Phosphate, Acetate, TE, TAE- calculation of Normality ,PPM- Ammonium sulphate precipitation.

UNIT II:

Spectroscopic Techniques: Spectroscopic Techniques: Colorimeter, Ultraviolet and visible, Infra red and Mass Spectroscopy.

UNIT III:

Chromatographic and Electrophoresis Techniques: Chromatographic Techniques: Paper, Thin Layer, Column, HPLC and GC. Electrophoresis Techniques: Starch Gel, AGE, PAGE.

UNIT IV:

Imaging techniques: Principle, Instrumentation and application of ECG, EEG, EMG, MRI, CT and PET scan radioisotopes.

UNIT V:

Fluorescence and radiation based techniques: Spectrofluorimeter, Flame photometer, Scintillation counter, Geiger Muller counter, Autoradiography.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Gain knowledge about the basics of instrumentation.	PO1,PO4,PO11
CO2	Exemplify the structure of atoms and molecules by using the principles of spectroscopy.	PO4,PO10,PO11
CO3	Evaluate by separating and purifying the components.	PO4,PO7,PO11
CO4	Understand the need and applications of imaging techniques.	PO7,PO8,PO11

CO5	Categorize the working principle and applications of fluorescence and radiation.	PO10,PO11

Text Books	
1.	Jayaraman J (2011). Laboratory Manual in Biochemistry, 2nd Edition. Wiley Eastern Ltd., New Delhi .
2.	Ponmurugan. P and Gangathara PB (2012). Biotechniques.1st Edition. MJP publishers.
3	Veerakumari, L (2009).Bioinstrumentation- 5 th Edition -.MJP publishers.
4	Upadhyay, Upadhyay and Nath (2002). Biophysical chemistry – Principles and techniques 3rd Edition. Himalaya publishing home.
5	Chatwal G and Anand (1989). Instrumental Methods of Chemical Analysis. S.Himalaya Publishing House, Mumbai.
References Books	
1	Rodney.F.Boyer (2000). Modern Experimental Biochemistry, 3rd Edition. Pearson Publication.
2	SkoogA.,WestM (2014). Principles of Instrumental Analysis – 14th Edition W.B.SaundersCo.,Philadephia.
3	N.Gurumani. (2006). Research Methodology for biological sciences- 1st Edition – MJP Publishers .
4	Wilson K, and Walker J (2010). Principles and Techniques of Biochemistry and Molecular Biology.7th Edition. Cambridge University Press .
5	Webster, J.G. (2004). Bioinstrumentation- 4th Edition - John Wiley & Sons (Asia) Pvt. Ltd, Singapore.
Web Resources	
1	http://www.biologydiscussion.com/biochemistry/centrifugation/centrifugeintroduction-types- uses-and-other-details-with-diagram/12489
2	https://www.watelectrical.com/biosensors-types-its-working-andapplications/
3	http://www.wikiscales.com/articles/electronic-analytical-balance/ Page 24 of 75
4	https://study.com/academy/lesson/what-is-chromatography-definition-typesuses.html
5	http://www.rsc.org/learn-chemistry/collections/spectroscopy/introduction

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L			M							S
CO2				L						M	S
CO3				L			M				S
CO4							S	S			S
CO5										M	S

Course Code	Course Title	L	T	P	C
23116SEC25L	Microbial Physiology and Metabolism Lab	0	0	3	3

Course Objectives

CO1: Understand the principles of motility tests.

CO2: Understand the basic concepts of staining methods.

CO3: Learn the bacterial count using different methods and anaerobic culture.

CO4: Study the morphological demonstration of microorganisms and identification.

CO5: Study the biochemical identification of the bacteria.

Course Content:

UNIT I:

Motility demonstration: hanging drop, wet mount preparation, semi-solid agar, Craigie's tube method. Staining techniques: Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining

UNIT II:

Direct counts – Direct cell count (Petroff-Hausser counting chamber), Turbidometry. Viable count - pour plate, spread plate.

Bacterial growth curve.

UNIT III:

Anaerobic culture methods. Antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains.

UNIT IV:

Morphological variations in algae, fungi and protozoa. Micrometry: Demonstration of the size of yeast, fungal filaments and protozoa.

UNIT V:

Methods of bacterial identification- morphological, physiological, and biochemical methods - IMViC test, H2S, TSI, Oxidase, catalase, urease test, and Carbohydrate fermentation test. Maintenance of pure culture, paraffin method, stab culture, maintenance of mold culture.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Describe hanging drop, wet mount preparation, semi-solid agar, Craigie's tube method.	PO6, PO7, PO8, PO9, PO11
CO2	Demonstrate Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining.	PO6, PO7, PO8, PO9, PO11

CO3	Explain antibiotic sensitivity testing: Disc diffusion test- quality control with standard strains.	PO6, PO7, PO8, PO9, PO11
CO4	Describe demonstration of the size of yeast, fungal filaments and protozoa.	PO6, PO7, PO8, PO9, PO11
CO5	Elaborate on the bacterial identification- morphological, physiological, and biochemical methods.	PO6, PO7, PO8, PO9, PO11

Text Books	
1	James G Cappucino and N. Sherman MB (1996). A lab manual Benjamin Cummins, New York .
2	Kannan. N (1996).Laboratory manual in General Microbiology. Palani Publications.
3	Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.
4	Gunasekaran. P (2007). Laboratory manual in Microbiology. New age international publisher.
5	Elsa Cooper (2018). Microbial Physiology: A Practical Approach. Callisto Reference publisher.
References Books	
1	DavidWhite., James Drummond., Clay Fuqua (2012) Physiology and Biochemistry of Prokaryotes. 4th Ed. Oxford University Press, New York.
2	Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.
3	Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.
4	Dawes, I.W and Sutherland L.W (1992). Microbial Physiology (2nd edition), Oxford Blackwell Scientific Publications.
5	Moat, A.G and J.W Foaster, (1995). Microbial Physiology, 3rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications.
Web Resources	
1	https://sites.google.com/site/microbial physiologyoddsem/teaching-contents
2	https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition
3	https://onlinecourses.swayam2.ac.in/cec20_bt14/preview
4	https://www.studocu.com/microbial-physiology-practicals
5	https://www.agr.hokudai.ac.jp/microbial-physiology

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1						M	L	M	L		M
CO2						M	M	L	M		L
CO3						L	M	M	L		M
CO4						L	M	M	M		M
CO5						M	M	M	M		M

Course Code	Course Title	L	T	P	C
23115SEC26L	Bio Instrumentation Lab	0	0	3	3

Learning Outcomes:

CO1: To get the knowledge on the working principle of laboratory instruments.

CO2: To understand the procedure for the pH measurement.

CO3: To learn separation of amino acids and sugars using paper & thin layer chromatography

CO4: To understand how to estimate sugars, amino acids and sugars using spectroscopic techniques

CO5: To understand other instruments related to research.

Course Content:

UNIT I: Studies on pH titration curves of amino acids/ acetic acid and determination of pKavalues and Handerson-Hasselbach equation.

UNIT II: Separation of bacterial lipids/amino acids/sugars/ by TLC or Paper Chromatography.

UNIT III: Separation of serum protein by horizontal submerged gel electrophoresis.

UNIT IV: Study of UV absorption spectra of macromolecules (protein, nucleic acid,bacterial pigments).

UNIT V: Quantitative estimation of hydrocarbons/pesticides/organic Solvents /methane by Gas chromatography. (Demonstration) ,Demonstration of PCR, DNA sequencer, Fermenter, Flow cytometry

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Acquire knowledge on the working principle of laboratory instruments.	**PO1,PO4,PO11**
CO2	Understanding the procedure for the pH measurement.	**PO4,PO10,PO11**
CO3	Learn Separation of amino acids and sugars using paper & thin layer chromatography.	**PO4,PO7,PO11**
CO4	Understand how to estimate sugars, amino acids and sugars using spectroscopic techniques	**PO7,PO8,PO11**
CO5	Understanding other instruments related to research	**PO10,PO11**

Text Books	
1	Keith Wilson and John Walker 2002 practical biochemistry – Principles and techniques. Fifth edn.Cambridge Univ. Press.

2	P. Asokan 2002. Analytical biochemistry – Biochemical techniques. Firstedition– Chinnaa publications, Melvisharam, Vellore
3	Rodney Boyer, 2001. Modern Experimental Biochemistry.III Ed. Addison Wesley Longman Pte.Ltd, Indian Branch, Delhi, India
4	Chatterjea, M. N., &Shinde, R. (2011). Textbook of medical biochemistry. Wife GoesOn.
5	Lehninger, A. L. (2004). Lehninger Principles of Biochemistry: David L. Nelson, Michael M. Cox. Recording for the Blind &Dyslexic

References Books	
1	N. Gurumani 2010 Research Methodology for Biological Sciences.MJP Publishers,Chennai.
2	David T. Plummer 1988. An introduction to practical biochemistry, Tata McGraw Hill pub. Co. Ltd, New Delhi.
3	J. Jeyaraman 1981. Laboratory Manual in Biochemistry.New Age International publishers, New Delhi. ReferenceBooks
4	S. Palanichamy and M. Shunmugavelu 2009.Research methods in biological sciences.Palani paramount publications,Palani.
5	K. Kannan 2003 Hand book of Laboratory culture media, reagents, stains and buffers Panima publishing corporation, NewDelhi.
Web Resources	
1	http://www.biologydiscussion.com/biochemistry/centrifugation/centrifugeintroduction-types-uses-and-other-details-with-diagram/12489
2	https://www.watelectrical.com/biosensors-types-its-working-and-applications/
3	http://www.wikiscales.com/articles/electronic-analytical-balance/
4	https://study.com/academy/lesson/what-is-chromatography-definition-typesuses.html
5	http://www.rsc.org/learn-chemistry/collections/spectroscopy/introduction.

Course Code	Course Title	L	T	P	C
23116SEC27	Nutrition & Health Hygiene	2	0	0	2

Course Objectives

CO1: Learn about nutrition and their importance
CO2: Make students understand the nutritional facts for a better life.
CO3: Learn information to optimize our diet
CO4: Impart knowledge on different health care programs taken up by India
CO5: Learn knowledge on different health indicators and types of hygiene methods

Course Content:

UNIT I:

Nutrition – definition, importance, Good nutrition, and mal nutrition; Balanced Diet: Basics of Meal Planning. Carbohydrates, Lipids, Proteins and Vitamins –functions, dietary sources, effects of deficiency. Macro and micro minerals –functions, effects of deficiency; food sources of Calcium, Potassium, and Sodium; food sources of Iron, Iodine, and Zinc. Importance of water– functions, sources, requirements and effects of deficiency.

UNIT II:

Nutrition for Life Cycle: Balanced diet - Normal, Pregnant, lactating women, Infancy, young children Adolescents, Adults, and the Elderly; Diet Chart; Nutritive value of Indian foods.

UNIT III:

Improper diets: Definition, Identification, Signs and Symptoms - malnutrition, under-nutrition, over-nutrition, Protein Energy Malnutrition, obesity; Nutritional Disease and Disorder - hypertension, diabetes, anemia, osteomalacia, cardiovascular disease.

UNIT IV:

Health - Determinants of health, Key Health Indicators, Environment health & Public health; Health-Education: Principles and Strategies. Health Policy & Health Organizations: Health Indicators and National Health Policy of Govt. of India; Functioning of various nutrition and health organizations in India.

UNIT V:

Hygiene – Definition; Personal, Community, Medical and Culinary hygiene; WASH (Water, Sanitation and Hygiene) programme. Rural Community Health: Village health sanitation & Nutritional committee. Community & Personal Hygiene: Environmental Sanitation and Sanitation in Public places.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Learn the importance of nutrition for a healthy life	**PO5, PO6, PO7, PO8, PO10**

CO2	Study the nutrition for life cycle	**PO5, PO6, PO7, PO8, PO10**
CO3	Know the health care programmes of India	**PO5, PO6, PO7, PO8, PO10**
CO4	Learn the importance of community and personal health & hygiene measures	**PO5, PO6, PO7, PO10**
CO5	Create awareness on community health and hygiene	**PO5, PO6, PO7, PO10**

Text Books	
1.	Bamji, M.S., K. Krishnaswamy& G.N.V. Brahmam (2009) Textbook of Human Nutrition(3rd edition) Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
2.	Swaminathan (1995)Food &Nutrition(Vol I, Second Edition) The Bangalore Printing &Publishing Co Ltd., , Bangalore
3	SK. Haldar(2022). Occupational Health and Hygiene in Industry. CBS Publishers.
4	Acharya, Sankar Kr, Rama Das, Minati Sen (2021). Health Hygiene and Nutrition Perception and Practices.Satish Serial Publishing House
5	Dass (2021).Public Health and Hygiene, Notion Press
References Books	
1	VijayaKhader (2000)Food, nutrition & health, Kalyan Publishers, New Delhi
2	Srilakshmi, B., (2010)Food Science, (5^{th} Edition) New Age International Ltd., New Delhi
3	Arvind Kumar Goel (2005). A College Textbook of Health & Hygiene,ABD Publishers
4	Sharma D. (2015).Textbook on Food Science and Human Nutrition. Daya Publishing House.
5	Revilla M. K. F., Titchenal A. and Draper J. (2020). Human Nutrition. University of Hawaii, Mānoa.
Web Resources	
1	National Rural Health Scheme: https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=969&lid=49
2	National Urban Health Scheme: https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=970&lid=137
3	Village health sanitation & Nutritional committee https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=149&lid=225
4	Health Impact Assessment - https://www.who.int/hia/about/faq/en/
5	Healthy Living https://www.nhp.gov.in/healthylivingViewall

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO1 0	PO11
CO1					S	M	M	M		S	
CO2					S	M	M	M		S	

CO3					S	M	M	M		S	
CO4					S	S	L			S	
CO5					S	S	M			S	

Course Code	Course Title	L	T	P	C
23116SEC28	Sericulture	2	0	0	2

Course Objectives:

CO1: Acquire knowledge on the concepts of origin, growth and study of Sericulture as science and the scientific approach of the mulberry plant.

CO2: Describe the morphology and physiology of silkworm.

CO3: Discuss effective management of silkworm diseases.

CO4: Demonstrate field skills in mulberry cultivation and silkworm rearing with an emphasis on technological aspects.

CO5: Demonstrate entrepreneurship abilities, innovative thinking, planning, and setting up small-scale enterprises.

Course Content:

UNIT I:

General introduction to Sericulture, its distribution in India. Botanical distribution and taxonomical characters of mulberry varieties and species.Biology of Mulberry plant and Mulberry crop cultivation and protection.

UNIT II:

Silkworm- biology-morphology of silkworm. Life cycle of silkworm- egg, larva, pupa, and moth.

UNIT III:

Silkworm pathology: Introduction to Parasitism, Commensalism, Symbiosis and Parasite relationship - Mulberry Silkworm Diseases: Introduction, types, Pebrine, Grasserie, Muscardine, Flacherie, Symptoms and Pathogens, Mode of Infection, Prevention and Control -Non – mulberry silkworm diseases: Pebrine, Bacterial and viral diseases. Brief Account of Pests and Predators of Silkworms, Nature of damage and control measures.

UNIT IV:

Rearing of silkworms. Cocoon assessment and processing technologies. Value added products of mulberry and silkworms.

UNIT V:

Entrepreneurship and rural development in sericulture:Planning for EDP, Project formulation, Marketing, Insectary facilities and equipment: Location, building specification, air conditioning and environmental control, furnishings and equipment, sanitation and equipment, subsidiary facilities.

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Discuss the overall aspects of Sericulture and the biology and varieties of mulberry plant.Creates awareness among students about the economic importance and suitability of Sericulture in Indian conditions.	PO1,PO5,PO7
CO2	Familiarize with the lifecycle of silk worm.	PO1, PO2
CO3	Explain common diseases of silkworm encountered during rearing, sources of infection, disease symptoms, pre-disposing factors and their management practices.	PO1, PO5
CO4	Attain thorough knowledge about the cultivation of mulberry, maintenance of the farm, seed technology, silkworm rearing, post cocoon techniques like stifling, reeling, and utilization of by-products.	PO7, PO8, PO10
CO5	Plan the facilities required for establishment of insectary. Competent to transfer the knowledge and technical skills to the Seri-farmers.Analyze the importance of sericulture in entrepreneurship development and emerge as potential entrepreneur.	PO5, PO7, PO8

Text Books	
1	Ganga, G. and Sulochana Chetty (2010). Introduction to Sericulture,, J., Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
2	Dr. R. K. Rajan&Dr. M. T. Himantharaj(2005). Silkworm Rearing Technology, Central Silk Board, Bangalore.
3	Dandin S B, Jayant Jayaswal and Giridhar K (2010). Handbook of Sericulture technologies,Central Silk Board, Bangalore.
4	M. C. Devaiah, K. C. Narayanaswamy and V. G. Maribashetty(2010). Advances in Mulberry Sericulture,,CVG Publications, Bangalore
5	T.V.SatheandJadhav.A.D.(2021). Sericulture and Pest Management, Daya Publishing House.

References Books	
1	S. Morohoshi (2001). Development Physiology of Silkworms 2nd **E**dition, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi
2	Hamamura, Y (2001). Silkworm rearing on Artificial Diet. Oxford & IBH publishing Co., Pvt. Ltd. NewDelhi.
3	M.Johnson, M.Kesary (2019). Sericulture, 5th. Edition. Saras Publications.
4	Manisha Bhattacharyya (2019).Economics of Sericulture, Rajesh Publications.
5	Muzafar Ahmad Bhat, Suraksha Chanotra, Zafar Iqbal Buhroo, Abdul Aziz and Mohd. Azam (2020).A Textbook on Entrepreneurship Development Programme in Sericulture, IP Innovative Publication.

Web Resources	
1	https://egyankosh.ac.in › bitstream
2	https://archive.org › details › SericultureHandbook
3	https://www.academic.oup.com
4	https://www.sericulture.karnataka.gov.in
5	https://www.silks.csb.gov.in

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO1 0	PO11
CO1	S				S		S				
CO2	M				S						
CO3	S				S						
CO4							S	S		S	
CO5					S		S	S			

Course Code	Course Title	L	T	P	C
231AECCCMS	Communication English	2	0	0	2

Course Objectives :

This course has been developed with the following objectives:

CO1: Identify common communication problems that may be holding learner's back
CO2: Identify what their non-verbal messages are communicating to others
CO3: Understand role of communication in teaching-learning process
CO4: Learning to communicate through the digital media
CO5: Understand the importance of empathetic listening
CO6: Explore communication beyond language.

Unit I

- Techniques of effective listening
- Listening and comprehension
- Probing questions
- Barriers to listening

Unit II

- Pronunciation
- Enunciation
- Vocabulary
- Fluency
- CommonErrors

Unit III

Techniques of effective reading

Gathering ideas and information from a given text

- Identify the main claim of the text
- Identify the purpose of the text
- Identify the context of the text
- Identify the concepts mentioned

Evaluating these ideas and information

- Identify the arguments employed in the text
- Identify the theories employed or assumed into text

Interpret the text

- To understand what a text says
- To understand what a textdoes
- To understand what a text means

Unit IV

Clearly state the claims

Avoid ambiguity, vagueness, unwanted generalizations and over simplification of issues

Provide background information

Effectively argue the claim

Provide evidence for the claims

Use examples to explain concepts

Follow Convention

Be properly sequenced

Use proper signposting techniques

Be well structured

- Well-knit logical sequence
- Narrative Sequence
- Category Groupings

Different modesofWriting -

- E-mails
- Proposal writing for HigherStudies
- Recording the proceedings of meetings
- Any other mode of writing relevant for learners

Unit V

Role of Digital literacy in professional life

Trends and opportunities in using digital technology in workplace

InternetBasics

Introduction to MS Officetools

- Paint
- Office
- Excel
- Powerpoint

Unit VI

- Introduction to social media websites
- Advantages of social media
- Ethics and etiquettes of social media
- How to use Google search better
- Effective ways of using SocialMedia
- Introduction to DigitalMarketing

Unit VII

- Meaning of non-verbal communication
- Introduction to modes of nonverbal communication
- Breaking the misbeliefs
- Open and Closed Body Language
- Eye Contact and FacialExpression
- HandGestures

- Do's andDon'ts
- Learning from experts
- Activities-BasedLearning

Course Outcome :

By the end of this program participants should have a clear understanding of what good communication skills are and what they can do to improve their abilities.

Reference:

1. SenMadhucchanda (2010), *An Introduction to Critical Thinking*, Pearson,Delhi
2. Silvia P. J. (2007), *How to Read a Lot*, American Psychological Association, Washington DC

Course Code	Course Title	L	T	P	C
231SSCBE	Basic Behavioral Etiquette	-	-	-	1

Aim:

Aim of this program is Eliminating negative thought, developing enriching habits, unlocking individual potentials and well versed communication

Course Objectives:

Training is mainly focused on discipline, grooming, career planning and building personality. As it is the first year of university, students are given awareness about the job market right from the start so that they prepare accordingly at their own pace and potential.

Course Content:

- The module consists of
- Communication Skills
- Goal Setting
- Career Planning
- Reaching your Potential
- Time Management
- Stress Management
- Grooming and Discipline
- Learning skills
- Listening Skills
- Team Building

SEMESTER III

Course Code	Course Title	L	T	P	C
23110AEC31	Tamil-III - **காப்பிய இலக்கியம்**	3	1	0	3

மூன்றாம் பருவம்

பாடநோக்கம் :

- தமிழ்க் காப்பியங்களை அறிமுகப்படுத்துதல்.
- காப்பியங்கள் கூறும் வாழ்வியல் அறங்களை உணர்த்துதல்.
- காப்பிய இலக்கியங்களில் இலக்கியச் சுவையை பயிற்றுவித்தல்.
- நாடக இலக்கியத்தின் தனித்துவத்தைக் கற்பித்தல்.

பயன்கள் :

CO1 : இலக்கியங்களின் சிறப்புகளை அறிவர்.

CO2 : காப்பியக் கதைகள் வழி அறச் சிந்தனை பெறுவர்

CO3 : பல்வேறு காப்பிய வடிவங்களை பற்றிய அறிவு பெறுவர்.

CO4 : நாடக படைப்பாக்கத்திற்கான தூண்டுதலைப் பெறுவர்.

அலகு -1 காப்பியங்கள்

1. சிலப்பதிகாரம் - மதுரை காண்டம் (வழக்குரை காதை)
2. .மணிமேகலை - விழாவறை காதை
3. சீவக சிந்தாமணி - குணமாலையார் இலம்பகம்

அலகு -2 காவியங்கள்

1. கம்பராமாயணம்- மந்தரை சூழ்ச்சி படலம்
2. மகாபாரதம் - ஆரண்ய பருவம்

அலகு -3 புராணங்கள்

1. பெரியபுராணம்- இளையான்குடி மாற நாயனார் புராணம்
2. சீறாப்புராணம் - ஈத்தங்குழை வரவழைத்தப் படலம்
3. தேம்பாவணி- பிரிந்த மகனை காண்படலம்

அலகு-4 - நாடகம்

1. சாபம்? விமோசனம்

அலகு-5 இலக்கிய வரலாறு

1. காப்பியங்கள்
2. இரட்டைக் காப்பியங்கள்
3. நாடக இலக்கியம்

பார்வை நூல்கள் :

1. காப்பியத்திறன்- மணிவாசகர் நூலகம், சிதம்பரம்.
2. தமிழ் காப்பியங்கள் - கி. வா .ஜெகன் ஜெகநாதன் , அமுத நிலையம், சென்னை .
3 .நவீன நாடக உருவாக்கம் - கோ பழனி , தமிழ் பல்கலைக்கழகம், தஞ்சாவூர்.
4. மு.இராமசுவாமி, செண்பகம் இராமசுவாமி, பாவை பதிப்பகம்,ஜானிஜான் சாலை,சென்னை - 14

இணையதளம் -www.tamilvu.org ,www.noolulagam.com

Course Code	Course Title	L	T	P	C
23111AEC31	Advanced English-III	3	1	0	3

Course Objective:

To familiarize with the organs of speech and the description and classification of speech sounds
To understand consonant cluster, syllable, word accent and intonation.
To know how to interpret graphics
To write slogans and advertisements

Course Content:

UNIT-I

The Origins of Language
The natural sound source
The social interaction source
The physical adaptation source: teeth and lips, mouth
and tongue, larynx and pharynx

UNIT-II

The Sounds of Language -
Phonetics
Voiced and voiceless sounds
Place of articulation
Manner of articulation
Consonants, Vowels, Diphthongs

UNIT-III

The Sound Patterns of Language
Phonology
Phonemes: Natural classes
Syllables: Consonant clusters
Coarticulation effects: Assimilation, Nasalization,
Elision , Normal

UNIT-IV

Word formation -
Coinage, Acronyms, Derivation, Prefixes and suffixes,
Infixes, Multiple

UNIT-V

Syntax

Course Outcome:

- ❖ Understand phonetics

- ❖ Develop writing skill
- ❖ Able to develop creative writing

Author	Title of the book	Edition / Year	Publisher
T.B. Balasubramaniyan	A textbook of phoneticsfor Indian Students	Reprint 2008	Macmillian
Meenakshi Sharma & amp; Sangeetha Sharma	TechnicalCommunication	2011	Oxford University Press

Course Code	Course Title	L	T	P	C
23111AEC32	**English-III**	3	1	0	3

Course Objectives:

CO1: To enhance the level of literary and aesthetic experience of students and to help them respond creatively.

CO2: To sensitize them to the major issues in the society and the world.

CO3: To sensitize them to the major issues in the society and the world.

CO4: To equip them to utilize the digital knowledge resources effectively for their chosen fields of study.

CO5: To help them think and write imaginatively and critically.

Course Content:

UNIT I:

Poetry:

1.1 The Voice of the Mountains - Mamang Dai
1.2 A Song of Hope - Oodgeroo Noonuccal
1.3 In an Artist's Studio - Christina Rossetti

UNIT II:

Scenes From Shakespeare:

2.1 Romeo & Juliet -The Balcony Scene
2.2 Macbeth -Banquet Scene
2.3 Julius Caesar - Murder Scene

UNIT III:

Speeches of Famous personalities

3.1 Yes, We Can -Barack Obama
3.2 You've Got to Find What You Love -Steve Jobs

UNIT IV:

Language Competency

4.1 Writing letters and emails
4.2 Writing and messaging in social media platforms
[blogs, twitter, instagram.facebook]
4.3 Learning netiquette, email etiquette

UNIT V:

English for Workplace

5.1 Data Interpretation and Reporting
5.2 Data Presentation and analysis
5.3 Meeting Etiquettes - language, dress code, voice modulation.

Online Meetings - Terms and expressions used
5.4 Conducting and participating in a meeting

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Broaden their outlook and sensibility and be acquainted with cultural diversity and divergence in perspectives.	PO1
CO2	Be updated with basic informatics skills and attitudes relevant to the emerging knowledge society	PO1,PO2
CO3	Produce grammatically and idiomatically correct language.	PO4,PO6
CO4	Gain knowledge in writing techniques to meet academic and professional needs.	PO4,PO 5,PO6
CO5	Be equipped with sufficient practice in Vocabulary, Grammar, Comprehension and Remedial English from the perspective of career oriented tests.	PO3,PO 8

Text Books (Latest Editions)	
1	Arden Shakespeare Complete works by Shakespeare (Author), William (Author), Bloomsbury, 2011)
References Books (Latest Editions,and the style as given below must be strictly adhered to)	
1.	The Shakespeare Book: Big Ideas Simply Explained, Stanley Wells et al. DK Publishing, 2015
2.	Famous Speeches by Mahatma Gandhi, Createspace Independent Publishing Platform, 2016
3.	How to Build a Professional Digital Profile Kindle Edition by Jeanne Kelly Bernish, Bernish Communications Associates, LLC; 1st edition (May 29, 2012)
4.	Keys to Teaching Grammar to English Language Learners, Second Ed.: A Practical Handbook by Keith S Folse, Michigan Teacher Training, 2016.
5.	Role Play-Theory and Practice.Krysia M Yardley-Matwiejczuk, SAGE publications ltd, 1997

Web Resources	
1.	The Voice of the Mountains by Mamang Dai: https://www.scribd.com/document/558838656/The-Voice-of-the-Mountain-By-Mamang-Dai-Adivasi-Resurgence
2.	A song of Hope by Kath Walker: http://www.wordslikethis.com.au/a-song-of-hope/
	In an artist's studio by Christina Rossetti:

3.	https://www.poetryfoundation.org/poems/146804/in-an-artist39s-studio
4.	Sita by Toru Dutt: https://www.poetrynook.com/poem/s%E2%94%9C%C2%ABta
5.	Tryst with Destiny: https://www.cam.ac.uk/files/a-tryst-with-destiny/index.html#:~:text=Jawaharlal%20Nehru%2C%20delivering%20his%20Tryst%20with%20Destiny%20speech.&text=%22Long%20years%20ago%20we%20made,awake%20to%20life%20and%20freedom.
6.	Yes, We Can: https://www.englishspeecheschannel.com/english-speeches/barack-obama-speech/
7.	You've got to find what you love: https://www.businessbusinessbusiness.com.au/steve-jobs-youve-got-to-find-what-you-love/#:~:text=Steve%20Jobs%2C%20in%20his%20commencement,emphasizes%20on%20believing%20in%20oneself.

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	2	3	3	2	2	2
CO3	3	3	3	2	3	3	3	2	3	2
CO4	3	3	3	3	3	3	3	2	2	2
CO5	3	2	3	3	3	3	3	2	2	3

3 – Strong, 2 – Medium , 1 – Low

Mapping with Programme Specific Outcomes:

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Course Code	Course Title	L	T	P	C
23116AEC33	Molecular Biology and Microbial Genetics	4	1	0	3

Course Objectives:

CO1: Provide knowledge on structure and replication of DNA.

CO2: Illustrate the significance and functions of RNA in protein synthesis.

CO3: Explain the cause and types of DNA mutation and DNA repair mechanisms.

CO4: Outline the role of plasmids and phages in genetics.

CO5: Examine mechanisms of gene transfer and recombination.

Course Content:

UNIT I:

DNA Structure - Salient features of double helix, forms of DNA. Denaturation and renaturation. DNA topology – Supercoiling, linking number, topoisomerases. DNA organization in prokaryotes, viruses, eukaryotes. Replication of DNA in prokaryotes and eukaryotes - Bidirectional and unidirectional replication, semi-conservative and semi-discontinuous replication. Mechanism of DNA replication – enzymes involved – DNA polymerases, DNA ligase, primase. DNA replication modes - rolling circle, D-loop modes.

UNIT II:

Transcription in Prokaryotes. Concept of transcription. RNA Polymerases - prokaryotic and eukaryotic. General transcription factors in eukaryotes. Distinction between transcription processes in prokaryotes versus eukaryotes. Translation in prokaryotes and eukaryotes - Translational machinery - ribosome structure in prokaryotes and eukaryotes, tRNA structure and processing. Inhibitors of protein synthesis in prokaryotes and eukaryotes. Overview of regulation of gene expression - *lac*, *trp* and *ara* operons as examples. Regulation of gene expression by DNA methylation.

UNIT III:

Mutation - Definition and types - base substitutions, frame shifts, deletions, insertions, duplications, inversions. Silent, conditional, and lethal mutations. Physical and chemical mutagens. Reversion and suppression. Uses of mutations. Repair Mechanisms - Photoreactivation, Nucleotide Repair, Base Excision Repair, Methyl Directed Mismatch Repair and SOS Repair.

UNIT IV:

Plasmid replication and partitioning, host range, plasmid incompatibility, plasmid amplification, regulation of plasmid copy number, curing of plasmids. Types of plasmids – R Plasmids, F plasmids, colicinogenic plasmids, metal resistance plasmids, Ti plasmid, linear plasmids, yeast 2µ plasmid. Bacteriophage-T4, Virulent Phage – Structure and lifecycle. Lambda phage-Structure, Lytic and Lysogenic cycle. Applications of Phages in Microbial Genetics.

UNIT V:

Gene Transfer Mechanisms- Conjugation and its uses. Transduction - Generalized and Specialized, Transformation - Natural Competence and Transformation. Transposition and Types of Transposition reactions. Mechanism of transposition: Replicative and non- replicative transposition. Transposable elements - Prokaryotic transposable elements – insertion sequences, composite, and non-composite transposons. Uses of transposons.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Analyze the significance of DNA and elucidate the replication mechanism.	PO4, PO5, PO7,PO9
CO2	Illustrate the types of RNA and protein synthesis machinery.	PO4, PO7,PO9
CO3	Infer the causes and types of DNA mutation and summarize the DNA repair mechanisms.	PO5, PO7,PO9
CO4	Evaluate the importance of plasmids and phages in genetics.	PO7,PO9
CO5	Analyze gene transfer and recombination methods.	PO5, PO6, PO7,PO9

Text Books	
1.	Malacinski G.M. (2008). Freifelder's Essentials of Molecular Biology. 4th Edition. Narosa Publishing House, New Delhi.
2.	Gardner E. J. Simmons M. J. and SnustedD.P.(2006). Principles of Genetics. 8th Edition. Wiley India Pvt. Ltd.
3.	Trun N. and Trempy J. (2009). Fundamental Bacterial Genetics. 1st Edition. Blackwell Science Ltd.
4.	Brown T. A. (2016). Gene Cloning and DNA Analysis- An Introduction. (7th Edition). John Wiley and Sons, Ltd.
5.	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.

References Books	
1.	Glick B. R. and Patten C.L. (2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press.

2.	Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition., Pearson New International edn.
3.	Nelson, D.L. and Cox, M.M. Lehninger(2017). Principles of Biochemistry. 7th Edition, W.H. Freeman.
4.	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.
5.	Primrose S.B. and Twyman R. M. (2006). Principles of Gene Manipulation and Genomics. (7th Edition). Blackwell Publishing

Web Resources	
1.	[PDF] Lehninger Principles of Biochemistry (8th Edition) By David L. Nelson and Michael M. Cox Book Free Download - StudyMaterialz.in
2.	https://microbenotes.com/gene-cloning-requirements-principle-steps-applications/
3.	https://courses.lumenlearning.com/boundless-biology/chapter/dna-replication/
4.	Molecular Biology Notes - Microbe Notes
5.	Molecular Biology Lecture Notes & Study Materials | Easy Biology Class

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				S	S	M	S	M	S	M	
CO2				S	M	M	S	M	S	L	
CO3				M	S	M	S	M	S	L	
CO4				M	M	M	S	M	S	L	
CO5				M	S	S	S	M	S	L	

Course Code	Course Title	L	T	P	C
23116GEC34	Clinical Laboratory Technology	4	1	0	3

Course Objectives:

CO1: Demonstrate ethical and professional conduct with patients, laboratory personnel, health-care professionals, and the public.

CO2: Explain how accurate and reliable information might be obtained about proper procurement, storage, and *handling* of laboratory *specimens*.

CO3: Develop a sound scientific knowledge foundation that prepares them to interpret, analyze and evaluate scientific knowledge in clinical practice.

CO4: Perform a full range of laboratory tests with accuracy and precision.

CO5: Establish quality assurance principles and practices to ensure the accuracy and reliability of laboratory information.

Course Content:

UNIT I:

Introduction to Clinical Laboratory Science: Basic laboratory principles - Code of conduct for medical laboratory personnel -Organization of clinical laboratory and role of medical laboratory technician - Safety measures. Assessment of a patient and brief history of collection. Maintenance of Hygiene & Infection Control Practices.

UNIT II:

Specimen collection and processing - Blood, urine, stool, sputum CSF, amniotic fluid and bile. Separation of serum and plasma, Handling of specimens for testing, preservation of specimens, transport of specimens and factors affecting the clinical results.

UNIT III:

Introduction to histopathology-Methods of examination of tissues and cells, Fixation of tissues: Classification and properties of fixatives. Tissue processing - Collection of specimens, Labeling and fixation, Dehydration, Clearing, Impregnation, Embedding - Paraffin block making, Section Cutting, Microtomes – types and mounting of sections.

UNIT IV:

Introduction to Haematology- Laboratory methods used in the investigation of coagulation disorders - coagulation tests , Routine coagulation tests, (prothrombin time , plasma recalcification time,partial thromboplastin time , activated partial thromboplastin time, thrombin time), Laboratory diagnosis of bleeding disorders. Estimation of fibrinogen, Assay of coagulation factors.

UNIT V:

Quality Standards in Health Laboratories – Development and implementation of standards, Accreditation Boards –NABL, ISO, CAP, COLA, Performing quality assessment - pre-analytical, analytical, and post-analytical phases of testing.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Describe characteristics of laboratory organizations and demonstrate professionalism by displaying professional conduct, model ethical behavior and operate as a vital member of the medical lab team. Practice safety or infection control procedures in the clinical laboratory, properly use safety equipment and maintain a clean, safe work environment.	PO3, PO11
CO2	Accurately collect specimens for various purposes. Determine appropriate tests based on test request, Maintain standard and transmission-based precautions, Engage in the scientific process by understanding the principles and practices of clinical study design, implementation, and dissemination of results.	PO5, PO6, PO11
CO3	Identify the basic structure of cells, tissues and organs and describe their contribution to normal function. Interpret light and electron microscopic histological images and identify the tissue source and structures. Relate and recognize the histological appearance of affected tissues to the underlying pathology.	PO6, PO8, PO9, PO11
CO4	Recognize the pathologies behind benign and malignant disorders of erythrocytes, leucocytes, thrombocytes and familiar with the diagnosis, evaluation, and management of hematologic malignancies.	PO5, PO6, PO9, PO11
CO5	Interpret, implement, and complying with laws, regulations and accrediting standards and guidelines of relevant governmental and non-governmental agencies.	PO1,PO 10

Text Books	
1.	Mukharji,K.L. (2000).Medical Laboratory Techniques, Vol - I, II & III, 5th Edition. Tata McGrawHill, Delhi.
2.	Ochei,A., Kolhatkar.A. (2000).Medical Laboratory Science: Theory and Practice, McGraw Hill Education.
3	RamnikSood (2015).Concise Book of Medical Laboratory Technology: Methods and Interpretation, 2nd Edition, Jaypee Brothers Medical Publishers, NewDelhi.
4.	S. Ramakrishnan, KN Sulochana(2012). Manual of Medical Laboratory Techniques,Jaypee Brothers Medical Publishers Pvt. Ltd
5.	Talib V.H. (2019).Handbook Medical Laboratory Technology, 2nd Edition, Directorate of health services, Government of India.

References Books	
1	Rutherford, B.H. Gradwohl , A.C. Sonnenwirth L. Jarett. Gradwohls. (2000). Clinical Laboratory Methods and Diagnosis, Vol-I, 8th edition, Mosby.
2	Baker, F.J., Silverton, R.E., and Pallister,.J. (1998). An Introduction to Medical Laboratory Technology, 7th Edition, CBS Publishers and Distributors Pvt. Ltd.

3	Godkar (2021).Textbook of Medical Laboratory Technology, 3rd Edition, Bhalani Publishing House.
4	M.N.Chatterjee and RanaShinde.(2008). Textbook of Medical Biochemistry, 7th Edition, Jaypee Brothers Medical Publishers Pvt. Limited.
5	James G Cappucino. and Natalie Sherman. (2016). Microbiology – A laboratory manual. (5th Edition). The Benjamin publishing company. New York.

Web Resources	
1	https://www.jaypeedigital.com › book
2	https://www.pdfdrive.com › wintrobes-clinical-hematology
3	https://currentprotocols.onlinelibrary.wiley.com/doi/pdf/10.1002/cpet.5
4	https://vlab.amrita.edu/index.php?sub=3&brch=272
5	https://nptel.ac.in/courses/102105087

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11
CO1			M								S
CO2					M	S					S
CO3						S		S		S	S
CO4					M	S			S		S
CO5	M									M	

Course Code	Course Title	L	T	P	C
23116SEC35L	Molecular Biology and Microbial Genetics Lab	0	0	3	3

Course Objectives:

CO1: Provide knowledge on structure and replication of DNA.

CO2: Elucidate the methods of Genomic and Plasmid DNA isolation.

CO3: Explain methods of protein separation.

CO4: Explain artificial transformation method.

CO5: Outline the role of phages in genetics.

Course Content:

UNIT I:

- Study of different types of DNA and RNA using micrographs and model / schematic representations.
- Study of semi-conservative replication of DNA through micrographs / schematic representations.

UNIT II:

- Isolation of Genomic and Plasmid DNA from *E. coli* and Analysis by Agarose gel electrophoresis.
- Estimation of DNA using colorimeter (diphenylamine reagent), UV spectrophotometer (A260 measurement).

UNIT III:

- Resolution and visualization of proteins by polyacrylamide gel electrophoresis (SDS-PAGE) – Demonstration.
- UV induced auxotrophic mutant production and isolation of mutants by replica plating technique – Demonstration.

UNIT IV:

- Perform artificial Transformation in *E. coli*.
- Isolation of antibiotic resistant mutants by gradient plate method. - Demonstration

UNIT V:

- Screening and isolation of phages from sewage.
- Perform RNA isolation.
- Estimate RNA.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Illustrate different types of DNA and RNA.	PO4, PO7, PO9, PO11
CO2	Utilize hands-on training in isolation of genomic and plasmid DNA.	PO4, PO7, PO9, PO11
CO3	Analyze importance of experimental microbial genetics.	PO4, PO7, PO9, PO11
CO4	Apply the knowledge of molecular techniques in various fields.	PO4, PO7, PO9, PO11
CO5	Investigate the significance of Phages.	PO4, PO7, PO9, PO11

Text Books	
1.	Crichton. M. (2014). Essentials of Biotechnology. Scientific International Pvt Ltd.New Delhi.
2.	Sambrook J. and Russell D.W. (2001). Molecular Cloning - A Laboratory Manual – 7th Edition. Cold Spring Harbor, N.Y: Cold Spring Harbor Laboratory Press.
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.	Gunasekaran P. (2007). Laboratory Manual in Microbiology. New Age International.
5.	James G Cappucino. and Natalie Sherman. (2016). Microbiology – A laboratory manual. (5th Edition). The Benjamin publishing company. New York.

References Books	
1	Glick B. R. and Patten C.L. Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press. 2018.
2	Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition., Pearson New International edn.
3	Nelson, D.L. and Cox, M.M. Lehninger(2017). Principles of Biochemistry. 7th Edition, W.H. Freeman.
4	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.
5	Brown T.A. (2016). Gene Cloning and DNA Analysis. (7th Edition). John Wiley and Jones, Ltd.
Web Resources	
1	https://www.molbiotools.com/usefullinks.html
2	(PDF) Molecular Biology Laboratory manual (researchgate.net)
3	https://www.molbiotools.com/usefullinks.html
4	https://geneticgenie.org3.
5	https://currentprotocols.onlinelibrary.wiley.com/doi/pdf/10.1002/cpet.5

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				S	L	M	S	M	S	M	S
CO2				S	L	M	S	M	S	M	S
CO3				S	L	M	S	M	S	M	S
CO4				S	L	M	S	M	S	M	S
CO5				S	L	M	S	M	S	M	S

Course Code	Course Title	L	T	P	C
23116SEC36L	Clinical Laboratory Technology Lab	0	0	3	3

Course Objectives:

CO1:Tofocus on basic concepts in biosafety

CO2: To get the knowledge of RBC, WBC and Platelets

CO3: To understanding the basic steps for tissue processing

CO4: To understand the estimation of glucose,albumin, Serum cholesterol in blood.

CO5: To get the knowledge of examination of urine

Course Content:

UNIT I:

- Bio safety Precautions and Guidelines- Disinfection practices in laboratory and wards- Assay for disinfection- Preparation of various reagents

UNIT II:

- Cell Counts- RBC, WBC and Platelets - Coomb's test- Staining of Blood Smear (Leishman Staining) - Bleeding and clotting time- Erythrocyte sedimentation rate

UNIT III:

- Basic steps for tissue processing - fixing, embedding, microtome, staining (Hematoxylin eosin stain) and mounting methods (Demonstration)

UNIT IV:

- Estimation of Glucose, albumin, Serum cholesterol in blood.

UNIT V:

- Physical examination of urine- Chemical Examination of urine- Sugar, Proteins, Ketone Bodies and Bile pigments

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Focus on basic concepts in biosafety	PO4, PO7, PO9, PO11
CO2	Study about Cell Counts- RBC, WBC and Platelets	PO4, PO7, PO9, PO11
CO3	Learn basic steps for tissue processing	PO4, PO7, PO9, PO11
CO4	Estimation of Glucose, albumin, Serum cholesterol in blood.	PO4, PO7, PO9, PO11
CO5	Study the Physical examination of urine	PO4, PO7, PO9, PO11

Text Books	
1.	Gradwohls, 2000. Clinical Laboratory Methods and Diagnosis. (ed) Ales C. Sonnenwirth and leonardjarret, M.D.B.I., NewDelhi.

References Books	
1	Kaplan, Clinical Chemistry, Mosby Company, St. Louis Washington, D.C. Toronto
2	Teitz, Clinical Chemistry. W.B. Saunders Company Harcourt (India) Private Limited NewDelhi.
3	Biochemistry, U. Satyanarayan, Books and Allied (P) Ltd.Kolkata-India
4	Mukharji, Medical Laboratory Techniques, Vol - I, II & III, 5th Edn. Tata McGrawHill,Delhi.
5	RamanicSood, Laboratory Technology (Methods and interpretation) 4th Ed. J.P. Bros, NewDelhi
Web Resources	
1	https://www.uchealth.org/professionals/uch-clinical-laboratory/specimen- collectinghandling-guide/specimen-collection-procedures/
2	**https://www.rcpath.org/discover-pathology/news/fact-sheets/haematology.html**
3	https://labtestsonline.org/tests/urinalysis4.https://www.nablindia.org/nabl/index.php?c=publicaccredationdoc&m=index&docType=both&Itemid=199

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				S	L	M	S	M	S	M	S
CO2				S	L	M	S	M	S	M	S
CO3				S	L	M	S	M	S	M	S
CO4				S	L	M	S	M	S	M	S
CO5				S	L	M	S	M	S	M	S

Course Code	Course Title	L	T	P	C
23116SEC37	Microbial marketable products	2	0	0	2

Course Objectives:

CO1: Impart knowledge about the significance of organic farming and strategies to increase the yield to conserve the environment..

CO2: To encourage organic farming in urban areas.

CO3: Comprehensive knowledge about bacterial biofertilizers, its advantages and future perspective.

CO4: Structure and characteristic features ofCyanobacteria and fungal biofertilizer

CO5: Develop the knowledge and skill to produce, analyze the quality of packaging, storage and assess the shelf life and bioefficacy of biofertilizers.

Course Content:

UNIT I:

Principle of organic farming: principles of health, fairness, ecological balance, and care.Environmental benefits of organic farming: sustainability- reduces non-renewable energy by decreasing agrochemical need. Biodiversity-crop rotation, inter-cropping. Ecological services – biological control, soil formation and nutrient cycling

UNIT II:

Organic farming for urban space; Create a Sustainable Organic Garden (Backyard- Square Foot Gardening, Small Space Gardening, Mini Farming) Composting, Vermicomposting

UNIT III:

Biofertilizers: Introduction, advantages and future perspective. Structure and characteristic features of bacterial biofertilizers- *Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium* and *Frankia*

UNIT IV:

Structure and characteristic features ofCyanobacterialbiofertilizers- *Anabaena, Nostoc* ;Structure and characteristic features of fungal biofertilizers- AM mycorrhiza

UNIT V:

Production of *Rhizobium, Azotobacter, Anabena*; Biofertilizers -Storage, shelf life, quality control and marketing

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Acquire the knowledge about *Spirullina* and its cultivation	PO1, PO2, PO7, PO8, PO10
CO2	Gain in depth knowledge about edible mushroom and its cultivation	PO1, PO5, PO10
CO3	Acquire a thorough understanding of the importance of probiotics in human health and their production on a large scale	PO1, PO5, PO7, PO8, PO10

CO4	Get an awareness of the availability of natural pigment and its application, Bio fertilizers and their application	PO1, PO5, PO7, PO8, PO10
CO5	Imbibe knowledge on the various marketing strategy such as patenting, trade mark, marketing, license procurement etc	PO1, PO5, PO7, PO8, PO10

Text Books	
1.	. Whitton, B. A. and potts, M. (2000). The ecology of cyanobacteria: their diversity in time and space. Kluwer Academic publisher,Dordrecht.
2.	Dubey, R.C. 2018. Text book of Biotechnology. S.Chand& company Ltd., New Delhi.
3.	Trivedi P.C. 2001. Algalbiotechnology.
4.	Fritsch, F.E. (1935) The Structure and Reproduction of the Algae ; Volume 1, First Edition . Cambridge UniversityPress
5.	Fritsch F. E. (1952) The Structure and Reproduction of the Algae ; Volume 2, First Edition. Cambridge UniversityPress.
References Books	
1	Masanobu Fukuoka, Frances Moore Lappe Wendell Berry (2009). The One-Straw Revolution: An Introduction to Natural Farming, 1st edition, YRB Classics.
2	SujitChakrabarty(2018). Organic Home Gardening Made Easy, 1st Edition,
3	Singh and Purohit (2008). Biofertilizer technology. Agrobios, India.
4	Bansal M (2019). Basics of Organic Farming CBS Publisher.
5	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.

Web Resources:

1. https://www.agrifarming.in/growing-spirulina
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6463069/
3. https://www.wincloveprobiotics.com/quality/production-process
4. https://www.frontiersin.org/articles/10.3389/fnut.2019.00007/full

Mapping with Programme Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	S	S					S	S		S	
CO2	S				S					S	
CO3	S				S		S	S		S	
CO4	S				S		S	S		S	
CO5	S				S		S	S		S	

Course Code	Course Title	L	T	P	C
23116SEC38	Aquaculture	2	0	0	1

Course Objectives:

CO1: Provide a deeper knowledge in aquaculture systems and methods.

CO2: Explain the significance and functions of design, types and construction of aquaculture ponds.

CO3: Demonstrate the biological characteristics of various aquaculture species.

CO4: Discuss the methods involved in post stocking management.

CO5: Illustrate major cultivable species for aquaculture.

Course Content:

UNIT I:

Aquaculture Systems and Methods - Scope and definition. Traditional, extensive, semi - intensive and intensive culture. Monoculture, polyculture, composite culture, mixed culture, mono-sex culture, cage culture, pen culture, raft culture, raceway culture.

UNIT II:

Aquaculture Engineering - Design and construction of pond, lay-out and design of aquaculture farm, construction, water intake system, drainage system - aeration and aerators. Ponds - Types of ponds.

UNIT III:

Selection of Species - Biological characteristics of aquaculture species; economic and market considerations; seed resources, collection and transportation. Pre-Stocking Management-Sun drying, ploughing / tilling, desilting, liming and fertilization, eradication of weed fishes. Stocking - Acclimatization of seed and release - species combinations - stocking density and ratio.

UNIT IV:

Post Stocking Management - Water and soil quality parameters required for optimum production, control of aquatic weeds and aquatic insects, algal blooms and microorganisms. Food conversion ratio (FCR). Growth - Measurement of growth, length - weight relationship.

UNIT V:

Major cultivable species for aquaculture –Culture of Indian Major Carps. Culture of Giant freshwater prawn, *Macrobrachiumrosenbergii* - seed collection formation sources. Hatchery management. Culture of tiger shrimp, *Penaeusmonodon* and *LitopenaeusVannamei.* Culture of pearl

oysters. Culture of seaweeds. Methods of Crab culture. Culture of ornamental fishes. Culture of Molluscs.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Analyze the significance and importance of aquaculture	PO4, PO5, PO7,PO9
CO2	Illustrate the types and construction of aquaculture ponds	PO4, PO7,PO9
CO3	Analyze the biological characteristics of species and choose the best species for aquaculture.	PO5, PO7,PO9
CO4	Follow methods involved for optimal growth of aquaculture species	PO7,PO9
CO5	Summarize major species suitable for aquaculture in a particular environment	PO5, PO6, PO7,PO9

Text Books	
1.	Santhanam, R. Velayutham, P. Jegatheesan, G. A (2019).Manual of Freshwater Ecology: An Aspect of Fishery Environment. Daya Publishing House, New Delhi.
2.	Stickney, R.R. (2016). Aquaculture: An Introductory Text. 3rd Edition. Centre for Agriculture and Bioscience International Publishing.
3.	Ackefors H., Huner J and Konikoff M. (2009). Introduction to the General Principles of Aquaculture. CRC Press.
4.	Mushlisin Z. A. (2012). Aquaculture. In Tech.
5.	Akpaniteaku R.C. (2018).Basic Handbook of Fisheries and Aquaculture. AkiNik Publications.
References Books	
1.	Arumugam N. (2014). Aquaculture. Saras Publication.
2.	Pillay T. V. R. and Kutty M.N. (2005). Aquaculture : Principles and Practices. 2ndEdition. Wiley India Pvt. Ltd.
3.	Tripathi S. D., Lakra W.S. and Chadha N.K. (2018). Aquaculture in India. Narendra Publishing House.
4.	Rath R.K.(2011). Fresh Water Aquaculture. 3rdEdition. Scientific Publishers.
5.	Lucas J. S., Southgate P.C. and Tucker C.S. (2019). Aquaculture: Farming Aquatic Animals and Plants. Wiley Blackwell.
Web Resources	
1.	Aquaculture: Types, Benefits and Importance (Fish Farming) - Conserve Energy Future (conserve-energy-future.com)
2.	Fisheries Department - Tamil Nadu (tn.gov.in)
3.	Aquaculture - Google Books
4.	aquaculture | Definition, Industry, Farming, Benefits, Types, Facts, & Methods | Britannica

5.	Fisheries & Aquaculture (investindia.gov.in)

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				S	S	M	S	M	S	M	
CO2				S	M	M	S	M	S	L	
CO3				M	S	M	S	M	S	L	
CO4				M	M	M	S	M	S	L	
CO5				M	S	S	S	M	S	L	

Course Code	Course Title	L	T	P	C
23116RMC39	Research Methodology	2	0	0	2

Aim:

To create a basic appreciation towards research process and awareness of various research publication

Objectives:

- To understand the steps in the research process and the suitable methods.
- To identify various research communications and their salient features
- To carry out basic literature survey using the common data-bases
- To give exposure to MATLAB platform for effective computational and graphic works required for quality research

Course Content:

UNIT I: Introduction to Research Methodology

Meaning of research – Objectives of research – Types of research – Significance of research – Research approaches

UNIT II: Research Methods

Research methods versus methodology – Research and scientific method – Criteria of good research – Problems encountered by researchers in India.

UNIT III: Literature Survey

Articles – Thesis – Journals – Patents – Primary sources of journals and patents – Secondary sources – Listing of titles – Abstracts – Reviews – General treatises – Monographs.

UNIT IV: Database Survey

Database search – NIST – MSDS – PubMed – Scopus – Science citation index – Information about a specific search.

UNIT V:

Basic Principles of Laboratory Safety and Waste management

Introduction - Access to Laboratory and Emergency Exits - Personal Protective Clothing and Equipment - Good Working Practices-Maintenance of Laboratory Equipment - Working with Hazardous Substances - Storage of Chemicals - Working with Flammable Solvents - Gas Cylinders-Fire Precautions - Emergency Procedures - First Aid - Accident Follow-Up - Safety Manual - Safety Training - Management of Laboratory Safety and Responsibilities - Waste Management.

Outcomes:

CO1- Understand research questions and tools

CO2- Experience in scientific writings

CO3- Practice in various aspects of scientific publications

CO4- Understand database survey

CO5- Analysis principles of laboratory safety and waste management

Prerequisites:

Basic computer literacy& skills for working in window-environment

Course Code	Course Title	L	T	P	C
231ACLSOAN	Office Automation	-	-	-	1

Course Objectives :

To provide an in-depth training in use of office automation, internet and internet tools. The course also helps the candidates to get acquainted with IT.

Course Content:

UNIT I

Knowing the basics of Computers

UNIT II

Word Processing (MS word)

UNIT III

Spread Sheet (MS XL)

UNIT IV

Presentation (MS Power Point)

UNIT V

Communicating with Internet

Course Outcomes:

After completion of the course, students would be able to documents, spreadsheets, make small presentations and would be acquainted with the internet.

Reference:

1. Fundamentals of computers - V.Rajaraman - Prentice- Hall of india
2. Microsoft Office 2007 Bible - John Walkenbach,Herb Tyson,Faithe Wempen,cary N.Prague,Michael R.groh,Peter G.Aitken, and Lisa a.Bucki -Wiley India pvt.ltd.
3. Introduction to Information Technology - Alexis Leon, Mathews Leon, and Leena Leon, Vijay Nicole Imprints Pvt. Ltd., 2013.
4. Computer Fundamentals - P. K. Sinha Publisher: BPB Publications
5. https://en.wikipedia.org
6. https://wiki.openoffice.org/wiki/Documentation
7. http://windows.microsoft.com/en-in/windows/windows-basics-all-topics

SEMESTER IV

Course Code	Course Title	L	T	P	C
23110AEC41	Tamil-IV **சங்க இலக்கியம்**	3	0	0	3

நான்காம் பருவம்

பாடநோக்கம் :

- பழந்தமிழ் இலக்கிய வளத்தை உணர்த்துதல்.
- சங்க அக, புற பாடல் மரபுகளைப் பயிற்றுவித்தல்.
- புற இலக்கியங்கள் காட்டும் வாழ்வியல் அறங்களை உணர்த்துதல்.

பயன்கள்:

CO1:பழந்தமிழ் இலக்கிய மரபை அறிவர்.

CO2 :சங்க இலக்கியங்களில் உள்ள அழகியல் கூறுகளை உணர்வர்.

CO3 :வாழ்வியல் அறங்கள் மற்றும் வரலாற்றுச் செய்திகளை அறிவர்.

அலகு-1

1. குறுந்தொகை- பாடல் எண்: 28 & 38
2. நற்றிணை- பாடல் எண்: 1, 27, 28,167 & 168
3. ஐங்குறுநூறு- பாடல் எண்: இளவேனில் பத்து

அலகு-2

1. கலித்தொகை- பாடல் எண்: 3 & 7
2. அகநானூறு- பாடல் எண்: 5, 42 & 100
3. புறநானூறு- பாடல் எண்: 182, 204, 41 & 121

அலகு-3

1. சிறுபாணாற்றுப்படை முழுவதும்

அலகு-4

1. திருக்குறள்- செய்நன்றி அறிதல், கூடா நட்பு ,நலம்புனைந்துரைத்தல்
2. நாலடியார் - பாடல் எண்: 1,172,215 & 253

அலகு-5 இலக்கிய வரலாறு

1. சங்க இலக்கியம்
2. எட்டுத்தொகை
3. பத்துப்பாட்டு
4. பதினெண் கீழ்க்கணக்கு நூல்கள்

பார்வை நூல்கள்

1.குறுந்தொகை - கழக வெளியீடு ,சென்னை

2.நற்றிணை - கழக வெளியீடு ,சென்னை

3.ஐங்குறுநூறு - கழக வெளியீடு ,சென்னை

4.கலித்தொகை - கழக வெளியீடு ,சென்னை

5.அகநானூறு - கழக வெளியீடு ,சென்னை

6.புறநானூறு - கழக வெளியீடு ,சென்னை

7.திருக்குறள் - பரிமேலழகர் உரை ,கழக வெளியீடு ,சென்னை

இணையதளம் -www.tamilvu.org ,www.noolulagam.com

Course Code	Course Title	L	T	P	C
23111AEC41	Advanced English-IV	3	0	0	3

Aim:
To improve the knowledge of English
Objective:
To familiarize with the objectives and types of interview
To know the types of questions and answering techniques
To prepare reviews and proposals
To learn the grammatical forms
To understand the meaning of a poem and write the content
To write for and against a topic
To draw a flowchart
To write definitions
Course Content:

UNIT 1
Parts of speech –Noun –Pronoun-Adjective-Verb-Adverb-Conjunction-PrepositionInterjection-Definition-Types-Examples
UNIT 2
Types Of Sentences-Statement-Interrogative-Exclamatory-Imperative
UNIT 3
Sentence Pattern-Types-SV-SVO-SVC-SVA-SVOO-SVOC-SVOA
UNIT 4
Tenses- Subject -Verb-Concord
UNIT5
Phrases And Clauses-Definition And Types
Outcome:
- ❖ Develop writing skill
- ❖ Comprehend and describe poems
- ❖ Learn interviewing skills

ReferencesBooks

Author	Title of the book	Edition / Year	Publisher
Rajendra Pal & J.S Korlahalli	Essentials of Business Communication	2015	Sultan Chand & Sons

Course Code	Course Title	L	T	P	C
23111AEC42	English-IV	3	1	0	3

Course Objectives:

CO1: To help learners imbibe the rules of language unconsciously and tune to deduce language structure and usage.

CO2: To enable them use receptive skills through reading and listening to acquire good exposure to language and literature

CO3: To help them develop style in speech and writing and manipulate the tools of language for effective communication.

CO4: To provide exposure to plays, autobiographies and expose them to value based ideas.

CO5: To enhance their language skills especially in the areas of grammar and pronunciation.

Course Content:

UNIT I:

Life Writing

1.1 I am Malala-Malala Yousafzai - Chapter 1

1.2 My Inventions - Nikola Tesla - Chapter 2

UNIT II:

One Act Plays

2.1The Zoo Story- Edward Albee

2.2 The Proposal- Anton Chekhov

UNIT III:

Interviews

3.1 Nelson Mandela's Interview with Larry King.

3.2 Rakesh Sharma's Interview with Indira Gandhi from Space

3.3 Lionel Messi with Sid Lowe (Print)

UNIT IV:

Language Competency

4.1 Refuting, Arguing & Debating

4.2 Making Suggestions & Responding to Suggestions, Asking for and Giving Advice or Help 4.3 Interviews (face to face, telephone and video conferencing)

UNIT V:

English for Workplace

5.1 Job Applications: Covering letters, CV and Resume

5.2 Creating a digital profile - Linkedin

5.3 Filling Forms (Online & Manual): creation of account, railway reservation, ATM, Credit/debit card

5.4 Body Language -Practical Skills for Interviews

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Learn to communicate effectively and appropriately in real life situation.	PO1
CO2	Use English effectively for study purpose across the curriculum	PO1,PO2
CO3	Develop interest in and appreciation of Literature	PO4,PO6
CO4	Develop and integrate the use of the four language skills	PO4,PO5,PO6
CO5	Enhance their language skills especially in the areas of grammar and pronunciation.	PO3,PO8

TextBooks(LatestEditions)	
1	I Am Malala The Girl Who Stood Up for Education and Was Shot by the Taliban by Malala Yousafzai, Christina Lamb , Little Brown, 2013.
2	My Inventions by Nikola Tesla Ingram Short title, 2011 Edition
ReferencesBooks (Latest editions,and the style as given below must be strictly adhered to)	
1	Writing Your Life: A Guide to Writing Autobiographies,Mary Borg, Taylor & Francis, 2021
2	One-act Plays for Acting Students: An Anthology of Short Norman A. Bert · 1987 ·
3	The One-Act Play Companion: A Guide to plays, playwrights ... Colin Dolley, Rex Walford · 2015
4	How to Build a Professional Digital Profile Kindle Edition by Jeanne Kelly Bernish, Bernish Communications Associates, LLC; 1st edition (May 29, 2012)
5	Role Play-Theory and Practice.Krysia M Yardley-Matwiejczuk, SAGE publications ltd, 1997

Web Resources	
1	For Readers' Theatre: https://www.youtube.com/watch?v=JaLQJt8orSw&t=469s(the link to the performance; refer scripts by Aaron Sheperd)
2	http://BBC learn English.com
3	http://onestopenglish.com
4	http://hearn-english-today.com
5	http://talkenglish.com
6	The Zoo Story: http://www.lem.seed.pr.gov.br/arquivos/File/livrosliteraturaingles/zoostory.pdf
7	The Proposal: https://www.one-act-plays.com/comedies/proposal.html
8	Nelson Mandela with Larry King Interviews: http://edition.cnn.com/TRANSCRIPTS/0005/16/lkl.00.html
9	Rakesh Sharma with Indira Gandhi Interview : https://www.ndtv.com/offbeat/what-first-indian-astronaut-rakesh-sharma-told-indira-gandhi-about-india-from-space-2204839

Mapping with Programme Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	2	3	3	2	2	2

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

3 – Strong, 2 – Medium , 1 - Low

Mapping with Programme Specific Outcomes:

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Course Code	Course Title	L	T	P	C
23116AEC43	Immunology and Immunotechnology	4	1	0	3

Course Objectives:

CO1: To gain knowledge about the immune system, organs of immunity and cells involved.

CO2: To distinguish the types of antigens and antibodies; their properties.

CO3: To provide in-depth knowledge on immuno-techniques.

CO4: To discuss the role of MHC system in transplantation; functions of Tumor specific antigens

CO5: To impart knowledge on immunological disorders.

Course Content:

UNIT I:

Organs and Cells in Immune System and Immune Response:Primary lymphoid organs, secondary lymphoid organs, and lymphoid tissues; T – cell and B –cell membrane bound receptors – apoptosis; T - cell processing, presentation and regulation; T –cell subpopulation, properties, functions and T – cell suppression; Physiology of immune response- innate, humoral and cell mediated immunity; Immunohematology.

UNIT II:

Antigen and Antibody:Antigens - Properties of haptens, epitopes, adjuvants, and cross reactivity; Antibodies- structure, properties, classes; Antigen and Antibody Reactions: precipitation, agglutination, complement fixation, opsonization, neutralization; Vaccines – active and passive immunization; Classification of vaccines; Other approaches to new vaccines; Types of vaccine - antibacterial, antiviral; Vaccination schedule.

UNIT III:

Immunoassay and Immunotechniques - Preparation and standardization of bacterial antigens; Raising of monoclonal and polyclonal antibodies; Purification of antibodies. Immunotechniques - RIA, RAST, ELISA, Immunofluorescence techniques and Flow cytometry

UNIT IV:

Transplantation and TumorImmunology - MHC Antigens - structure and function; HLA system - Regulation and response to immune system; Transplantation immunology - tissue transplantation and grafting; Mechanism of graft acceptance and rejection; HLA typing; Tumor specific antigens; Immune response to tumors; Immune diagnosis; cancer immunotherapy.

UNIT V:

Immunological disorders and diseases - Hypersensitivity reactions (Type I, II, III and IV); acquired immunodeficiency syndrome; Autoimmune disorders and diseases: organ specific and non-organ specific.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Assess the fundamental concepts of immunity, contributions of the organs and cells in immune responses.	PO1, PO4, PO6, PO9,
CO2	Investigate the structures of Ag and Ab; Immunization.	PO1, PO4, PO5, PO9
CO3	Justify the Immunoassay and Immunotechniques.	PO1, PO4, PO5, PO7
CO4	Explain about the immunologic processes governing graft rejection and therapeutic modalities for immunosuppression in transplantation	PO1, PO3, PO4, PO5, PO9
CO5	Analyze the overreaction by our immune system leading to hypersensitive conditions and its consequences.	PO1, PO4, PO5, PO6

Text Books
Richard Coico, Geoffrey Sunshine, Eli Benjamini. (2003). Immunology – A Short Course. 5thEdition., Wiley-Blackwell, New York.
Judith A.Owen, Jenni Punt, Sharon A. Stranford, Janis Kuby. (2013). Immunology, 7thEdition., W. H. Freeman and Company, New York.
Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. (2021). Cellular and Molecular Immunology, 10thEdition.,Elsevier.
Robert R. Rich, Thomas A. Fleisher, William T. Shearer, Harry Schroeder, Anthony J. Frew, Cornelia M. Weyand. (2018).Clinical Immunology: Principles and Practice, 5th Edition. Elsevier.
Pravash Sen. Gupta. (2003). Clinical Immunology. Oxford University Press.

References Books	
Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.	
Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11thEdition.,Wiley-Blackwell.	
William R Clark. (1991). The Experimental Foundations of Modern Immunology. 3rdEdition. John Wiley and Sons Inc. New York.	
Frank C. Hay, Olwyn M. R. Westwood. (2002). Practical Immunology, 4thEdition., Wiley-Blackwell.	
Noel R. Rose, Herman Friedman, John L. Fahey. (1986). Manual of Clinical Laboratory Immunology. ASM.3rd Edition.	
	Web Resources
1	https://www.ncbi.nlm.nih.gov/books/NBK279395/
2	https://med.stanford.edu/immunol/phd-program/ebook.html

3	https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall-2005/pages/lecture-notes/
4	Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov)
5	Immunology - an overview | ScienceDirect Topics

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S			M		S			M
CO2	S			M	M				M
CO3	S			S	S		S		
CO4	S		M	S	S				M
CO5	S			S	M	M			

Course Code	Course Title	L	T	P	C
23116GEC44	Biostatistics & Bioinformatics	4	1	0	3

Course Objectives:

CO1: Acquire knowledge about the Developments and Applications of Bioinformatics.

CO2: Gain knowledge about the importance of the bioinformatics, databases, tools and software of bioinformatics and explain different types of Biological Databases**.**

CO3: Understand the basics of sequence alignment, sequence analysis and Protein structure prediction method.

CO4: Demonstrate the basic methods of data collection, graph construction and sampling techniques and Calculate measures of central tendency.

CO5: Correlate and analyze biological data through various statistical methods and interpret biological data via various probabilistic distribution methods.

Course Content:

UNIT I:

Introduction to Bioinformatics – Genome, Transcriptome and Proteome, Gene prediction rules and software. Nucleic acid Databases – Primary and Secondary Databases – Structure Database – CATH, SCOP – Data base Searching – BLAST and FASTA, BLOSSUM.

UNIT II:

Sequence analysis (Proteins and Nucleic acids), Protein Database: Comparison of Protein sequences and Database searching – methods for protein structure prediction - Homology modeling of proteins, visualization tools (RASMOL)

UNIT III:

Multiple Sequences alignment – method of multiple sequences alignment- Evolutionary analysis, clustering methods Phylogenic trees - Methods to generate phylogenetic tree- Tools for multiple sequences alignment and phylogenetic analysis - History of Drug Discovery, Steps in Drug design - Chemical libraries – Role of molecular docking in drug design.

UNIT IV:

Statistics – collection, classification, tabulations of Statistical Data – Diagrammatic representation – Graphs – Sampling method and standard error. Measures of central tendency – measures of dispersion.

UNIT V:

Correlations and regression. Probability distribution-Binomial, Negative binomial, multinomial distribution, Poisson distribution. Tests of significance – t tests – F tests – Chi square test. Analysis of variance – Statistical Soft wares.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Understand the importance of principal concepts about biostatistics	PO1, PO4, PO6, PO9,
CO2	Know the knowledge about statistics and its relation with other science and research aspects	PO1, PO4, PO5, PO9
CO3	Obtain the knowledge on bioinformatics databases, perform text- and sequence-based searches	PO1, PO4, PO5, PO7
CO4	To become familiar with the use of a wide variety of internet applications, biological databases and will be able to apply these methods to research problems.	PO1, PO3, PO4, PO5, PO9
CO5	Correlate and analyze biological data through various statistical methods and interpret biological data via various probabilistic distribution methods	PO1, PO4, PO5, PO6

Text Books
Andreas D. Baxevanis And B. F. Francis Ouellette. 2001. **Bioinformatics.**A Practical Guide to the Analysis of Genes and Proteins (Second Edition). John Wiley & Sons, Inc.
Arthur M. LESK, 2003 Introduction to Bioinformatics Oxford University Press
Attwood T. K. And Parry-Smith D. J. 2003. Introduction to Bioinformatics. Pearson Education (Singapore) Pvt. Ltd.
Balasubramanian, D., Bryce, C. F. A., Dharmalingam, K., Green, J. And Kunthala Jayaraman. 1996. Concepts in Biotechnology (Edts.) University Press (India) Ltd.
Basu, O., S.K. Thukral. 2007. Bioinformatics-Databases, Tools and Algorithms. Oxford University Press, New Delhi.

References Books
Bryan Bergeron, M.D. 2006. Bioinformatics Computing. 2006. Prentice Hall of India Pvt Limited, New Delhi.
Gautham, N. 2006. Bioinformatics- Databases and Algorithms, Narosa Publishing House Hall of India Pvt. Ltd, New Delhi.
Ignacimuthu, S.S.J. 2005. Basic Bioinformatics, Narosa Publishing House, India.
Lesk, A.M. 2006. Introduction to Bioinformatics. (2nd Edition). Oxford University Press, New Delhi.

Web Resources
https://pubmed.ncbi.nlm.nih.gov/24272431/#:~:text=Bioinformatics%20is%20an%20interdisciplinary%20field,a%20computational%20point%20of%20view.
https://www.ncbi.nlm.nih.gov/protein/
https://www.ebi.ac.uk/Tools/msa/clustalo/

https://www.statisticssolutions.com/statistical-data-analysis/
https://www.bmj.com/about-bmj/resources-readers/publications/statistics-square-one/11-correlation-and-regression

Course Code	Course Title	L	T	P	C
23116SEC45L	Immunology and Immunotechnology Lab	0	0	3	3

Course Objectives:

CO1: To gain hands-on knowledge to identify Blood group and typing.

CO2: To acquire adequate skill to perform latex agglutination reactions.

CO3: To analyze precipitation reactions in gels.

CO4: To investigate the antigen & antibody reactions in electrophoresis.

CO5: To familiarize with Separation of Lymphocytes.

Course Content:

UNIT I:

Identification of blood group and typing.

Coomb's test. TPHA

UNIT II:

T cell identification (Demonstration)

Latex Agglutination reactions- RF, ASO, CRP

UNIT III:

Ouchterlony's Double Diffusion Method (antigen pattern).

Single Radial Immuno Diffusion Method.

UNIT IV:

Electrophoresis - Serum, Counter and Immuno.

UNIT V:

Separation of Lymphocytes by gradient centrifugation method.

ELISA: Hepatitis/ HIV

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Assess the blood groups and types	PO1,PO5, PO6, PO7, PO8
CO2	Competently perform serological diagnostic tests such as RF, ASO, CRP	PO4, PO5, PO6, PO7, PO8
CO3	Illustrate the antigen antibody reactions in gel.	PO5, PO6, PO7, PO8, PO9

CO4	Compare & contrast antigens and antibodies in electrophoresis	PO5, PO6, PO7, PO8, PO9
CO5	Examine the concept of ELISA.	PO5, PO6, PO7, PO8, PO9

Text Books	
1.	**Talwar. (2006). Hand Book of Practical and Clinical Immunology, Vol. I, 2nd edition, CBS.**
2.	Asim Kumar Roy. (2019). Immunology Theory and Practical**,** Kalyani Publications.
3.	Richard Coico, Geoffrey Sunshine, Eli Benjamini. (2003). Immunology – A Short Course. 5thEdition., Wiley-Blackwell, New York.
4.	Judith A.Owen, Jenni Punt, Sharon A. Stranford, Janis Kuby. (2013). Immunology, 7thEdition., W. H. Freeman and Company, New York.
5.	Pravash Sen. Gupta. (2003). Clinical Immunology. Oxford University Press.
References Books	
1	Frank C. Hay, Olwyn M. R. Westwood. (2008).Practical Immunology, 4th Edition, Wiley-Blackwell.
2	Wilmore Webley. (2016). Immunology Lab Manual, LAD Custom Publishing.
3	Rose. (1992). Manual of Clinical Lab Immunology, ASM.
4	Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.
5	Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11thEdition.,Wiley-Blackwell.
Web Resources	
1	https://www.researchgate.net/publication/275045725_Practical_Immunology-_A_Laboratory_Manual
2	https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelinger-lab/documents/Immunology-Lab-Manual.pdf
3	https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC106J-lab-manual.pdf
4	Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov)
5	Immunology - an overview | ScienceDirect Topics

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M				S	S	S	S	
CO2				S	M	M	S	S	
CO3					M	S	S	S	M
CO4					M	M	S	S	M
CO5					M	M	S	S	M

Course Code	Course Title	L	T	P	C
23116SEC46L	Biostatistics & Bioinformatics Lab	0	0	3	2

Course Objectives:

CO1: Analyze the Biological databases
CO2: Able to perform BLAST and FASTA
CO3: Represent data in to graphical form
CO4: Test the level of significance of biological data and interpret the results.
CO5: Determine averages of the biological data

Course Content:

UNIT I:
- ❖ Biological databases (NCBI, Swissprot and PDB)

UNIT II:
- ❖ BLAST FASTA

UNIT III:
- ❖ Identification of functional domains in nucleotide binding proteins using a domain analysis server like SMART

UNIT IV:
- ❖ Preparation of bar diagram, line diagram and pie diagram using MS EXCEL.
- ❖ Calculation of Central tendency- mean, geometric mean, median using MS EXCEL

UNIT V:
- ❖ Calculation of dispersion – Mean deviation, quartile deviation and standard deviation using MS EXCEL
- ❖ Calculation of student's t test using MS EXCEL

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	To identify the protein sequence of the species using PIR and Swissprot /	PO1, PO4, PO6, PO9,
CO2	To understand the nucleotide sequence data of the given species using NCBI / EMBL / DDBJ.	PO1, PO4, PO5, PO9
CO3	To study the multivariate analysis in biostatistics	PO1, PO4, PO5, PO7
CO4	To analysis the data from experiments and interpretation of the *results*	PO1, PO3, PO4, PO5, PO9
CO5	To Read and learn statistical measures individually.	PO1, PO4, PO5, PO6

	Web Resources
1.	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC102476/
2.	https://pediaa.com/difference-between-blast-and-fasta/

Course Code	Course Title	L	T	P	C
23116SEC47	Vaccine Technology	2	0	0	2

Course Objectives:

CO1: To provide knowledge on the basics of immunization and induction of immunity.

CO2: To learn the types of vaccines, its immunological effects and regulatory guidelines.

CO3: To learn the role of rDNA in vaccine technology.

CO4: To provide the knowledge on conventional to recent technology of vaccine production

CO5: To learn about ethical issues and regulations in vaccine production and clinical trials

Course Content:

UNIT I:

History of vaccination, Active and passive immunization; requirements for induction of immunity, Epitopes, linear and conformational epitopes, characterization and location of APC, MHC and immunogenicity.

UNIT II:

Viral/bacterial/parasite vaccine differences, methods of vaccine preparation – Live, killed, attenuated, sub unit vaccines;Licensed vaccines, Viral Vaccine - Poliovirus vaccine-inactivated & Live, Rabies vaccines, Hepatitis A & B vaccines, Bacterial Vaccine - Anthrax vaccines, Cholera vaccines, Diphtheria toxoid, Parasitic vaccine - Malaria Vaccine.

UNIT III:

Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein-based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines. Recent advances in Malaria, Tuberculosis, HIV.

UNIT IV:

Fundamental research to rational vaccine design. Antigen identification and delivery, T-Cell expression cloning for identification of vaccine targets for intracellular pathogens,Rationale vaccine design based on clinical requirements: Scope of future vaccine strategies.

UNIT V:

Vaccine additives and manufacturing residuals, Regulation and testing of vaccines, Regulation of vaccines in developing countries, Quality control and regulations in vaccine research, Animal testing, Rational design to clinical trials, Large scale production, Commercialization. Vaccine safety ethics and Legal issues.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Explain the significance of critical antigens, immunogens and adjuvants in developing effective vaccines.	**PO1,PO10**
CO2	Understand the types of vaccines.	**PO5**
CO3	Construct vaccine applying rDNA technology.	**PO7,PO10**
CO4	Formulate the strategies for developing an innovative vaccine technology with different mode of vaccine delivery.	**PO9,PO10**

CO5	Evaluate the regulatory issues and guidelines for the management of vaccine production.	**PO3,PO5**

Text Books	
1.	Ronald W. Ellis.(2001). New Vaccine Technologies.Landes Bioscience.
2.	Cheryl Barton. (2009). Advances in Vaccine Technology and Delivery.Espicom Business Intelligence.
3	Male, David. Ed. (2007). Immunology. 7th Edition. Mosby Publication.
4	Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne. (2002). Immunology. 6th Edition, Freeman.
5	Brostoff J, Seaddin JK, Male D, Roitt IM. (2002). Clinical Immunology. 6th Edition, Gower Medical Publishing.
References Books	
1	Stanley A. Plotkin, Walter Orenstein& Paul A. Offit.(2013). Vaccines, 6th Edition. BMA Medical Book Awards Highly Commended in Public Health. Elsevier Publication.
2	Coico, R. etal. (2003). Immunology: A Short Course. 5th Edition, Wiley – Liss.
3	Parham, Peter.(2005). The Immune System. 2nd Edition, Garland Science.
4	Abbas, A.K. etal. (2007). The Cellular and Molecular Immunology. 6th Edition, Sanders / Elsevier.
5	Weir, D.M. and Stewart, John (2000). Immunology. 8th Edition, Churchill Pvt. Ltd.
Web Resources	
1	https://www.slideshare.net/adammbbs/pathogenesis-3-rd-internal-updated-43458567
2	https://www.bio.fiocruz.br/en/images/stories/pdfs/mpti/2013/selecao/vaccine-processtechnology.pdf
3	https://www.dcvmn.org/IMG/pdf/ge_healthcare_dcvmn_introduction_to_pd_for_vaccine_ production_29256323aa_10mar2017.pdf
4	https://www.sciencedirect.com/science/article/pii/B9780128021743000059
5	https://www.researchgate.net/publication/313470959_Vaccine_Scaleup_and_Manufacturing

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M									M	
CO2					S						
CO3							M			M	
CO4									L	M	
CO5			L		M						

Course Code	Course Title	L	T	P	C
23116SEC48	Apiculture	2	0	0	2

Course Objectives:

CO1: To understand the biology of honey bees.
CO2: To study honey bee colony establishment.
CO3: To develop knowledge on honey extraction.
CO4: To understand the diseases of honey bees and their control.
CO5: To gain information on financial assistance and funding agencies for beekeeping industry.

Course Content:

UNIT I:

Biology of Bees: Honeybee – Systematic position – Species of Honey bees – Life history of Honey bee – behaviour – swarming – Pheromone.

UNIT II:

Social life in Bees:Bee colony – Castes – natural colonies and their yield – Types of bee hives – Structure – location, care and management.

UNIT III:

Bee Rearing:Apiary – Care and Management – Artificial bee hives – types – construction of spaceframes – Selection of sites – Handling – Maintenance – Instruments employed in Apiary – Extraction instruments.

UNIT IV:

Bee Economy: Honey – Composition – uses – Bee wax and its uses – yield in national and international market – Diseases of honey bees and their control methods. Economics of bee culture.

UNIT V:

Entrepreneurship: venture – Preparing proposals for financial assistance and funding agencies – Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Understand the systematic position and life history of honey bee.	**PO1, PO2, PO10**
CO2	Reveal the different stages and types of bees and discuss about the care and management of apiculture.	**PO1, PO2, PO4, PO5**
CO3	Describe the practice of bee rearing process and analyze instruments employed in apiary.	**PO2,PO4, PO5, PO10, PO11**
CO4	Compare and contrast the composition of honey and bee wax and interpret the yield in National and International markets.	**PO4, PO5, PO7, PO8, PO10**
CO5	Clarify the proposal for financial assistance and funding agencies and reveal the modern methods employed in artificial bee hives.	**PO5, PO8, PO9, PO10, PO11**

Text Books	
1.	Dewey M. Caron. (2013). Honey Bee Biology and Beekeeping. Revised Edition. Wicwas Press, Kalamazoo. ISBN 10: 1878075292
2.	R. A. Morse. (1993). Rearing queen honey bees. Wicwas press, NY. ISBN-10 : 1878075055
3.	Ted Hooper. (2010). Guide to Bees & Honey: The World's Best Selling Guide to Beekeeping. Northern Bee Books. Oxford. ISBN 10: 1904846513
4.	Jayashree K. V., Tharadevi C.S. and Arumugam N. (2014) Apiculture. Saras Publication
5.	Raj H. (2020). Vinesh Text Book of Apiculture. S. Vinesh and Co.

References Books	
1	Dewey M. Caron. (2020). The Complete Bee Handbook: History, Recipes, Beekeeping Basics, and More,Rockridge Press. ISBN-10 : **1646119878**
2	Joachim Petterson. (2016). Beekeeping: A Handbook on Honey, Hives & Helping the Bees, Weldon Owen.
3	Eva Crane. (1999). The World History of Beekeeping and Honey Hunting. Routledge. India.ISBN-10 : 0415924677
4	Pagar B. S. (2016). Textbook Of Apiculture. Sahitya Sagar.
5	Sehgal P.K. (2018). Text Book of Sericulture, Apiculture **a**nd Entomology. Kalayani.
Web Resources	
1	Bee Keeping Basics. Retrieved from:https://denton.agrilife.org/files/2013/08/beekeeping-basics.pdf
2	Beekeeping as an Entrepreneurship, Retrieved from: https://lupinepublishers.com/agriculture-journal/pdf/CIACR.MS.ID.000270.pdf
3	Raising Bumble Bees at Home: A Guide to Getting Started. Retrieved from: https://www.ars.usda.gov/ARSUserFiles/20800500/BumbleBeeRearingGuide.pdf
4	Apiculture – Biology for Everybody (homeomagnet.com)
5	Apiculture: Introduction to Apiculture (iasri.res.in)

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	S	S								S	
CO2	S	S		S	S						
CO3		S		S	M					S	S
CO4				S	M		S	S		M	
CO5					S			S	S	S	S

Course Code	Course Title	L	T	P	C
23116BRC49	Participation in Bounded Research	2	0	0	2

Course Code	Course Title	L	T	P	C
231AECCEVS	Environmental Studies	2	-	-	2

CourseObjectives:

Creating awareness about environmental problems among people.
Imparting basic knowledge about the environment and its allied problems.
Developing an attitude of concern for the environment.
Motivating the public to participate in environment protection and environment improvement.
Acquiring skills to help the concerned individuals in identifying and solving environmental problems.
Striving to attain harmony with Nature.

Course Content:

1.Nature of Environmental Studies

- Definition, scope and importance.
- Multidisciplinary nature of environmental studies
- Need for public awareness.

2. Natural Resources and Associated Problems.

- Forest resources: Use and over — exploitation, deforestation, dams and their effects on forests and tribal people.
- Water resources: Use and over — utilization Of surface and ground water, floods, drought, conflicts over water, dams benefits and problems.
- Mineral resources: Usage and exploitation. Environmental effects of extracting and using mineral resources.
- Food resources: World food problem, changes caused by agriculture effect of modern agriculture, fertilizer — pesticide problems.
- Energy resources: Growing energy needs, renewable and non — renewable energy resources, use of alternate energy sources. Solar energy, Biomass energy, Nuclear energy.
- Land resources: Solar energy, Biomass energy, Nuclear energy, Land as a resource, land degradation, man induced landslides, soil erosion and desertification,
- Role of an individual in conservation of natural resources.

3.Ecosystems

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Producers, consumers and decomposers.
- Energy flows in the ecosystem.
- Ecological succession.
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristics features, structure and function of the following ecosystem:

a) Forest ecosystem, b) Grassland ecosystem, c) Desert ecosystem,
d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

4. Biodiversity and its conservation

- Introduction — Definition: genetic, species and ecosystem diversity.
- Bio — geographical classification of India.
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
- India is a mega — diversity nation.
- Western Ghat as a biodiversity region.

- ❖ Hot— spot of biodiversity.
- ❖ Threats to biodiversity habitat loss, poaching of wildlife, man — wildlife conflicts.
- ❖ Endangered and endemic species of India.
- ❖ Conservation of biodiversity: In — situ and Ex — situ conservation of biodiversity.

5.Environmental Pollution

- ❖ Definition: Causes, effects and control measures of: Air pollution, Water pollution, soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards.
- ❖ Solid waste Management: Causes, effects and control measures of urban and industrial wastes.
- ❖ Role of an individual in prevention of pollution.

6.Social Issues and the Environment

- ❖ Disaster management: floods, earthquake, cyclone, tsunami and landslides.
- ❖ Urban problems related to energy Water conservation, rain water harvesting, watershed management
- ❖ Resettlement and rehabilitation of people; its problems and concerns.
- ❖ Environmental ethics: Issue and possible solutions.
- ❖ Global wanTling, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation.
- ❖ Consumerism and waste products.

7.Environmental Protection

- ❖ From Unsustainable to Sustainable development.
- ❖ Environmental Protection Act.
- ❖ Air (Prevention and Control of Pollution) Act.
- ❖ Water (Prevention and control of Pollution) Act.
- ❖ Wildlife Protection Act.
- ❖ Forest Conservation Act.
- ❖ Population Growth and Human Health, Human Rights.

8.Field Work

- ❖ Visit to a local area to document environmental assets — River / Forest / Grassland / Hill / Mountain.

or

- ❖ Visit to a local polluted site — Urban / Rural *I* lad Listrial / Agricultural.

or

- ❖ Study of common plants, insects, birds.

or

- ❖ Study of simple ecosystems -— ponds, rivers, hill slopes, etc.

References:

1. Agarwal, K.C,200l, Environmental Biology, Nidi Pub. Ltd., Bikaner.
2. Bharucha Erach, The l3iodiversity of India, Mapin Publishing Pvt, Ltd., Ahmedabad 380013, India, Email: rn4pin@icenet.net (R)
3. Brunner R.C., 1989, 1-lazardous Waste Incineration, McGraw Hill Inc. 480p
4. Clank R.S., Marine Pollution, Clanderson Press Oxford (TB)
5. Cunningham, W.P. Cooper, T.H. Gorhani, E. & Hepworth, M.T.2001, Environmental Encyclopedia, Jaico Pub. Mumbai, Il96p
6. De A.K., Environmental Chemistry, Wiley Wastern Ltd.
7. Down to Earth, Centre for Science and Environment, New Delhi. (R)
8. Gleick, H., 1993, Water in crisis, Pacific Institute for studies in Dcv., Environment & Security. Stockholm Env Institute. Oxford Univ. Press 473p
9. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bompay (R)
10. Heywood, V.K. & Watson, R.T.1995, Global Biodiversity Assessment, Crnbridge Univ. Press 1140 p.

11. Jadhav, H. and Bhosale, VJvI. 1995, Environmental Protection and Laws, Himalaya Pub. House, Delhi 284p.
12. Mickinney, M.L. and School. R.M. 1196, Environmental Science Systems and Solutions, Web enhanced edition, 639p.
13. Miller T.G. Jr. Environmental Science. Wadsworth Publications Co. (TB).
14. Odum, E.P. 1971, Fundamentals of Ecology, W.B. Saunders Co. USA,574zp.
15. Rao M.N. and Dana, A.K. 1987, Waste Water Treatment, Wxford & IBH Publ. Co. Pvt. Ltd., 345p
16. Sharma B.K., 2001, Environmental Chemistry, Gokel PubI. Hkouse, Meerut, Survey of the Environment, The Hindu (M)
17. Townsend C., Harper, J, and Michael Begon, Essentials of Ecology, Blackwell Science (TB)
18. Trivedi R.K. Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, vol. 1 and II, Environmental Media (R)
19. Trivedi R.K. and P.K. Goel, Introduction to air pollution, Techno— Science Publications (TB)
20. Wagner K.D., 1998, Environmental management, W.B. Saunders Co.Philadelphia, USA 499p,

Learning Outcomes:

Students who graduate with a major in environmental science will be able to:

1. Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale;
2. Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment;
3. Demonstrate ecology knowledge of a complex relationship between predators, prey, and the plant community;
4. Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues; and
5. Understand how politics and management have ecological consequences.

Course Code	Course Title	L	T	P	C
231LCSCLS	Leadership & Management Skills	-	-	-	1

CourseObjectives:

CO 1: Help students to develop essential skills to influence and motivate others
CO 2:Inculcate emotional and social intelligence and integrative thinking for effective leadership
CO 3:Create and maintain an effective and motivated team to work for the society
CO 4: Nurture a creative and entrepreneurial mindset
CO 5:Make students understand the personal values and apply ethical principles in professional land social contexts.

Course Content:

UNIT I:

Leadership Skills

a. Understanding Leadership and its Importance
   - What is leadership?
   - Why Leadership required?
   - Whom do you consider as an idealleader?

b. Traits and Models of Leadership
   - Are leaders born or made?
   - Key characteristics of an effective leader
   - Leadership styles
   - Perspectives of different leaders

c. Basic Leadership Skills
   - Motivation
   - Teamwork
   - Negotiation
   - Networking

UNIT II:

Managerial Skills

a. Basic Managerial Skills
   - Planning for effective management
   - How to organize teams?
   - Recruiting and retaining talent
   - Delegation of tasks
   - Learn to coordinate
   - Conflict management

b. Self Management Skills
   - Understanding self concept
   - Developing self-awareness
   - Self-examination
   - Self-regulation

UNIT III:

Entrepreneurial Skills

a. Basics of Entrepreneurship
   - Meaning of entrepreneurship
   - Classification and types of entrepreneurship
   - Traits and competencies of entrepreneur

b. Creating Business Plan

- Problem identification and idea generation
- Idea validation
- Pitch making

UNIT IV:

Innovative Leadership and Design Thinking

a. Innovative Leadership

- Concept of emotional and social intelligence
- Synthesis of human and artificial intelligence
- Why does culture matter for today's global leaders

b. Design Thinking

- What is design thinking?
- Key elements of design thinking:
  - Discovery
  - Interpretation
  - Ideation
  - Experimentation
  - Evolution.
- How to transform challenges into opportunities?
- How to develop human-centric solutions for creating social good?

UNIT V:

Ethics and Integrity

a. Learning through Biographies

- What makes an individual great?
- Understanding the persona of a leader for deriving holistic inspiration
- Drawing insights for leadership
- How do leaders sail through difficult situations?

b. Ethics and Conduct

- Importance of ethics
- Ethical decision-making
- Personal and professional moral codes of conduct
- Creating a harmonious life

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Examine various leadership models and understand/assess their skills, strengths and abilities that affect their own leadership style and can create their leadership vision	**PO1**
CO2	Learn and demonstrate a set of practical skills such as time management,self management, handling conflicts, team leadership, etc.	**PO1,PO2**
CO3	Understand the basics of entrepreneurship and develop business plans	**PO4,PO6**
CO4	Apply the design thinking approach for leadership	**PO4,PO5, PO6**
CO5	Appreciate the importance of ethics and moral values for making a balanced personality.	**PO3,PO8**

References Books	
1	*Elkington, J., &Hartigan, P. (2008). The Power of Unreasonable People: How Social Entrepreneurs Create Markets that Change the World. Harvard Business Press.*
2	*GolemanD. (1995). Emotional Intelligence. Bloomsbury Publishing India PrivateLimited*

3	*Kalam A. A. (2003). Ignited Minds: Unleashing the Power within India. Penguin BooksIndia*
4	*Kelly T., Kelly D. (2014). Creative Confidence: Unleashing the Creative Potential WithinUs All.WilliamCollins*
5	*KurienV.,& Salve G. (2012). I Too Had a Dream. Roli Books PrivateLimited*
6	*Livermore D. A. (2010). Leading with cultural intelligence: The New Secret to Success. New York: American ManagementAssociation*
7	*McCormackM.H.(1986).WhatTheyDon'tTeachYouatHarvardBusinessSchool:NotesFromA Street-Smart Executive. RHUS*
8	*O'Toole J. (2019) The Enlightened Capitalists: Cautionary Tales of Business Pioneers Who Tried to Do Well by Doing Good.Harpercollins*
9	*SinekS. (2009). Start with Why: How Great Leaders Inspire Everyone to Take Action.Penguin*
10	*Sternberg R. J., Sternberg R. J., &BaltesP. B. (Eds.). (2004). International Handbook of Intelligence. Cambridge UniversityPress.*

SEMESTER V

Course Code	Course Title	L	T	P	C
23110AEC51	Bacteriology and Mycology	5	1	0	4

Course Objectives:

CO1: Understand the role of normal flora and pathogenic microbes of various diseases and clinical microbiological techniques.
CO2: Basic knowledge about Gram positive pathogenic bacteria and their epidemiology
CO3: Acquire knowledge about Gram negative pathogenic bacteria and nosocomial infections
CO4: Comprehensive knowledge about medically important, its classification and its significance
CO5: Gain knowledge about the general characteristics and mode of action of various antibacterial agents.

Course Content:

UNIT I:

History, Classification of Medically Important Microbes, Koch's, and River's postulates-A brief account on the normal microbial flora of the healthy human body – Host-pathogen interactions: Definitions of infection, invasion, primary and opportunistic pathogens, pathogenicity, virulence, toxigenicity, carriers, endemic, epidemic, pandemic diseases and epidemiology – putative virulence factors of human pathogens –infectious disease cycle. Collection and transport of clinical specimens for bacterial and fungal infections.

UNIT II:

Medically important Gram Positive infections - Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention and treatment of the following bacterial diseases (a) Streptococcal infections (*Streptococcus pyogenes*, *Streptococcus faecalis*), (b) Staphylococcal infections (*Staphylococcus aureus*), (c) Tetanus (*Clostridium tetani*)(d) Diphtheria (*Corynebacteriumdiphtheriae*) (e) Anthrax (*Bacillus anthracis*) (f) Tuberculosis (*Mycobacterium tuberculosis*), (g) Leprosy (*Mycobacterium leprae*).

UNIT III:

Medically important Gram-Negative infections - Causative agent, clinical symptoms, pathogenesis, mode of transmission, prevention, and treatment of the following bacterial diseases (a) Meningitis (*Streptococcus pneumoniae, Neisseria meningitidis*) (b) typhoid (*Salmonella typhi, Salmonella paratyphi*) (c) cholera (*Vibrio cholerae*) (d) bacillary dysentery (*Shigelladysenteriae*); Sexually Transmitted disease (syphilis–*Treponemapallidum*.Gonorrhoea - *Neisseria gonorrhoeae*); Nosocomial infections – definition, importance, and their control (*Pseudomonas aeruginosa*).

UNIT IV:

Medically important Fungi - Classification of medically important fungi; Superficial mycoses: PityriasisVersicolor; TineaNigra; Piedra. Cutaneous mycoses: *Microsporum*spps.,*Trichophyton*spps., and *Epidermophytonfloccosum*. Subcutaneous mycoses: Chromoblastomycosis; Sporotrichosis; Systemic Mycoses - Blastomycosis; Histoplasmosis; Opportunistic Infections -Candidiasis; Cryptococcosis; Zygomycosis; Mycotoxins: Aflatoxin

UNIT V:

Antimicrobial agents -General characteristics and mode of action of Antibacterial agents: Modes of action with an example for each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Understand the importance of normal flora of the human body and acquire knowledge on the process of infectious disease.	**PO1, PO3, PO5, PO7, PO10, PO11**
CO2	Explain the various bacterial pathological events during the progression of an infectious disease, and apply the underlying mechanisms of spread of disease and its control.	**PO1, PO3, PO5, PO7, PO10, PO11**
CO3	Compile a list of disease-causing bacteria and compare their modes of infection, symptoms, diagnosis and treatment.	**PO1, PO3, PO5, PO7, PO10, PO11**
CO4	Comprehend human-fungal interaction, which can be applied to obtain in-depth knowledge on fungal diseases and the mechanism behind the disease process.	**PO1, PO3, PO5, PO7, PO10, PO11**
CO5	Explain the types of mycoses caused in humans and categorize the modes of infection, pathogenesis, and treatment with introduction to mycotoxins.	**PO1, PO3, PO4, PO5,PO6, PO7,PO9, PO10**

Text Books	
1	Tom Parker, M. Leslie H. Collier. (1990). Topley&Wilson's Principles of Bacteriology, Virology and Immunity,8th Edition. London: Edward Arnold.
2	Greenwood, D., Slack, R.B. and Peutherer, J.F. (2012) Medical Microbiology, 18thEdition. Churchill Livingstone, London.
3	Finegold, S.M. (2000) Diagnostic Microbiology, 10th Edition. C.V. Mosby Company, St. Louis.
4	Ananthanarayanan, R. and JayaramPanicker C.K. (2020) Text book of Microbiology. Orient Longman, Hyderabad.
5	JagdishChander (2018). Textbook of Medical Mycology, 4th edition, Jaypeebrothers medical publishers.
References Books	
1	Gerhardt, P., Murray, R.G., Wood, W.A. and Kreig, N.R. (Editions) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC.
2	Kevin Kavanagh, (2018). Fungi Biology and Applications 3rd Edition. Wiley Blackwell publishers.
3	C.J. Alexopoulos, C.W. Mims, M. Blackwell, (2007). Introductory Mycology, 4th edition. Wiley publishers.
4	A.J. Salle (2007). Fundamental principles of bacteriology, fourth edition, Tata McGraw-Hill Publications.
5	Christopher C. Kibbler ,Richard Barton,Neil A. R. Gow, Susan Howell,Donna M. MacCallum, Rohini J. Manuel (2017). Oxford Textbook of Medical Mycology. Oxford University Press.
Web Resources	
1	http://textbookofbacteriology.net/nd
2	https://microbiologysociety.org/members-outreach-resources/links.html
3	http://mycology.cornell.edu/fteach.html
4	https://www.adelaide.edu.au/mycology/
5	https://www.isham.org/mycology-resources/mycological-links

Mapping with Programme Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	S		S		S		S			M	S
CO2	S		S		S		S			M	S
CO3	S		S		S		S			M	S
CO4	S		S		S		S			M	S
CO5	S		S	M	S	M	S		S	M	

Course Code	Course Title	L	T	P	C
23111AEC52	Virology and Parasitology	5	1	0	4

Course Objectives:

CO1: To gain knowledge on properties and classification of viruses and collection of relevant clinical samples for diagnosing viral infections.
CO2: To understand pathogenic microorganisms of viruses and the mechanisms by which they cause disease in the human body.
CO3: To gain knowledge about reemerging viral infections and develop diagnostic skills, including the use and interpretation of laboratory tests in the diagnosis of infectious diseases.
CO4: Understand the types of parasites causing infections in the intestine.
CO5: To develop skills in the diagnosis of parasitic infections.

Course Content:

UNIT I:

General Properties, replication and Classification of viruses (Baltimore classification), Cultivation of viruses- in animals, embryonated eggs and tissue culture, Virus purification assays - collection and transport of clinical specimens for viral infections.

UNIT II:

Viral diseases with reference to symptoms, pathogenesis, transmission, prophylaxis and control – Arboviruses (Flavi virus), Picorna viruses (Polio virus and Rhinovirus), Hepatitis viruses (HAV, HBV, HCV, HDV, HEV), Rabies virus, Orthomyoviruses (Influenza virus) and Paramyxoviruses (Mumps and Measles virus), Pox viruses (Variola, Vaccinia), Herpes viruses (Herpes simplex, Varicella zoster), Adeno viruses, Rota viruses and HIV viruses. Oncogenic viruses (Human Papilloma virus): Introduction, characteristics of transformed cells, mechanism of viral oncogenesis and clinical manifestations.

UNIT III:

Emerging and reemerging viral infections (SARS, Swine flu, Ebola, Dengue, Chikungunya- and Corona) – causes, spread and preventive measures. Detection of viruses in clinical specimens – Serological and Molecular diagnosis of virus infections – Antiviral agents, Interferons and Viral Vaccines, Immunization schedules.

UNIT IV:

General introduction to Medical Parasitology, Classification of medically important parasites. Morphology, life cycle, pathogenesis, clinical features, laboratory diagnosis, prevention and treatment of diseases caused by the following organisms: *Entameobahistolytica*, flagellates (*Giardia lamblia, Leishmania donovani*), Sporozoa- *Plasmodium*s pps.

UNIT V:

Introduction to Helminthes, Platyhelminthes – *Taenia* – *Fasciola* – *Paragonimus* – *Schistosoma*spps.. Nemathelminthes – Ascaris– *Ankylostoma* – *Enterobius* – *Trichuris* – *Trichinella* – *Wuchereria* – *Dracanculus.* Collection, transport and examination of specimen Laboratory techniques in parasitology Examination of faeces for ova and cyst by direct wet mount and iodine wet mount, Concentration methods (Floatation and Sedimentation techniques), Examination of blood for parasites. Cultivation of parasites.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Understand the structure and properties of viruses, cultivation methods and diagnosis of viral diseases.	PO5,PO10
CO2	Knowledge of basic and general concepts of causation of disease by the pathogenic microorganisms and various parameters of assessment of their severity and the methods of diagnosis.	PO5,PO10
CO3	Insights to treatment options of viral diseases.	PO5,PO10
CO4	Knowledge about the importance of protozoans in the intestine.	PO5,PO10
CO5	Knowledge of Nematodes as infectious agent	PO5,PO10

TEXT BOOKS	
1.	S., Rajan(2007). Medical microbiology, MJP publisher.
2.	JeyaramPaniker, C.K. (2006). Text Book of Parasitology Jay Pee Brothers,NewDelhi.
3	AroraD.R. and AroraB. (2002). Medical Parasitology, 1st Edition CBS Publishers & Distributors, New Delhi.
4	Chatterjee (1986). Medical Parasitology. Tata McGraw Hill, Calcutta.
5	Parija S. C. (1996). Text Book of Medical Parasitology.4th edition, Orient Longman, AllIndia Publishers & Distributors.

References Books	
1	Jawetz, E., Melnick, J.L. and Adelberg, E.A. (2000). Review of Medical Microbiology, 19th Edition. Lange Medical Publications, U.S.A.
2	Ananthanarayan, R. and JeyaramPaniker, C.K. (2009). Text Book of Microbiology, 8th Edition. Orient Longman, Chennai .
3	Conrat HF, Kimball PC and Levy JA. (1988). Virology. II edition. Prentice Hall, Englewood Cliff, New Jersey..
4	Topley& Wilsons's (1990). Principles of Bacteriology, Virology and Immunity, 8th Edition, Vol. III Bacterial Diseases, Edward Arnold, London.
5	Finegold, S.M. (2000). Diagnostic Microbiology, 10th Edition. C.V. Mosby Company,St.Louis.

Web Resources	
1	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4047123/
2	https://www.ncbi.nlm.nih.gov/pubmed/21722309
3	https://www.sciencedirect.com/science/article/pii/S2211753919300193
4	https://cmr.asm.org/content/30/3/811
5	https://www.nejm.org/doi/full/10.1056/NEJMoa1811400

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1					M					M	
CO2					M					M	
CO3					M					M	
CO4					M					M	
CO5					M					M	

Course Code	Course Title	L	T	P	C
23116AEC53	Environmental and Agriculture Microbiology	5	0	0	4

Course Objectives:

CO1: To discuss the distribution and association of microorganism in various ecosystems and to know about the role of microorganism in water pollution and water quality.

CO2: To acquire knowledge about the role of microorganism in water pollution and water quality

CO3: Gain knowledge about microbes as biofertilizers and the aspects of application.

CO4: To learn about the process of solid waste management and sewage water treatment.

CO5: Gain knowledge on various plant diseases and pathogens

Course Content:

UNIT I:

Microorganisms and their Habitats: Structure and function of ecosystems.

Terrestrial Environment: Soil profile and soil microflora, Microbial succession in decomposition of soil organic matter. Role of microorganisms in elemental cycles in nature: Carbon, Nitrogen.

Aquatic Environment: Microflora of freshwater and marine habitats, factors influencing microbial growth in aquatic environments.

Atmosphere: Aeromicroflora and dispersal of microbes, Assessment of air quality, Enumeration of microorganism in air, Air sanitation.

Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels.

Predisposing factors for Environmental diseases – infectious (water and air borne) and pollution related, spread and control of these diseases. Environmental Protection Agency (EPA) - role in environmental protection

UNIT II:

Water potability: Sources and types of water surface, ground, stored, distilled, mineral and de-mineralized water and their pollution, biological indicators of water Pollution, Eutrophication. Conventional Bacteriological standards of Water Quality, MPN index, coliform test, Membrane filtration. BOD, COD. Advanced molecular methods for water analysis. Water borne diseases. Central Pollution Control Board (CPCB) standards**.**

UNIT III:

Microbial Interactions: Rhizosphere microflora. Concepts of Nitrogen fixation – Symbiotic and asymbiotic nitrogen fixers.Brief account of microbial interactions: Symbiosis, neutralism, commensalism, competition, Ammensalism, Synergism, parasitism, and predation. General account and Significance of Biofertilizers and biocontrol agents – Bacterial, cyanobacterial, VAM. Mass production of Rhizobialbiofertilizer. Biocontrol agents – Bacterial, viral, fungal.

UNIT IV:

Waste treatment and bioremediation**:** Solid waste management: Sources and types of solid waste, composting, vermin composting, production of biogas. Liquid waste management: Primary, secondary, and tertiary sewage treatment. Bioremediation and waste management: Need and scope of bioremediation. Degradation of hydrocarbons, oil spills, heavy metals – Chromium, lead, and xenobiotics – PCB.

UNIT V:

Plant pathology: Mode of entry of pathogens, Microbial enzymes, toxins, growth regulators and suppressor of plant defense in plant diseases. Plant defense mechanisms. Bacterial diseases – Citrus canker, Blight of paddy. Viral disease – TMV, CMV. Fungal disease- red rot of sugarcane, Tikka disease. Plant disease management.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Describe about the structure and function of ecosystems and understand the role of microbes in various environments	PO1
CO2	Identify the cause of water pollution, and perform methods to assess the quality of water.	PO4,PO5,PO6,PO7, PO8
CO3	Explain the productionof biofertilizers and biopesticides.	PO1, PO7,PO8
CO4	Explainabout waste treatment process and microbial decomposition and bio-remediation process.	PO6
CO5	Describe about plant diseases caused by microbes and acquire a clear idea on plant pathogenic interaction	PO1,PO5

Text Books	
1.	Joseph C. Daniel. (2006). Environmental aspects of Microbiology 2nd Edition. BrightSun Publications.
2.	Pradipta. K.M. (2008). Textbook of Environmental Microbiology.I.K.Publishing. House.
3.	Ramanathan, and Muthukaruppan SM. (2005). Environmental Microbiology.OmSakthiPathipagam, Annamalai Nagar.
4.	K. Vijaya Ramesh.(2004).Environmental Microbiology. 1st Edition. MJP Publishers.
5.	SubbaRao.N.S.(2017). Soil Microbiology.4th Edition. Oxford and IBH Publishing Pvt.Ltd.
References Books	
1	Dirk, J. Elasas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil Microbiology, Marcel Dekker INC, New York, Hong Kong.
2	EcEldowney S, Hardman D.J., Waite D.J., Waite S.(1993). Pollution: Ecology and Biotreatment – Longman Scientific Technical.
3	Mitchel, R.(1992). Environmental Microbiology. Wiley –John Wiley and Sons. Inc. Publications, New York.
4	Clescri, L.S., Greenberg, A.E. and Eaton, A.D.(1998). Standard Methods for Examination of Water and Wastewater, 20thEdition. American Public Health Association.
5	Atlas, R.M. and Bartha, R.(1992). Microbial Ecology: Fundamentals andApplications, 2nd Edition. The Benjamin / Cummings Publishing Co.,Redwood City, CA.
Web Resources	
1	https://nptel.ac.in/courses/126105016
2	https://www.classcentral.com/course/swayam-plant-pathology-and-soil-health-14236
3	https://www.wasteonline.org.uk/resources/InformationSheets/WasteDisposal.htm
4	https://plantpath.cornell.edu/labs/enelson/PDFs/Hill_et_al_2000.pdf
5	https://onlinelibrary.wiley.com/doi/full/10.1111/j.1365-2389.2005.00781.x

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	S										
CO2				M	S	S	S	S			
CO3	S						S	S			
CO4						S					
CO5	M				M						

Course Code	Course Title	L	T	P	C
23116DSC54A	Biosafety & bioethics	5	1	0	4

Course Objectives:

CO1: To create a research environment - encourage investigation, analysis and studying the bioethical principles, values, concepts, and social and juridical implications contained in the Universal Declaration on Bioethics and Human

CO2: Rights in order to assist their application and promotion in the areas of science, biotechnology and medicine.

CO3: To discuss various aspects of biosafety regulations, IPR and bioethics concerns arising from the commercialization of biotech products.

CO4: To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.

CO5: To understand the importance of IPR, Patents and Patent laws.

Course Content:

UNIT I:

Basics of Biosafety - Laboratory Hazards and Hazard symbols. Definitions on Biohazard, Biosafety and Biosecurity- Biohazard- LAI, BP. Biohazard Classification. Biological Risk Groups. Need and application of biosafety. Good Laboratory Practices (GLP), Good Manufacturing Practices (GMP).

UNIT II:

Hazardous materials in Biotechnology - Categories of Waste in the Biotechnology Laboratories, Biohazardous waste and their disposal and treatments- issues in use of GMO's, risk for animal/human/ agriculture and environment owing to GMO. Hazardous materials, Emergency response/ first aids in Laboratories.

UNIT III:

Biological Safety Containment in Laboratory - Primary and secondary containments - Physical and biological containment. Types of biosafety containments (level I, II, III), PPE, Biosafety guidelines in India - Roles of Institutional Biosafety Committee, RCGM, GEAC.

UNIT IV:

Introduction and need of Bioethics - its relationship with other branches, Ethical implications of biotechnological products and techniques. Ethical Issues involving human cloning, human genome project, prenatal diagnosis, agriculture and animal rights, Social and ethical implications of biological weapons

UNIT V:

IPR, Patents and Patent laws - Intellectual property rights-TRIP- GATT International conventions patents, Methods of application of patents, Legal implications. Biodiversity and farmer rights, Objectives of the patent system, Basic principles and general requirements of patent law, Biotechnological inventions, and patent law. Legal development-Patentable subjects and protection in biotechnology. The patenting of living organisms.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Understand the control measures of laboratory hazards (chemical, biological and physical) and to practice safety strategies and personal protective equipment	**PO1, PO2, PO3, PO7, PO10**
CO2	Develop stratagems for the use of genetically modified organisms and Hazardous materials	**PO1, PO3, PO4**
CO3	Develop skills of critical ethical analysis of contemporary moral problems in medicine and health care.	**PO1, PO6**
CO4	Analyze and respond to the comments of other students regarding philosophical issues.	**PO3, PO4**
CO5	Pave the way for the students to catch up Intellectual Property(IP) as a career option a. R&D IP Counsel b. Government Jobs – Patent Examiner c. Private Jobs d. Patent agent and Trademark agent e. Entrepreneur	**PO1, PO7, PO10**

Text Books	
1.	Usharani .B, S Anbazhagi, C K Vidya, (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	DeepaGoel and ShominiParashar, (2013). IPR, Biosaftey and Bioethics- 1st Edition, Pearson education: Chennai, ISBN-13: 978-8131774700
4	Rajmohan Joshi (2006). Biosafety and Bioethics. Gyan Books publisher.
5	Sateesh. M.K. (2013). Bioethics and Biosafety. i.K. International pvt,Ltd.
References Books	
1	Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management, India, IN: Cengage Learning India Private Limited, ISBN-10: 9386668572
2	Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights, India, IN: PHI learning Private Limited, ISBN : 9788120349896
3	Ahuja, V K. (2017). Law relating to Intellectual Property Rights, India, IN: Lexis Nexis, ISBN-10: 8131251659.
4	Edited by Sylvia Uzochukwu, Nwadiuto (Diuto) Esiobu, Arinze Stanley Okoli, Emeka Godfrey Nwoba, EzebuiroNwagboChristpeace, Charles OluwaseunAdetunji, Abdulrazak B. Ibrahim, Benjamin Ewa Ubi (2022). Biosafety and Bioethics in Biotechnology-Policy, Advocacy, and Capacity Building,1st edition. CRC Press
5	Sree Krishna. V (2007). Bioethics and Biosafety in Biotechnology. New age international publishers.
Web Resources	
1	Subramanian, N., &Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf.
2	World Intellectual Property Organisation. (2004). WIPO Intellectual propertyHandbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub _489.pdf.
3	https://www..niehs.nih.gov/bioethics
4	https://www.sist.sathyabama.ac.in
5	https://www.longdom.org/bioethics-and-biosafety

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	S	S	S				M			M	
CO2	S		S	S							
CO3	S					S					
CO4			S	S							
CO5	S						M			S	

Course Code	Course Title	L	T	P	C
23116DSC54B	Food Processing Technology	5	0	0	3

Course Objectives:

CO1: To provide knowledge on objectives of food preservation.

CO2: To explain the freshness criteria and quality assessment of meat and fish.

CO3: To outline the methods of milk processing and fermented milk products.

CO4: To explain the importance of fat and oil processing.

CO5: To discuss the methods of microbiological examination of foods.

Course Content:

UNIT I:

Introduction to food preservation –objectives and techniques of food preservation. Preservation: principles of high temperature, low temperature, radiation, chemical preservatives and bio preservatives.

UNIT II:

Freshness criteria and quality assessment of meat and fish –spoilage and methods of preservation. Production of byproducts after processing waste and their utilization. Role of packaging material, types of packaging material.

UNIT III:

Composition of milk; assessment of milk, thermal processing of fluid milk-pasteurization (LTH, HTST&UHT techniques). Fermented milk products-cheese, Butter milk, Yogurt, Kumis, Kefir and Acidophilus milk. Hygiene and sanitation requirement in food processing and fermentation industries.

UNIT IV:

Importance of fats and oils in Food-Extraction of fats and Oils-Rendering, pressing, solvent extraction, pressing of oil- degumming, refining, bleaching, deodorization, fractionation, pyrolysis of fats, toxicity of frying oil.

UNIT V:

Methods for the microbiological examination of foods. Food borne illness and diseases. Microbial cultures for food fermentation. Indian Factories Act on safety, HACCP, Safety from adulteration of food.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Assess the fundamental concepts of food preservation.	PO1, PO3, PO5,PO6, PO8
CO2	Investigate the quality assessment of meat and fish.	PO1, PO5, PO6, PO7, PO8
CO3	Design the processing of milk and milk quality assessment.	PO1, PO5, PO6, PO7, PO8
CO4	Explain about the importance of fats and oils.	PO1, PO4, PO6, PO7, PO8
CO5	Plan the food safety and adulteration detection.	PO3, PO4, PO6, PO7, PO8

Text Books	
1.	Avantina Sharma. (2006). Text Book of Food Science and Technology, International Book Distributing Co, Lucknow, UP.
2.	Sivasankar. (2005). Food Processing and Preservation, 3rd Edition.,Prentice hall of India Pvt Ltd, NewDelhi.
3	Ramaswamy H & Marcotte M. (2006). Food Processing: Principles & Applications. Taylor & Francis.
4	NIIR Board of Food and Technologist. (2005). Modern Technology of Food Processing and Agrobased industries, National Institute of Industrial Research, Delhi.
5	Adams M.R. and Moss M. O (2007). Food Microbiology. New Age International.

Reference Books	
1	Fellos PJ. (2005). Food Processing Technology: Principle &Practice 2nd Edition. CRC.
2	Peter Zeuthen and Leif Bogh-Sorenson. (2005). Food Preservation Techniques, WoodlandPublishing Ltd, Cambridge, England.
3	Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Pilar Cano. (2004). Novel Food Processing Technologies, CRC.
4	Suman Bhatti, Uma Varma. (1995). Fruit and vegetable processing organizations and institutions, 1st Edition., CBS Publishing, New Delhi.
5	MirdulaMirajkar, Sreelatha Menon. (2002). Food Science and Processing Technology Vol-2,Commercial processing and packaging, Kanishka publishers, New Delhi.
Web Resources	
1	https://sites.google.com/a/uasd.in/ecourse/food-processing-technology
2	https://nptel.ac.in/courses/126105015
3	https://engineeringinterviewquestions.com/biology-notes-on-food-adulteration/
4	food processing | Definition, Purpose, Examples, & Facts | Britannica
5	Food Processing Technology | Food News & Views Updated Daily (foodprocessing-technology.com)

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M		M		S	M		S	
CO2	M				S	M	S	S	
CO3	M				S	M	S	S	
CO4	M			S		S	S	S	
CO5			M	M		M	S	S	

Course Code	Course Title	L	T	P	C
23116DSC54C	Disaster Management	5	1	0	4

AIM:

Disaster management aims to reduce, or avoid the potential losses from hazards, assure prompt and appropriate assistance to victims of disaster, and achieve rapid and effective recovery.

Course Objectives:

CO1: To provide students an understanding the need for studying the disaster management

CO2: Develop an understanding about the various types of disasters.

CO3: To expose students to the risk and vulnerability analysis

CO4: To create awareness about disaster prevention and risk reduction

CO5: To establish a relationship between disasters and developments.

CO6: To understand Rehabilitation, Reconstruction and Recovery in the event of Disaster

CO7: To gain knowledge on Climate Change Adaptation and IPCC Scenario and Scenarios in the context of India.

Course Content

Unit I: Introduction to Disasters

Chapter No. 1 Disaster: Concept, Meaning, and Definition

Chapter No. 2 History of Major Disaster Events in India

Chapter No. 3 Types of Disasters – Natural Disasters: Famine, Drought, Flood, Cyclone, Tsunami, Earthquake

Unit II: Disaster Mitigation and Disaster Management

Chapter No. 4 Man-made Disasters: Riots, Blasts, Industrial, Militancy

Chapter No. 5 Profile, Forms and Reduction of Vulnerability

Chapter No. 6 Disaster Mitigation: Concept and Principles

Unit III: Impact of Disaster

Chapter No. 7 Disaster Management: Concept and Principles

Chapter No. 8 Pre-disaster- Prevention and Preparedness

Chapter No. 9 Physical, Economic, Social, Psycho-socio Aspects, Environmental Impacts

Unit IV: Disaster Process and Intervention

Chapter No. 10 During Disaster- Rescue and Relief

Chapter No. 11 Post-disaster- Rehabilitation and Reconstruction

Chapter No. 12 Victims of Disaster- Children, Elderly, and Women

Chapter No. 13 Displacement- Causes, Effects and Impact

Unit V: Disaster Intervention

Chapter No. 14 Major Issues and Dynamics in the Administration of Rescue, Relief, Reconstruction and Rehabilitation

Chapter No. 15 Components of Rescue, Relief, Reconstruction; Rehabilitation

Chapter No. 16 Disaster Policy in India; Disaster Management Authority- NDMA, SDMA, DDMA; Disaster Management Act, 2005

Key Words: Disaster, Disaster Mitigation, Disaster Management and Disaster

Process

Course Outcomes:

CO1: Understand the need and significance of studying disaster management
CO2: Understand the different types of disasters and causes for disasters.
CO3: Gain knowledge on the impacts Disasters on environment and society
CO4: Study and assess vulnerability of a geographical area.
CO5: Students will be equipped with various methods of risk reduction measures and risk mitigation.
CO6: Understand the role of Information Technology in Disaster Management
CO7: Understand Geographical Information System applications in Disaster Management

References:

1. Anil Sinha (2001), Disaster Management-Lessons Drawn and Strategies for Future. New Delhi, Jain Publications.
2. Backer, C.W. and Chapman, W. (ed.). (1969), Man and Society in Disasters, New Delhi,
3. Clarke, J.I., Peter Curson, et. al. (ed.) (1991), Population and Disaster, Oxford, Basil Blackwell Ltd.
4. Cuny, Frederick (1984), Disasters and Development, Oxford, Oxford University Press. Disaster Management Act 2005
5. Garb, S. and Eng. E (1969), Disasters Hand Book, New York, Springer.
6. Gupta, M.C, L.C. Gupta, B. K. Tamini and Vinod K. Sharma (2000), Manual on Natural Disaster Management in India, New Delhi, National Institute of Disaster Management.
7. Hoff, A. (1978), People in Crisis- Understanding and Helping, California, Addison Wesley.
8. Maskrey, Andrew (1989), Disaster Mitigation: A Community Based Approach, Oxford, Oxfarm.
9. Narayan, Sachindra (ed.) (2000), Anthropology of Disaster Management, New Delhi, Gyan Publishing House.
10. Nidhi G Dhawan (2014), Disaster Management and Preparedness, New Delhi, Jain Publications.
11. Parasuraman, S. and Unnikrishnan, P.V. (2000), India Disasters Report: Towards Policy Initiative, New Delhi, Oxford University Press.
12. Satendra, K.J. Anandha Kumar and V.K. Naik (2013), India's Disaster Report, New Delhi, National Institute of Disaster Management.
13. Singh, R.B. (ed.) (2000), Disaster Management, New Delhi, Rawat Publications.
14. Sinha, P.C. (ed.) (1998), Encyclopedia of Disaster Management (Vol.1-10), New Delhi, Anmol Publications.
15. Tata Institute of Social Sciences (2002). Special Volume on Disaster Management, Indian Journal of Social Work, Vol.63, Issue 2, April.

Course Code	Course Title	L	T	P	C
23116DSE54D	Nano Biotechnology	5	1	0	4

AIM

- To provide basic knowledge in the interface between chemistry, physics and biology on the nanostructural level with a focus on biotechnological usage.

Course Objective

CO1- Nanoscience is the study of materials which are in nanoscale range.
CO2 -Conversion of any material in nanoscale results in alteration of its physicochemical, biological, mechanical, optical, electronic, etc. properties.
CO3 -To learn advanced research and promote innovation through applications of nanobiotechnology to address issues in health, energy, agriculture and environment.
CO4 -To get the knowledge about Applications of nanotechnology
CO5- To know about the Merits and demerits of nanoparticles

Unit I: Introduction to bionanotechnology

Milestones in History – nanotechnology – concept and future prospects – application in Life Sciences. Terminologies – nanotechnology, bionanotechnology, nanobiomaterials, biocompatibility, nanomedicine, nanowires, quantum Dots, nanocomposite, nanoparticles, nanosensors. Biotechnology to bionanotechnology, natural bionanomachines. Current status of bionanotechnology.

Unit II: Synthesis of nanoparticles

Molecular nanotechnology – nanomachines – collagen. Uses of nanoparticles – cancer therapy – manipulation of cell and biomolecules. Cytoskeleton and cell organelles. Types of nanoparticle production – physical, chemical and biological. Microbial synthesis (bacteria, fungi and yeast) of nanoparticles – mechanism of synthesis.

Unit III: Types of nanoparticles and methods of characterization

Nanoparticles – types, functions – Silver, Gold and Titanium. Physical and chemical properties of nanoparticles. Characterization of nanoparticles – UV- Vis spectroscopy, particle size analyzer, Electron Microscopy – HRTEM, SEM, AFM, EDS, XRD. Other tools and techniques required for bionanotechnology: rDNA technology, site directed mutagenesis, fusion proteins, X- Ray crystallography, NMR. Bioinformatics: molecular modeling, docking, computer assisted molecular design.

Unit IV :Applications of nanotechnology

Drug and gene delivery – protein mediated and nanoparticle mediated. Uses of nanoparticles in MRI, DNA and Protein Microarrays. Nanotechnology in the health sector. Nanomedicines, Antibacterial activities of nanoparticles. Nanotechnology in agriculture. Toxicology in nanoparticles – Dosimetry.

Unit V: Merits and demerits of nanoparticles

Advantages of nanoparticles – drug targeting, protein detection, MRI, development of green chemistry – commercial viability of nanoparticles. Disadvantages – pollution and health risks associated with nanoparticles.

Course Outcomes:

CO1- Describe the basic science behind the properties of materials at the nanometre scale

CO2- Advanced experimental and computational techniques for studying nanomaterials.

CO3- Learn clearly and effectively using conventional scientific and mathematical notation.

CO4- Systematically solve scientific problems related specifically to nanotechnological materials.

CO5 - Student clearly get the knowledge of Merits and demerits of nanoparticles

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1. Parthasarathy BK. Introduction to Nanotechnology, Isha Publication. 2007.
2. Elisabeth Papazoglou and Aravind Parthasarathy. Bionanotechnology. Morgan and Claypool Publishers. 2007.
3. Bernd Rehm. Microbial Bionanotechnology: Biological Self-assembly Systems and Biopolymer-based Nanostructures. Horizon Scientific Press. 2006.
4. David E Reisner and Joseph D Bronzino. Bionanotechnology: Global Prospects. CRC Press. 2008.
5. Ehud Gazit. Plenty of Room for Biology at the Bottom: An Introduction to Bionanotechnology. Imperial College Press. 2006.
6. Kamali Kannangara. Nanotechnology: Basic science and emerging technologies-Mick Wilson, Overseas Press. 2005.
7. Mark A Ratner and Bandyopadhyay AK. Nano Materials. Nanotechnology: A gentle introduction to the Next Big Idea, New Age Publishers. 2002.
8. Pradeep T. Nano Essentials Understanding nanoscience and Nanotechnology. 1st edition. TMH publications. 2007.
9. Parag Diwan and Asish Bharadwaj. Nanomedicines, Pentagon Press. 2006.
10. Vladimir P Torchilin. Nanoparticles as Drug Carriers. Imperial College Press, North Eastern University, USA. 2006.

Course Code	Course Title	L	T	P	C
23116DSE54E	Bioremediation and Waste Management	5	1	0	4

AIM

To reduce pollutant levels to undetectable, nontoxic or acceptable levels.

OBJECTIVES:

CO1 - To get the knowledge of waste management system

CO2 - Student to get the full knowledge regarding recycling of waste management system

CO3 -Student will understand about Microbial Activity in the bioremediation process

CO4 - To know about the Principles of Bioremediation and the the metabolic activity

CO5 - To get the clear knowledge about Aerobic Bioremediation

UNIT – I

Wastes– Classification and Quantification – Solid Waste Management and Disposal: Sources and Generation of Solid Waste – characterization, composition and classification. Hazardous Waste Management: Cyanides, Dioxins, Detergents, Plastics, Nylon and Paper. Waste Minimization approaches – Monitoring and Management strategies. Radioactive Waste: Sources, half life of radioactive elements, modes of decay. Effects on Plants, Animal and Man.

UNIT - II

Recycling of Wastes – Types – sources – composition of waste – recycling of waste for Industrial, Agricultural and Domestic Purposes; Recycling of Metals, Reuse, recovery and reduction of paper and plastics; Recycling in Food Manufacturing, Beverages, Apparel, Leather, Paper, Pulp, Chemical and other industries; Fly Ash utilization. Waste Disposal Methods – composting, incineration, pyrolysis, medical waste disposal strategies.

UNIT – III

Microbial Activity in Soil and Groundwater, Lithosphere as Microbial habitat, Microorganisms in rock and minerals, Mineral soil and Organic soil. Physiological groups of prokaryotes, Geomicrobial transformations – Biodegradation of carbonates – Biomobilization of silicon, phosphate, nitrogen. Geomicrobiology of fossil fuel, methane, peat, coal and petroleum.

UNIT – IV

Principles of Bioremediation – Rapid growth and Metabolism- Genetic plasticity – Metabolic pathways for the degradation of xenobiotics, hydrocarbons – Microbial site characterization – Biodegradation potential – Bioprocess design, optimization – Microbial removal rates – inherent problems associated with biotreatment studies. Microbiological methodologies – Standard biotreatability protocols – Quantification of biodegradation; Biocleaning -Chernobyl radioactive contaminated area - Phytoremediation.

UNIT – V

Aerobic Bioremediation: Bioremediation of Surface Soils: Fate and transport of contaminants in the Vadose zone – Biodegradation in soil ecosystems – Types of soil treatment systems – Bioreactors. Bioremediation in freshwater and marine systems: Bench and Pilot Scale studies – in situ Bioreactor treatment of sediments – in situ treatment in marine ecosystem. Anoxic/Anaerobic Bioremediation: Anoxic/Anaerobic Processes –Fermentation, Degradation of xenobiotics – Anoxic/Anaerobic bioremediation of hydrocarbons, Phenols, Chlorophenolic compounds, Polycyclic Aromatic Hydrocarbons (PAH), Heterocyclic Compounds, Cyanide, dyes,

COURSE OUTCOMES:

CO1- Understanding on the management of solid and liquid wastes

CO2- Learn the principles of remedial measures of recycling, reuse and recover from the wastes.

CO3- Understand the mechanism and role of microbes in the degradation of various pollutants

CO4- Learn the Principles of Bioremediation

CO5- Understanding the Aerobic Bioremediation

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2. Bioremediation, Baker,K.H. and Herson,D.S., (1994) Mc Graw–Hill Inc, New York.
3. Biology of Microorganisms, VII Ed., Brock,T.D., Madigan,M.T. Martinko,J.M. and Parker, J (1994) Prentice Hall, New Jercy.
4. Geomicrobiology, Ehrlich,H.L (1996) Marcel Dekker Inc., New York.
5. Bioremediation – Principles, Eweis,J.B., Ergas,S.J, Change,D.P.Y and Schroeder, E.D (1998). Mc Graw-Hill Inc.
6. Environmental Engineering, Kiely, G (1998) Irwin/Mc Graw Hill International, U.K.
7. Hazardous Waste Management, II Ed, LaGrega,M.D.,Buckingham,P.L., and Evans, J.C (2001) Mc Graw Hill Inc.

Course Code	Course Title	L	T	P	C
23116DSE54F	Microbiological Analysis of Air and Water	5	1	0	4

OBJECTIVES:

CO1 - To get the knowledge of Aeromicrobiology

CO2 - Student to get the full knowledge regarding Air Sample Collection and Analysis

CO3 -Student will understand about Control Measures

CO4 - To know about the Principles of Water Microbiology

CO5 - To get the clear knowledge about Microbiological Analysis of Water and Control Measures

Unit 1 Aeromicrobiology

Bioaerosols, Air borne microorganisms (bacteria, Viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres, allergens

Unit 2 Air Sample Collection and Analysis

Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi, Identification characteristics

Unit 3 Control Measures

Fate of bioaerosols, inactivation mechanisms – UV light, HEPA filters, desiccation, Incineration

Unit 4 Water Microbiology

Water borne pathogens, water borne diseases

Unit 5 Microbiological Analysis of Water and Control Measures

Sample Collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests for fecal coliforms (b) Membrane filter technique and (c) Presence/absence tests

Precipitation, chemical disinfection, filtration, high temperature, UV light

COURSE OUTCOMES:

CO1- Understanding on the Aeromicrobiology

CO2- Learn the principles of Air Sample Collection and Analysis.

CO3- Understand the Control Measures

CO4- Learn the Principles of Water Microbiology

CO5- Understanding the Microbiological Analysis of Water and Control Measures

Reference:

1. da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012) Microbiological Examination Methods of Food and WaterA Laboratory Manual, CRC Press

2. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA

3. Maier RM, Pepper IL and Gerba CP. (2009).Environmental Microbiology. 2nd edition, Academic Press

4. Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007) Manual of Environmental Microbiology, 3rd edition, ASM press

Course Code	Course Title	L	T	P	C
23116DSE54G	Biofertilizers and Biopesticides	5	1	0	4

Unit 1 Biofertilizers

General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers. Symbiotic N2 fixers: Rhizobium - Isolation, characteristics, types, inoculum production and field application, legume/pulses plants Frankia - Isolation, characteristics, Alder, Casurina plants, non-leguminous crop symbiosis. Cyanobacteria, Azolla - Isolation, characterization, mass multiplication, Role in rice cultivation, Crop response, field application.

Unit 2 Non - Symbiotic Nitrogen Fixers

Free living Azospirillum, Azotobacter - free isolation, characteristics, mass inoculums, production and field application.

Unit 3 Phosphate Solubilizers

Phosphate solubilizing microbes - Isolation, characterization, mass inoculum production, field Application

Unit 4 Mycorrhizal Biofertilizers

Importance of mycorrizal inoculum, types of mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhizae and VAM.

Unit 5 Bioinsecticides

General account of microbes used as bioinsecticides and their advantages over synthetic pesticides, Bacillus thuringiensis, production, Field applications, Viruses – cultivation and field applications.

Reference:

1. Kannaiyan, S. (2003). Bioetchnology of Biofertilizers, CHIPS, Texas.

2. Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.

3. Reddy, S.M. et. al. (2002). Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.

4. Subba Rao N.S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. Pvt. Ltd. NewDelhi.

5. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG

6. Aggarwal SK (2005) Advanced Environmental Biotechnology, APH publication.

Course Code	Course Title	L	T	P	C
23116SEC55L	Bacteriology, Mycology Virology and Parasitology Lab	0	0	5	4

Course Objectives:

CO1: To familiarize students with medical microbiology techniques and technical knowledge on collection and processing of clinical samples.
CO2: To learn the techniques for isolation and identification of bacterial pathogens.
CO3: To gain expertise in various techniques of clinically important viral pathogens and their identification.
CO4: To get acquainted with medically important fungi and their metabolism.
CO5: To categorize parasites and understand their role in infections.

Course Content:

UNIT I:

1. Collection and Transport of Clinical specimens.
2. Simple, Differential and Special staining of Clinical materials.
3. Culture techniques used to isolate microorganisms.

UNIT II:

1. Identification of bacterial pathogens by their biochemical reactions.
2. Antimicrobial susceptibility testing by disc-diffusion technique and determination of Minimum Inhibitory Concentration.

UNIT III:

1. Isolation of Bacteriophages from Sewage and other natural sources.
2. Identification of Viruses in Slides/Smears/Spotters. Demonstration of Negri bodies (Staining).
3. Cultivation of Viruses in Embryonated eggs – Amniotic, Allantoic, Yolk sac routes and Chorio-allantoic membrane.

UNIT IV:

1. Microscopic identification of medically important Fungi – KOH and Lactophenol cotton Blue staining.
2. Slide culture techniques for fungal Identification
3. Identification of Dermatophytes.

   Germ tube test, Carbohydrate fermentation and assimilation tests for Yeasts.

UNIT V:

1. Direct Examination of Faeces – wet mount and Iodine mount – Demonstration of Protozoan cysts and Helminthes eggs.
2. Concentration techniques of stool specimen – Floatation and Sedimentation methods.
3. Examination of blood for Malarial parasites – thin and thick smear preparations.
4. Identification of Medically important parasites in slides / specimens as spotters.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Demonstrate methods to observe and measure microorganisms by standard microbiological techniques	PO4, PO5, PO7.
CO2	Identify pathogenic microorganisms in the laboratory set-up and interpret their sensitivity towards commonly administered antibiotics.	PO4, PO5, PO7, PO8.
CO3	Understand experimental tools used to cultivate and characterize clinically important viruses and bacteriophages	PO4, PO5, PO7, PO8.
CO4	Elucidate clinically important fungi.	PO4, PO5, PO7, PO8.
CO5	Investigate Parasites of medical importance and identify them from clinical specimens.	PO4, PO5, PO7, PO8.

TEXT BOOKS	
1.	Dubey, R.C. and Maheswari, D.K. (2020). S. Chand Publishers. ISBN-13: 978-8121921534, ISBN-10: 8121921538.
2.	K.R. Aneja (2017). Experiments in Microbiology, Plant Pathology, Tissue Culture and Microbial Biotechnology. 5th Edition. New Age International Publishers. ISBN-10: 9386418304, ISBN-13: 978-9386418302.
3	Collee, J.G., Fraser, A.G., Marnion, B.P. and Simmons, A. (1996). Mackie & McCartney Practical Medical Microbiology. 14th Edition. Elsevier. ISBN-10: 813120393X, ISBN-13: 978-8131203934.
4	Prince CP (2009). Practical Manual of Medical Microbiology, Ist edition, Jaypee digital publishing.
5	James H. Jorgensen, Karen C. Carroll, Guido Funke, Michael A. Pfaller, Marie Louise Landry, Sandra S. Richter, David W. Warnock (2015). Manual of Clinical Microbiology, 11th Edition, ASM press

	References Books
1	Patricia M. Tille (2021). Bailey & Scott's Diagnostic Microbiology, 15th Edition. Elsevier. ISBN-10: 0323681050, ISBN-13: 978-0323681056.
2	Monica Cheesbrough (2006). District Laboratory Practice in Tropical Countries. Part 1. 2nd Edition. Cambridge University Press. ISBN-10: 0521171571, ISBN-13: 978-0521171571.
3	Michael A. Pfaller (ed.) (2015). Manual of Clinical Microbiology. Vol. 1 and 2. 11th Edition. ASM Press. ISBN-10: 9781555817374, ISBN-13: 978-1555817374.
4	Josephine A. Morello, Paul A. Granato and Helen EckelMizer (2002). Laboratory Manual and Workbook in Microbiology. 7th Edition. The McGraw Hill Company. ISBN: 0-07-246354-6.
5	Rowland, S.S., Walsh, S.R., Teel, L.D. and Carnahan, A.M. ((1994). Pathogenic and Clinical Microbiology: A Laboratory Manual. Lippincott Williams & Wilkins. ISBN-10: 0316760498, ISBN-13: 9780316760492.

	Web Resources
1	https://www.microcarelab.in/media/microcarelab.in/files/Sample-Collection-Manual.pdf
2	http://ssu.ac.ir/cms/fileadmin/user_upload/Daneshkadaha/pezeshki/microb/file_amuzeshi/Lab_QA_Microbiology_QA.pdf
3	https://www.academia.edu/11977315/Basic_Laboratory_Procedures_in_Clinical_Bacteriology
4	https://cmr.asm.org/content/31/3/e00062-17.full.pdf
5	https://microbiologyinfo.com/techniques-of-virus-cultivation/

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				S	M		S				
CO2				S	S		S	L			
CO3				S	S		S	L			
CO4				S	S		S	L			
CO5				S	S		S	L			

Course Code	Course Title	L	T	P	C
23116SEC56L	Environmental, Agriculture, Food, Dairy and Probiotic Microbiology Lab	0	0	5	4

Course Objectives:

CO1: To Assess the water quality and potability.

CO2: To acquire knowledge on enumeration of bacteria from milk and milk quality analysis

CO3: To investigate various extracellular enzyme producers in soil and to gain knowledge on preparation of biofertilizers

CO4: Improve knowledge on plant pathogens

CO5: To acquire knowledge on preparation of probiotics and prebiotics

Course Content:

UNIT I:

1. Physical, chemical, and microbiological assessment of water and potability test forwater.
   - ❖ Physical a – Color, pH,
   - ❖ Chemical - alkalinity, acidity, DO, BOD, COD
   - ❖ Microbiological – MPN index (Presumptive, Completed and Confirmatorytest)
2. Study of air microflora by settle plate method.

UNIT II:

3. Isolation and identification of bacteria and fungi from fruits and vegetables
4. Direct microscopic count of milk.
5. Methylene blue reductase test and Resazurin test
6. Microbiological examination of milk by SPC.

UNIT III:

8.Isolation of extracellular enzyme producers –Amylase, protease, lipase

8. Microbiological assay of antibiotics by cup plate method and other methods
9. Isolation of *Rhizobium*/ *Azotobacter*/ phosphate solubilizing organisms
10. Preparation of biofertilizers – Demonstration

UNIT IV:

11.Study of plant pathogens- Tikka Disease, Red rot of sugarcane, Citrus canker, Blight of paddy.

12. Study of fungi - *Mucor,Curvularia, Alternaria, Rhizopus, Aspergillus*

UNIT V:

13. Isolation of constituent flora of fermented milk.
14. Growth of probiotic LAB in broth, milk and whey.
15. Preparation of probiotic fermented milks like dahi, yoghurt, lassi and whey drink.
16. Effect of prebiotics on the growth of LAB in milk and broth.
17. Survivability of probiotic organisms in fermented milks.
18. Antimicrobial potential of the functional dairy products.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Assess the microbial quality of water and relate the experimental results to the prescribed standards by the statutory bodies	PO1, PO4,PO5,PO6, PO7, PO8
CO2	Evaluate the quality of milk and enumerate bacteria in milk by standard plate count method	PO5,PO6, PO7, PO8
CO3	Identify extracellular enzyme producing and nitrogen fixing microorganism form soil and to prepare a biofertilizer.	PO1,PO8
CO4	Identifyvarious plant pathogenic bacteria	PO1
CO5	Synthesize probiotic fermented milks using microorganisms	PO1,PO7,PO8

Text Books	
1.	Cappucino J and Sherman N.(2010). Microbiology: A Laboratory Manual. 9th Edition. Pearson Education Limited.
2.	Kannan. N. (1996). Laboratory manual in General Microbiology. Palani Publications.
3.	R C Dubey and D K Maheswari.(2002). Practical Microbiology. S. Chand Publishing.
4.	Neelima Garg, K.L. Garg, K.G. Mukerji (2010).Laboratory Manual of Food Microbiology, Wiley publication
5.	Aneja, KR.(2010). Experiments in Microbiology, Plant pathology and Biotechnology. New Age International (P) Limited.

References Books	
1	Christon J. Hurst Editor in Chief, Ronald L. Crawford, Jay L. Garland, David A. Lipson, Aaron L. Mills, Linda D. Stetzenbach (2007). Manual of Environmental Microbiology, Third Edition,Wiley publication.
2	James G Cappucino and Natalie Sherman.(2016). Microbiology – A laboratory manual. 4th Edition. The Benjamin publishing company, New York.
3	Marylynn V. Yates, Cindy H. Nakatsu, Robert V. Miller, Suresh D. Pillai 2016). Manual of Environmental Microbiology, 4th Edition,ASM press.
4	Burns, Richard G (2005). Environmental MicrobiologyA Laboratory Manual, 2nd Edition .Lippincott Williams & Wilkins, Inc.
5	Ian Pepper, Charles Gerba, Jeffrey Brendecke (2004). Environmental Microbiology-A laboratory manual, Elsevier.

Web Resources	
1	https://micobenotes.com/fields-of-microbiology/
2	https://bio.libretexts.org
3	https://www.google.com
4	https://www.sfamjournals.onlinelibrary.wiley.com
5	https://www.degruyter.com

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S			M	S	S	S	S
CO2					M	M	M	M
CO3	M							S
CO4	M							
CO5	M						S	S

Course Code	Course Title	L	T	P	C
231AECCVED	Value Education	2	-	-	2

VALUE EDUCATION - 1

Course Objectives

CO 1: Provide insights into the central dogma of molecular biology and explain the mechanism of DNA replication.

CO 2: Elaborate the mechanism of transcription and reverse transcription.

CO 3: Highlight the characteristics of genetic code and describe the process of protein synthesis.

CO 4: Introduce the concept of regulation of gene expression in prokaryotes

CO 5: Familiarize the different types of mutations and explain the mechanism of DNA repair.

Course Content:

UNIT I:

Central Dogma of molecular Biology, DNA as the unit of inheritance. Experimental evidences by Griffith's transforming principle, Avery, McLeod and McCarthy's experiment, and Hershey and Chase Experiment. Replication in prokaryotes: Modes of replication, Meselson and Stahl's experimental proof for semiconservative replication. Mechanism of Replication – Initiation, events at Ori C, Elongation – replication fork, semi discontinuous replication, Okazaki fragments, and termination. Bidirectional replication, Inhibitors of replication. Models of replication-theta, rolling circle and D loop model.

UNIT II:

Transcription - Mechanism of transcription: DNA dependent RNA polymerase(s), recognition, binding and initiation sites, TATA/ Pribnow box, elongation and termination. Post-transcriptional modifications; inhibitors of transcription. RNA splicing and processing of mRNA, tRNA and rRNA. Reverse transcription.

UNIT III:

Genetic Code and its characteristics, Wobble hypothesis. Translation: Adaptor role of tRNA, Activation of amino acids, Initiation, elongation and termination of protein synthesis, post-translational modifications and inhibitors of protein synthesis

UNIT IV:

Regulation of gene expression in Prokaryotes – Principles of gene regulation, negative and positive regulation, concept of operons, regulatory proteins, activators, receptors, regulation of lac operon and trp operon.

UNIT V:

Mutation: Types-Nutritional, Lethal, Conditional mutants. Missense mutation and other point mutations. Spontaneous mutations; chemical and radiation – induced mutations. DNA repair: Direct repair, Photo reactivation, Excision repair, Mismatch repair, Recombination repair and SOS repair.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Illustrate the Central Dogma of molecular biology, explain the multiplication of DNA in the cell and describe the types and modes of replication.	PO1
CO2	Elaborate the mechanism of transcribing DNA into RNA, discuss the formation of different types of RNA.	PO1,PO2
CO3	Decipher the genetic code and summarize the process of translation.	PO4,PO6
CO4	Comprehend the principles of gene expression and explain the concept of operon in prokaryotes.	PO4,PO5, PO6
CO5	Distinguish the types of mutations and explain the various mechanisms of DNA repair.	PO3,PO8

Text Books (Latest Editions)	
1	Veer Bala Rastogi, 2008, Fundamentals of Molecular Biology, 1st edition, Anebooks India.
2	David Friefelder,1987, Molecular Biology, 2nd edition, Narosa Publishing House.
3	Dr.P.S.Verma and Dr.V.K.Agarwal,2013,Cellbiology, Genetics, Molecular Biology, Evolution and Ecology,1stedition,S.Chand&CompanyPvt.Ltd.
References Books	
1	Karp,G.,2010,Cell and Molecular Biology: Concepts and Experiments, 6thedition, John Wiley & Sons.Inc.
2	DeRobertis,E.D.P. and DeRobertis,E.M.F.,2010,Cell and Molecular Biology, 8thedition, Lippincott Williams and Wilkins, Philadelphia.
3	James.D.Watson,2013, Molecular Biology of the Gene7thedition, Benjamin Cummings.
Web Resources	
1	www.mednotes.net/notes/biology
2	https://www.onlinebiologynotes.com/repair-mechanism-of mutation/
3	https://teachmephysiology.com/biochemistry/protein-synthesis/dna-translation/

Mapping with Programme Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO 1	3						3			3
CO 2	3						3			3
CO 3	3						3			3
CO 4	3	2					3			3
CO 5	3	2					3	1		3

3 – Strong, 2 – Medium, 1 - Low

SEMESTER VI

Course Code	Course Title	L	T	P	C
23116AEC61	Food, Dairy and Probiotic Microbiology	5	0	0	4

Course Objectives:

CO1: To impart current knowledge of basic and applied microbiological aspects of fluid milks and dairy products for improved quality and food safety.

CO2: Gives an insight into various types of food borne diseases and their prevention

CO3: To gain information about microflora of milk

CO4: To study about the production of fermented dairy products

CO5: To impart current knowledge of probiotics, prebiotics and functional dairy foods for the health benefits.To create a sustainable environmentally and technologically advanced dairy farm

Course Content:

UNIT I:

Food as a substrate for micro organisms-.Micro organisms important in food microbiology; Molds, yeasts and bacteria -General Characteristics - Classification and importance. Principles of food preservation - Asepsis - Removal of micro organisms, - High temperature - Low temperature - Drying - Food additives. Nanoscience in food preservation; microencapsulation.

UNIT II:

Contamination and spoilage of food products -Food borne infections (Bacillus cereus, ,Salmonellosis, Shigellosis, ,*Listeria monocytogenes* and *Campylobacter jejuni*) and intoxications – (*Staphylococcus aureus*, *Clostridium botulinum* ,*Clostridium perfringens* and mycotoxins) Food borne disease outbreaks - newly emerging pathogens. Conventional and Novel technology in control of food borne pathogens and preventive measures - Food sanitation - plant sanitation - Employees' health standards. Regulatory Agencies &criteria for food safety.

UNIT III:

Microflora of raw milk - sources of contamination. Spoilage and preservation of milk and milk products. -antimicrobial systems in raw milk. Importance of biofilms, their role in transmission of pathogens in dairy products and preventive strategies.

UNIT IV:

Food fermentations: Indian Pickles Bread,vinegar, fermented vegetables (sauerkraut), fermented dairy products (yoghurt, cheese, AcidophilusMilk,Kefir,Koumiss). Oriental fermented foods-Miso –Tempeh Ontjom . Natto, Idli Spoilage and defects of fermented dairy products -. Functional fermented foods and nutraceuticals, bioactive proteins and bioactive peptides, genetically modified foods.

UNIT V:

Probiotic microorganisms, concept, definition safety of probiotic microorganisms, legal status of probiotics Characteristics of Probiotics for selection: stability maintenance of probiotic microorganisms. Role of probiotics in health and disease: Mechanism of probiotics. Application of bacteriocins in foods.Biopreservation. Prebiotics: concept, definition, criteria, types and sources of prebiotics, prebiotics and gut microflora - Prebiotics and health benefits: mineral absorption, immune response, cancer prevention, elderly health and infant health, prebiotics in foods.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Gain knowledge about food as a substrate for various microbes, Understand about the principles and application of different types of food spoilage and preservation technique,	PO7,PO8,PO10
CO2	Acquire a thorough understanding of food borne diseases, testing methods, and preventive technique	PO5,PO10
CO3	Gain information about spoilage of milk and its products and its antimicrobial properties	PO5,PO7
CO4	Learn about the various fermented product and its various stage spoilage	PO7,PO8,PO10
CO5	Impart current knowledge of probiotics, prebiotics and functional dairy foods for the health benefits	PO5,PO6

Text Books	
1.	Frazier WC and West off DC. (2017). Food microbiology. 5th Edition TATA McGraw Hill Publishing Company Ltd. New Delhi.
2.	Adams, M.R., Moss, M.O.(2018). Food Microbiology 1stedition. New Age Publishers by New Age International (P) Ltd., Publishers.
3	R.C. Dubey. (2014). Advanced Biotechnology. S. Chand publishers.
4	Banwart GJ. (1989). Basic food microbiology, Chapman & Hall, New York.
5	Sugumar D. (1997). Outlines of dairy technology, Oxford University press. 1997.

References Books	
1	Jay JM, Loessner MJ and Golden DA.(2005). Modern Food Microbiology. 7th Edition CBS Publishers and Distributors, Delhi, India.
2	Prescott, Harley and Klein Wim.(2008). Microbiology, 7th Edition McGraw Hill Publications.
3	Robinson, R. K.(2002). Dairy Microbiology Handbook - The Microbiology of Milk and Milk Products (Third Edition), A John Wiley & Sons, Inc., New York.
4	Yuankunlee,Sepposalminen. (2008). Handbook of probiotics and prebiotics Second Edition. A John Wiley & Sons publication Inc.
5	DharumauraiDhansekaran, AlwarappanSankaranarayanan. (2021). Advances in Probiotics Microorganisms in Food and Health 1st Edition. eBook ISBN:9780128230916.

	WEB RESOURCES
1	https://www.researchgate.net/publication/15326559_A_Dynamic_Approach_to_Predicting_BacterialGrowth_in_Food/link/5a1d2e02aca2726120 b28eba/download
2	https://www.fda.gov/food/laboratory-methods-food/bam-foodsamplingpreparation-sample-homogenate
3	https://www.researchgate.net/publication/243462186_Foodborne_diseases_in_India_-_A_review
4	https://www.researchgate.net/publication/228662659_Fermented_Dairy_Products_Starter_Cultures_and_Potential_Nutritional_Benefits/link/000084160cf23f86393d5764/

	download
5	https://www.fda.gov/food

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1							S	S		M	
CO2					S					M	
CO3					S		M				
CO4							S	S		M	
CO5					M	M					

Course Code	Course Title	L	T	P	C
23116AEC62	Recombinant DNA Technology	5	1	0	4

Course Objectives:

CO1: Understand the principles of rDNA technology.
CO2: Illustrate the molecular tools employed in gene cloning.
CO3: Discuss the importance of various molecular techniques and their importance in Biotechnology.
CO4: Acquire knowledge about the concepts of tissue culture methods and transgenic organisms
CO5: Examine recent trends in genetic engineering and its application in human welfare.

Course Content:

UNIT I:

Milestones in rDNA Technology - Gene Manipulation - Steps involved in Gene Cloning. Isolation of Chromosomal and Plasmid DNA. Restriction endonuclease - Discovery, Types, Mode of action- Application of Ligase, DNA Polymerase ,DNA Modifying enzymes and Topoisomerases.Use of Linkers and Adapters.

UNIT II:

Artificial Gene Transfer methods- Calcium ChlorideInduction, Electroporation, Microinjection, Biolistic method, Liposome and Viral-mediated delivery. Cloning vectors – Properties and Applications - Plasmid Based Vectors- Natural Vectors-pSC101 and pMB1.Artificial Vectors- pBR322 and pUC. Phage Based Vectors- Lambda phage. Hybrid Vectors, Phagemid, Cosmid, BAC and YAC. Screening of Recombinants. Genomic DNA and cDNA library - Construction and Screening.

UNIT III:

Molecular Tools- PCR- Types. Gel Electrophoresis- AGE and PAGE BlottingTechniques- Southern, Western & Northern.DNAsequencingmethods-Sanger'sandAutomated method. Recent Trends in Genetic Engineering- Targeted Genome Editing- ZFNs, TALENs, CRISPRs. GeneTargeting-Knock-in & Knock-outs. DNA Finger Printing.

UNIT IV:

Plant Biotechnology – Media, Growth Regulators and Equipment for Plant Tissue Culture- Explant Culture- Micropropagation- Callus and Protoplast Culture-Production of Bio-ActiveSecondary Metabolites by Plant Tissue Culture -Agrobacterium and Crown Gall Tumors, Ti-Plasmid and RiPlasmid -Animal Biotechnology - Principles of Animal Cell Culture, Media and Equipment for Animal Cell Culture – Primary and Secondary Cultures- Cell Lines- Types, Establishment and MaintenanceofCellLines

UNIT V:

Applications of Genetic Engineering - Transgenic Animals – Mice and Sheep-Recombinant Cytokines and their use in the Treatment of Animal infections- Monoclonal Antibodies in Therapy-Vaccines and their Applications in Animal Infections - Human Gene Therapy-Germline and Somatic Cell Therapy -*Ex-vivo* Gene Therapy-SCID (Severe Combined Immuno Deficiency) – *In-vivo* Gene Therapy- CFTR (Cystic Fibrosis Transmembrane Regulator) –Vectors in Gene Therapy-Viral and Non - Viral Vectors. Transgenic Plants– Bt Cotton, Bt Corn, Round Ready soybean, Flavr Savr Tomato and Golden Rice.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Illustrate the steps involved in introduction and expression of foreign DNA into bacteria, animal and plants cells and their screening.	PO4, PO6, PO7, PO9
CO2	Discuss the various cloning vectors and their applications.	PO4, PO6, PO7, PO9
CO3	Assess the usage and advantages of molecular tools.	PO4, PO6, PO7, PO9
CO4	Explain plant and animal tissue culture protocols and gene transfer mechanisms.	PO4, PO6, PO7, PO9
CO5	Elucidate and understand the application of genetic engineering and gene therapy.	PO4, PO6, PO7, PO9

Text Books	
1.	Brown T.A.(2016). Gene Cloning and DNA Analysis. 7thEdition . John Wiley and Jones, Ltd.
2.	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.
3.	Keya Chaudhuri (2013). Recombinant DNA technology. The Energy and Resources Institute
4.	Siddra Ijaz, Imran UlHaq (2019). Recombinant DNA Technology. Cambridge Scholars Publishing.
5.	Monika Jain (2012). Recombinant DNA Techniques: A Textbook, I Edition,Alpha Science International Ltd

References Books	
1.	Maloy S. R., Cronan J.E. Jr. and FreifelderD.(2011). Microbial Genetics. 2nd Edition. Narosa Publishing Home Pvt Ltd.
2.	Glick B. R. and Patten C.L.(2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5th Edition. ASM Press.
3.	Russell P.J. (2010). iGenetics - A Molecular Approach, 3rd Edition. Pearson New International Edition.
4.	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.
5.	James D.Watson, Michael Gilman, Jan Witkowski, Mark Zoller (1992). Recombinant DNA. Scientific American Books

Web Resources	
1	https://www.britannica.com/recombinant-DNA-technology
2	https://www.byjus.com/recombinant-dna-technology
3	https://www..rpi.edu
4	https://www..ncbi.nlm.nih.gov
5	https://www.le.ac.uk/recombinant-dna-and-genetic-techniques

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				S	L	S	S	M	S		
CO2				S	L	S	S	M	S		
CO3				S	L	S	S	M	S		
CO4				S	L	S	S	M	S		
CO5				S	L	S	S	M	S		

Course Code	Course Title	L	T	P	C
23116DSC63A	Pharmaceutical Microbiology	5	1	0	4

Course Objectives:

CO1: To provide the knowledge on basics of chemotherapy

CO2: To learn the assays and testing methods of antibiotics.

CO3:.To gain information about spoilage of pharmaceutical products

CO4: To provide the knowledge on drug discovery and clinical trials

CO5: To learn about regulations in pharmaceutical industry

Course Content:

UNIT I:

Introduction to Pharmaceutical microbiology: Ecology of microorganisms in pharmaceutical industry: Atmosphere, water, skin and respiratory flora of workers, raw materials, packaging, building and equipments and their control measures; Design and layout of sterile manufacturing.

UNIT II:

Microbial contamination and spoilage of pharmaceutical products: Microbial aspects of pharmaceutical products; Sterilization of pharmaceutical products: Heat, gaseous, radiation and filtration; Contamination and Spoilage of Pharmaceutical products: sterile injectable and non-injectable, ophthalmologic preparation, implants.

UNIT III:

Production of antibiotics: Production of antibacterial – Penicillin, Tetracycline; antifungal – Griseofulvin, Amphotericin; antiparasitic agents – Artemesin, Metronidazole; Semi-synthetic antibiotics and anticancerous agents; Additional application of microorganisms in pharmaceutical sciences: Enzymes- Streptokinase, Streptodornase, L-asperginase and clinical dextrin; Immobilization procedures for pharmaceutical applications (liposomes); Biosensors in pharmaceuticals.

UNIT IV:

Production of immunological products and their quality control: Vaccines - DNA vaccines, synthetic peptide vaccines, multivalent vaccines; Vaccine clinical trials; Immunodiagnostics - immuno sera and immunoglobulin; Quality control in Pharmaceutical: In – Process and Final Product Control; Sterility tests.

UNIT V:

Quality Assurance and Validation:Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry; Regulatory aspects of quality control; Quality assurance and quality management in pharmaceuticals – BIS (IS), ISI, ISO, WHO and US certification.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Learn the basics of chemotherapy and action of antibiotics	**PO1,PO10**
CO2	Carry out the microbiological assay of antibiotics	**PO7**
CO3	Analyze Microbiological standardization of Pharmaceuticals ,sterility testing of pharmaceutical productsApplysterilization in pharmaceutical industry	**PO5,PO8,PO10**
CO4	Evaluate the process and develop new strategies for rational drug design	**PO9,PO10**
CO5	Learn the Regulatory guidelines in pharmaceuticals product.	**PO3,PO5**

Text Books	
1	Chand Pasha Kedernath. (2021). Text book of Pharmaceutical Microbiology. Ramnath Publisher.
2	Hugo WB and Russell AD. (2004).Pharmaceutical Microbiology VII edition. Blackwell Scientific Publication, Oxford.
3	Franklin,DJ. and Snow, GA. (2013). Biochemistry of antimicrobial action.Chapman& Hall.
4	Kuntal Das (2019). Pharmaceutical Microbiology, second edition, NiraliPrakashan.
5	PriyatamaPowar, Shital Nimbargi, VaijayantiSapre (2020). Pharmaceutical Microbiology, I edition, Technical publications.
References Books	
1	Handa, S.S. and Kapoor, V.K. (2022) .Pharamcognosy. 4thEdition.VallabhPrakashanPublishers,New Delhi.
2	Kokate, C.K., Durohit, A.P. and Gokhale, S.R.,(2002). Pharmacognosy. 12thedition NiraliPrakasham Publishers, Pune.
3	S. P. Vyas & V. K. Dixit.(2003). Pharmaceutical Biotechnology. CBS Publishers & Distributors, New Delhi.
4	Wallis, T.E. (2005). Text book of Pharmacognosy. 5th edition. CBS publishers and distributors, New Delhi.
5	Garrod, L.P., Lambert, HP. And C'Grady, F. (1973). Antibiotics and Chemotherapy. (eds). Churchill Livingstone.
Web Resources	
1	https://www.pharmapproach.com/introduction-to-pharmaceutical-microbiology/
2	https://www.iptsalipur.org/wp-content/uploads/2020/08/BP303T_PMB_UNIT_I.pdf
3	https://www.pharmanotes.org/2021/11/pharmaceutical-microbiology-b-pharma.html
4	https://snscourseware.org/snscphs/notes.php?cw=CW_604b15c6313c5
5	https://www.thermofisher.com

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M									M	
CO2							M				
CO3					S			M		M	
CO4									L	M	
CO5			L		M						

Course Code	Course Title	L	T	P	C
23116DSE63B	Entrepreneurship and Bio-business	5	0	0	4

Course Objectives:

CO1: Understanding basic concepts in the area of entrepreneurship, the role and importance of entrepreneurship for economic development

CO2: Developing personal creativity and entrepreneurial initiative, adopting the key steps in the elaboration of business ideas.

CO3:.Understanding the stages of the entrepreneurial process and the resources needed for the successful development of entrepreneurial ventures.

CO4: Explain the central components of successful business strategies in biotechnology, and create a business plan.

CO5: Explain the Project Management, Technology Management and Startup Schemes

Course Content:

UNIT I:

Bio Entrepreneurship: Introduction to bio-business, SWOT analysis of bio-business. Ownership, Development of Entrepreneurship; Stages in entrepreneurial process; Government schemes and funding. Small scale industries: Definition; Characteristics; Need and rationale.

UNIT II:

Entrepreneurship Opportunity in Agricultural Biotechnology: Business opportunity, Essential requirement, marketing, strategies, schemes, challenges and scope-with case study on Plant cell and tissue culture technique, polyhouse culture. Herbal bulk drug production, Nutraceuticals, value added herbal products. Bioethanol production using Agricultural waste, Algal source. Integration of system biology for agricultural applications. Biosensor development in Agriculture management.

UNIT III:

Entrepreneurship Opportunity in Industrial Biotechnology**:** Business opportunity, Essential requirement, marketing strategies, schemes, challenges, and scope- Pollution monitoring and Bioremediation for Industrial pollutants. Integrated compost production- microbe enriched compost. Bio pesticide/ insecticide production. Biofertilizer. Single cell protein.

UNIT IV:

Therapeutic and Fermented products: Stem cell production, stem cell bank, production of monoclonal/polyclonal antibodies, secondary metabolite production – antibiotics, probiotic and prebiotics.

UNIT V:

Project Management, Technology Management and Startup Schemes: Building Biotech business challenges in Indian context-biotech partners (BIRAC, DBT, Incubation centers. etc.,), operational biotech parks in India. Indian Company act for Bio business-schemes and subsidies. Project proposal preparation, Successful start-ups-case study.

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Describe and apply several entrepreneurial ideas and business theories in a practical framework.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12, PO13, PO14
CO2	Analyse the business environment in order to identify business opportunities, identify the elements of success of entrepreneurial ventures, evaluate the effectiveness of different entrepreneurial strategies and interpret their own business plan.	PO2, PO5, PO7, PO8, PO10, PO12, PO14
CO3	Express the mass production of microbial inoculants used as Biofertilizers and Bioinsecticides in response with field application and crop response.	PO4, PO6, PO9, PO11
CO4	Analyze the application and commercial production of Monoclonal antibodies, Cytokines. TPH and teaching kits.	PO5, PO6, PO9, PO11
CO5	Integrate and apply knowledge of the regulation of biotechnology industries, utilize effective team work skills within an effective management team with a common objective, and gain effective team work skills, with an awareness of cultural diversity and social inclusiveness.	PO2,PO7, PO8

Text Books	
1.	Craig Shimasaki. (2014). Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Academic Press.
2.	Ashton Acton, O. (2012). Biological Pigments– Advances in Research and Application Scholorly Editions: Atlanta, Georgia.
3.	Jennifer Merritt, Jason Feifer (2018). Start Your Own Business, 7th edition, Entrepreneur Press publisher.
4.	Peter F. Drucker (2006). Innovation and Entrepreneurship. Harper Business publisher.
5.	Leah Cannon (2017). How to Start a Life Science Company: A Comprehensive Guide for First-Time Entrepreneurs. International Kindle paperwhite.

References Books	
1	Crueger, W, and Crueger. A.(2000). Biotechnology: A Text Book of Industrialmicrobiology, 2nd Edition, Sinauer Associates: Sunderland.Mass.
2	Paul S Teng. (2008). Bioscience Entrepreneurship in AsiaWorld Scientific Publishing Company.
3	Charles E. Bamford, Garry D. Bruton (2015). ENTREPRENEURSHIP: The Art, Science, and Process for Success, 2nd Edition, McGraw Hill publisher.
4	Yali Friedman (2014). Building Biotechnology: Biotechnology Business, Regulations, Patents, Law, Policy and Science 4th Edition, Logos press publication.
5	Stephanie A. Wisner (2022). Building Backwards to Biotech: The Power of Entrepreneurship to Drive Cutting-Edge Science to Market, International Kindle paperwhite.

Web Resources	
1	https://www.bio-rad.com/webroot/web/pdf/lse/literature/Biobusiness.pdf
2	https://www.crg.eu/biobusiness-entrepreneurship
3	https://www.entrepreneur.com
4	https://www.birac.nic.in
5	https://www.springer.com

Mapping with Programme Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	S	S	S	S	S	S	S	S	S	S	S
CO2		S			M		S	S		M	
CO3											
CO4				S		S			S		S
CO5		S					S	S			

Course Code	Course Title	L	T	P	C
23116DSE65C	Food Fermentation Techniques	4	0	0	3

Unit 1 Fermented Foods

Definition, types, advantages and health benefits

Unit 2 Milk Based Fermented Foods

Dahi, Yogurt, Buttermilk (Chach) and cheese: Preparation of inoculums, types of microorganisms and production process

Unit 3 Grain Based Fermented Foods

Soy sauce, Bread, Idli and Dosa: Microorganisms and production process

Unit 4 Vegetable Based Fermented Foods

Pickels, Saeurkraut: Microorganisms and production process

Unit 5 Fermented Meat and Fish with Probiotic Foods

Types, microorganisms involved, fermentation process

Probiotic Foods -Definition, types, microorganisms and health benefits

Reference:

1. Hui YH, Meunier-Goddik L, Josephsen J, Nip WK, Stanfield PS (2004) Handbook of food and fermentation technology, CRC Press

2. Holzapfel W (2014) Advances in Fermented Foods and Beverages, Woodhead Publishing.

3. Yadav JS, Grover, S and Batish VK (1993) A comprehensive dairy microbiology, Metropolitan

4.Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer

Course Code	Course Title	L	T	P	C
23116DSE65D	Genomics and Proteomics	4	0	0	3

AIM

To monitor the properties of the entire complement of proteins from a given cell or organism,

OBJECTIVES:

To gain the knowledge and analyze the varying proteomes of an organism at different times in order to highlight differences between them.

COURSE OUTCOME:

CO1- Students gain the knowledge about the interactions between the proteins

CO2- Get the information to predict cell behavior or develop drug targets.

CO3- Rapidly evolving scientific area into ***genomes***, proteomes and databases

CO4- Learn to store various data NCBI, DDBJ and EMBL

Unit I

Genomics: genetic and physical maps, physical mapping and map-based cloning, choice of mapping population, simple sequence repeat loci, southern and fluorescence in situ hybridization(FSH) for genome analysis, chromosome microdisection, molecular markers in genome analysis

Unit II

Genome sequencing: genome sizes, organelle genomes, genomic libraries, strategies for genome sequencing, packaging, transfection and recovery of clones, application of sequence information for identification of defective genes. Pharmacogenetics, cancer genetics; immunogenetics; mapping of human genome; somatic cell genetics; DNA polymorphism in mapping; structure and function; biochemical genetics; polygenic inheritance

Unit III

Proteomics: Sample preparation, Gel-based proteomics - two-dimensional gel electrophoresis (2-DGE), two-dimensional fluorescence difference in-gel electrophoresis (DIGE), Staining methods, PF-2D, Tandem FPLC, Mass spectroscopy: basic principle, ionization sources, mass analyzers, different types of mass spectrometers (MALDI-TOF Q-TOF, LC-MS).

Unit IV

Nuclear magnetic resonance spectroscopy (NMR), basic principles, chemical shift, spinspin interaction, NOE, 2D-NMR, NOESY,COSEY. X-ray Crystallography: Principle of X-ray diffraction, scattering vector, structure factor, phase problem, reciprocal lattice and Ewald sphere, Miller indices, Zone axes, crystal lattice, Lane Equations, Bragg's law, special properties of protein crystals, model building, refinement and R-factor.

Unit V

Protein Engineering: Protein sources, Industrial and medical application of proteins, different expression of proteins for large scale purifications, protein engineering strategy, rational and random mutagenesis. Applications of protein engineering-protein in Chemical and Medical Industries: Generation of heat stable, pH stable engymes, application in vaccine development, drug development, sensor development.

References

1. Gupta, P.K. 2004. Biotechnology and Genomics. First edition. Rastogi Publications, Meerut.
2. Miglani, G.S. 2007. Advanced Genetics. New Delhi: Narosa Publishing House.
3. Primrose, S.B. and Twyman, R.M. 2006. Principles of Gene Manipulation and Genomics. Blackwell Publishing, Australia.
4. Singh, B.D. 2009. Biotechnology: Expanding Horizons. Second Edition. Kalyani Publishers, Ludhiana.
5. Singh, B.D. 2009. Plant Biotechnology. Kalyani Publishers, Ludhiana.
6. Thompson, J.D., Schaeffer-Reiss, C., and Ueffing, M. 2008. Functional Proteomics. Methods and Protocols. Humana Press, New York.
7. Twyman, R.M. 2004. Principles of Proteomics. Taylor & Francis.

Course Code	Course Title	L	T	P	C
23116DSE65E	Plant Tissue Culture	4	0	0	3

AIM

- To understand the knowledge on culturing **plant** seeds, organs, explants, tissues.

OBJECTIVE

- To understanding the basic process of preparing media for plant tissue culture.
- To learn micronutrients, macronutrients and organic elements.

COURSE OUTCOME

CO1- To inculcate the basics of plant tissue culture

CO2- To impart the knowledge about the various aspects of tissue culture and their applications

CO3- Learn the role of micro and macro- nutrients in tissue culture plantation.

Unit I

Introduction - history, scope and concepts of basic techniques in plant tissue culture. Laboratory requirements and organisation. Sterilization-filter, heat and chemical. Media preparation - inorganic nutrients, organic supplements, carbon source, gelling agents, growth regulators and composition of important culture media (MS, White,s and Gamborg's media).

Unit II

Cell, tissue and organ culture - Isolation of single cells, selection and types of cells, tissue explants and organs for culture - paper, raft nurse technique, plating method, microchamber techniques, cell suspension cultures - batch, continuous, chemostat culture - synchronization of suspension culture, cellular totipotency, cytological, cytochemical and vascular differentiations - totipotency of epidermal and crown – gall cells.

Unit III

Micropropagation - clonal propagation of elite germplasm, factors affecting morphogenesis and proliferation rate, technical problems in micropropagation. Organogenesis - formation of shoots and roots - role of growth regulators and other factors, somaclonal and gametoclonal variations. Somatic embryogenesis - Process of somatic embryogenesis, structure, stages of embryo development, factors affecting embryogenesis, synthetic seeds.

Unit IV

Haploid production - androgenesis, gynogenesis - techniques of anther culture – segmentation pattern in microspore - isolated pollen culture - plantlets from haploids - diploidisation - factors influencing androgenesis, haploidy through gynogenesis, haploid mutants, utilization of haploids in plant breeding. Protoplast culture: Isolation of protoplasts - mechanical and enzymatic sources, culture of protoplasts, viability. Protoplastfusion - spontaneous, mechanical, induced

electrofusion, selection of somatic hybrids, cybrids, importance.

Unit V

Cryopreservation and gene bank - Modes of preservation, preparation of materials for deep freezing, cryopotectors, storage strategies, assessment of successful cryopreservation, application and limitations. Application of tissue culture in forestry, horticulture, agriculture and pharmaceutical industry, transgenic plants.

REFERENCES

1. Bhojwani, S.S. and Razdan, M.K. (1983). *Plant Tissue Culture: Theory and Practice*. Elsevier Science Publishers, Netherlands.
2. Dodds, J.H. and Roberts, I.W. (1985). *Experiments in Plant Tissue Culture*. Cambridge University Press, UK.
3. Fowler, M.W. (1986). *Industrial Application of Plant Cell Culture. In: Yeoman, M. M. (ed.). Plant Cell Culture Technology*. Blackwell, Oxford, London.
4. Hammoond, J., McGarvey, P. and Yusibov, V. (2000). *Plant Biotechnology*. Springer Verlag, New York.
5. Johri, B.M. (1982). *Experimental Embryology of Vascular Plants*. Narosha Publishing House, New Delhi.
6. Kalyan Kumar, De (1992). *An Introduction to Plant Tissue Culture*. New Central Book Agency, Calcutta.
7. Ramawat, K.G. (2000). *Plant Biotechnology*. S. Chand and Co. Ltd., New Delhi.
8. Razdan, M.K. (2004). *Introduction to Plant Tissue Culture* (2nd ed.). Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
9. Reinert, J. and Bajaj, Y.P.S. (1977). *Plant Cell Tissue and Organ Culture: A Laboratory Manual*. Narosa Publishing House, New Delhi.

Vasil, I.K. (1986). *Cell Culture and somatic Cell Genetics of Plants* (3 Volumes). Academic Press Inc.

Course Code	Course Title	L	T	P	C
23116DSE65F	Advances in Microbiology	4	0	0	3

Unit 1 Evolution of Microbial Genomes

Salient features of sequenced microbial genomes, core genome pool, flexible genome pool and concept of pangenome, Horizontal gene transfer (HGT), Evolution of bacterial virulence - Genomic islands, Pathogenicity islands (PAI) and their characteristics

Unit 2 Metagenomics

Brief history and development of metagenomics, Understanding bacterial diversity using metagenomics approach, Prospecting genes of biotechnological importance using metagenomics Basic knowledge of viral metagenome, metatranscriptomics, metaproteomics and metabolomics.

Unit 3 Molecular Basis of Host-Microbe Interactions

Epiphytic fitness and its mechanism in plant pathogens, Hypersensitive response (HR) to plant pathogens and its mechanism, Type three secretion systems (TTSS) of plant and animal pathogens, Biofilms: types of microorganisms, molecular aspects and significance in environment, health care, virulence and antimicrobial resistance

Unit 4 Systems and Synthetic Biology

Networking in biological systems, Quorum sensing in bacteria, Co-ordinated regulation of bacterial virulence factors.

Unit 4 Synthetic Biology

Basics of synthesis of poliovirus in laboratory, Future implications of synthetic biology with respect to bacteria and viruses

Reference:

1. Fraser CM, Read TD and Nelson KE. Microbial Genomes, 2004, Humana Press

2. Miller RV and Day MJ. Microbial Evolution- Gene establishment, survival and exchange, 2004,

3.Bull AT. Microbial Diversity and Bioprospecting, 2004, ASM Press 4. Sangdun C. Introduction to Systems Biology, 2007, Humana Press

5. Klipp E, Liebermeister W. Systems Biology – A Textbook, 2009, Wiley –VCH Verlag

6. Caetano-Anolles G. Evolutionary Genomics and Systems Biology, 2010, John Wiley and Sons 7. Madigan MT, Martink JM, Dunlap PV and Clark DP (2014) Brook's Biology of Microorganisms, 14th edition, Pearson-Bejamin Cummings

8. Wilson BA, Salyers AA Whitt DD and Winkler ME (2011)Bacterial Pathogenesis- A molecular Approach, 3rd edition, ASM Press,

9. Bouarab K, Brisson and Daayf F (2009) Molecular Plant-Microbe interaction CAB International
10. Voit EO (2012) A First Course in Systems Biology, Ist edition,Garland Science

Course Code	Course Title	L	T	P	C
23116PRW64	Project & Viva Voice	8	0	0	4

Projects enable students to get hands-on training in microbiological techniques needed for research. Thus the students can share diverse perspectives resulting in pooling of knowledge and skills. Group work may approach tasks and solve problems in novel, interesting ways, thereby converting established theoretical concepts to practical skills. If structured properly, it will promote team work and collaboration. Group projects also will help students to choose a research design, solve real life problems and benefit the society at large. Thus group project facilitates the students to convert ideas to practice thereby creating a research culture among students.

Guidelines for group project:

A research problem needs to be selected based on creative ability and scientific thought.

A brief description of the problem needs to be given.

Hypothesis statements should be framed.

Objectives by which the project work is to be carried out should be clearly stated.

Methodology has to be designed to test the hypothesis.

Results obtained need to be replicable.

Documented report has to be submitted on completion of the project.

Course Code	Course Title	L	T	P	C
231ACSIKWS	Indian Knowledge System	-	-	-	2

Course Objectives:

The course design seeks to address the following issues:

• To introduce to the students the overall organization of IKS

• To develop an appreciation among the students the role and importance of Veda, Vedāṅgas, Upa Vedas and Purāṇas

• To show case the multi-dimensional nature of IKS and their importance in the contemporary society • To motivate the students to take up a detailed study of some of these topics and explore their application potential

Course Content

Unit I: Introduction to Indian Knowledge System (IKS), Definition, Concept and Scope of IKS (4)

- Definition, Concept and Scope of IKS
- IKS based approaches on Knowledge Paradigms
- IKS in ancient India and in modern India

Unit II: IKS and Indian Scholars, Indian Literature (8)

- Philosophy and Literature (Maharishi Vyas, Manu, Kanad, Pingala, Parasar, Banabhatta, Nagarjuna and Panini)
- Mathematics and Astronomy (Aryabhatta, Mahaviracharya, Bodhayan, Bhashkaracharya, Varahamihira and Brahmgupta)
- Medicine and Yoga (Charak, Susruta, Maharishi Patanjali and Dhanwantri)
- Sahitya (Vedas, Upvedas, Upavedas (Ayurveda, Dhanurveda, Gandharvaveda)
- Puran and Upnishad) and shad darshan (Vedanta, Nyaya.Vaisheshik, Sankhya, Mimamsa, Yoga, Adhyatma and Meditation)
- Shastra (Nyaya, vyakarana, Krishi, Shilp, Vastu, Natya and Sangeet)

Unit III: Indian Traditional/tribal/ethnic communities, their livelihood and local wisdom

- Geophysical aspects, Resources and Vulnerability
- Resource availability, utilization pattern and limitations
- Socio-Cultural linkages with Traditional Knowledge System
- Tangible and intangible cultural heritage.

Unit IV: Unique Traditional Practices and Applied Traditional Knowledge (8)

- Myths, Rituals, Spirituals, Taboos and Belief System, Folk Stories, Songs, Proverbs, Dance, Play, Acts and Traditional Narratives
- Agriculture, animal husbandry, Forest, Sacred Groves, Water Mills, Sacred Water Bodies, Land, water and Soil Conservation and management Practices
- Indigenous Bio-resource Conservation, Utilization Practices and Food Preservation Methods, Handicrafts, Wood Processing and Carving, -Fiber Extraction and Costumes
- Vaidya (traditional health care system), Tantra-Mantra, Amchi Medicine System
- Knowledge of dyeing, chemistry of dyes, pigments and chemicals

Unit V: Protection, preservation, conservation and Management of Indian Knowledge System (4)

- Documentation and Preservation of IKS
- Approaches for conservation and Management of nature and bio-resources
- Approaches and strategies to protection and conservation of IKS

Course Outcomes:

CO1: Explain the historicity of Indian Knowledge System and the broad classification of Indian philosophical systems

CO2: Explain the potential of Sanskrit in natural language processing

CO3: Explain the features of Indian numeral system and its role in science & technology advancement

CO4: Illustrate the basic elements of the Indian calendar and the components of Indian Panchanga

CO5: Outline the science, engineering & technology heritage of ancient and medieval India

□□□□□□